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Commentary on NTP cell phone data for assessing human health risks despite unfounded criticisms aimed at minimizing findings

Melnick RL. Commentary on the utility of the National Toxicology Program study on cell phone radiofrequency radiation data for assessing human health risks despite unfounded criticisms aimed at minimizing the findings of adverse health effects. Environ Res. 2018 Sep 19;168:1-6. doi: 10.1016/j.envres.2018.09.010.

Abstract

The National Toxicology Program (NTP) conducted two-year studies of cell phone radiation in rats and mice exposed to CDMA- or GSM-modulated radiofrequency radiation (RFR) at exposure intensities in the brain of rats that were similar to or only slightly higher than potential, localized human exposures from cell phones held next to the head. This study was designed to test the (null) hypothesis that cell phone radiation at non-thermal exposure intensities could not cause adverse health effects, and to provide dose-response data for any detected toxic or carcinogenic effects. Partial findings released from that study showed significantly increased incidences and/or trends for gliomas and glial cell hyperplasias in the brain and schwannomas and Schwann cell hyperplasias in the heart of exposed male rats. These results, as well as the findings of significantly increased DNA damage (strand breaks) in the brains of exposed rats and mice, reduced pup birth weights when pregnant dams were exposed to GSM- or CDMA-modulated RFR, and the induction of cardiomyopathy of the right ventricle in male and female rats clearly demonstrate that the null hypothesis has been disproved. The NTP findings are most important because the International Agency for Research on Cancer (IARC) classified RFR as a "possible human carcinogen" based largely on increased risks of gliomas and acoustic neuromas (which are Schwann cell tumors on the acoustic nerve) among long term users of cell phones. The concordance between rats and humans in cell type affected by RFR strengthens the animal-to-human association. This commentary addresses several unfounded criticisms about the design and results of the NTP study that have been promoted to minimize the utility of the experimental data on RFR for assessing human health risks. In contrast to those criticisms, an expert peer-review panel recently concluded that the NTP studies were well designed, and that the results demonstrated that both GSM- and CDMA-modulated RFR were carcinogenic to the heart (schwannomas) and brain (gliomas) of male rats.

https://www.ncbi.nlm.nih.gov/pubmed/30243215

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Evaluation of Genotoxicity of Cell Phone Radiation in Male and Female Rats and Mice Following Subchronic Exposure

Smith-Roe SL, Wyde ME, Stout MD, Winters JW, Hobbs CA, Shepard KG, Green AS, Kissling GE, Tice RR, Bucher JR, Witt KL. Evaluation of the genotoxicity of cell phone radiofrequency radiation in male and female rats and mice following subchronic exposure. 49th Annual Meeting of the Environmental Mutagenesis and Genomics Society. San Antonio, Texas, Sep 22-26, 2018. Environmental and Molecular Mutagenesis; 59 (Suppl. 1): 85-85. Meeting abstract: P9. Sep 2018.

National Toxicology Program/NIEHS, Research Triangle Park, NC, and Integrated Laboratory Systems, Inc., Research Triangle Park, NC.

Abstract

The National Toxicology Program tested the two common radiofrequency radiation (RFR) modulations emitted by cellular telephones in a 2-year rodent cancer bioassay that included additional animal cohorts for interim assessments of genotoxicity endpoints.

Male and female Sprague Dawley rats and B6C3F1/N mice were exposed from gestation day 5 or postnatal day 35, respectively, to code division multiple access (CDMA) or global system for mobile (GSM) modulations semi-continuously for 18 h/day in 10 min intervals in reverberation chambers at specific absorption rates (SAR) of 1.5, 3, or 6 W/kg (rats) or 2.5, 5, or 10 W/kg (mice). Rats and mice were exposed at 900 MHz or 1900 MHz, respectively. The interim cohorts, 5 animals per treatment group, were examined after 19 (rats) or 13 (mice) weeks of exposure for evidence of RFR-induced genotoxicity. DNA damage was assessed in three brain regions (frontal cortex, hippocampus, and cerebellum), and in liver cells and blood leukocytes using the comet assay. Chromosomal damage was assessed in peripheral blood erythrocytes using the micronucleus assay.

DNA damage was significantly increased in the frontal cortex of male mice (both modulations), peripheral leukocytes of female mice (CDMA only), and hippocampus of male rats (CDMA only). DNA damage was nominally elevated in several other tissues of RFR-exposed rats, although statistical significance was not achieved. No significant increases in micronucleated red blood cells were observed in rats or mice.

These results suggest that exposure to RFR has the potential to induce measurable DNA damage under certain exposure conditions.

https://onlinelibrary.wiley.com/doi/abs/10.1002/em.22231

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Personal exposure to radio-frequency electromagnetic fields in Europe: Is there a generation gap?

Eeftens M, Struchen B, Birks LE, Cardis E, Estarlich M, Fernandez MF, Gajšek P, Gallastegi M, Huss A, Kheifets L, Meder IK, Olsen J, Torrent M, Trček T, Valič B, Vermeulen R, Vrijheid M, van Wel L, Guxens M, Röösli M. Personal exposure to radio-frequency electromagnetic fields in Europe: Is there a generation gap? Environ Int. 2018 Sep 11;121(Pt 1):216-226. doi: 10.1016/j.envint.2018.09.002.

Highlights

• Exposure to RF-EMF from uplink sources is higher in parents than in their children.
• Diurnal patterns for uplink indicate more phone use between 8 AM and 8 PM.
• Exposure to RF-EMF is correlated between children and parents from the same family.
• Higher RF-EMF levels are found in transport, where the uplink contribution is relatively high.
• The lowest levels are measured at home, school and work, where people spend most time.

Abstract

BACKGROUND: Exposure to radiofrequency electromagnetic fields (RF-EMF) from mobile communication technologies is changing rapidly. To characterize sources and associated variability, we studied the differences and correlations in exposure patterns between children aged 8 to 18 and their parents, over the course of the day, by age, by activity pattern, and for different metrics of exposure.

METHODS: Using portable RF-EMF measurement devices, we collected simultaneous real-time personal measurements of RF-EMF over 24 to 72 h in 294 parent-child pairs from Denmark, the Netherlands, Slovenia, Switzerland, and Spain. The devices measured the power flux density (mW/m2) in 16 different frequency bands every 4 s, and activity diary Apps kept by the participants were used to collect time-activity information in real-time. We analyzed their exposures by activity, for the different source constituents of exposure: downlink (radiation emitted from mobile phone base stations), uplink (transmission from phone to base station), broadcast, DECT (digital enhanced cordless telecommunications) and Wi-Fi. We looked at the correlations between parents and children overall, during day (06:00-22.00) and night (22:00-06:00) and while spending time at home.

RESULTS: The mean of time-weighted average personal exposures was 0.16 mW/m2 for children and 0.15 mW/m2 for parents, on average predominantly originating from downlink sources (47% for children and 45% for parents), followed by uplink (18% and 27% respectively) and broadcast (25% and 19%). On average, exposure for downlink and uplink were highest during the day, and for Wi-Fi and DECT during the evening. Exposure during activities where most of the time is spent (home, school and work) was relatively low whereas exposure during travel and outside activities was higher. Exposure to uplink increased with age among young people, while DECT decreased slightly. Exposure to downlink, broadcast, and Wi-Fi showed no obvious trend with age. We found that exposure to total RF-EMF is correlated among children and their parents ($R_{spearman} = 0.45$), especially while at home (0.62) and during the night (0.60). Correlations were higher for environmental sources such as downlink (0.57) and broadcast (0.62) than for usage-related exposures such as uplink (0.29).

CONCLUSION: The generation gap between children and their parents is mostly evident in uplink exposure, due to more and longer uplink and cordless phone calls among parents, and their tendency to spend slightly more time in activities with higher environmental RF-EMF exposure, such as travel. Despite these differences in personal behavior, exposure to RF-EMF is moderately correlated between children and their parents, especially exposures resulting from environmental RF-EMF sources.

https://www.ncbi.nlm.nih.gov/pubmed/30216774

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Mobile antenna's impact on human health

Subhan F, Khan A, Ahmed S, Malik SN, Bakshah ST, Tahir S. Mobile antenna's and its impact on human health. J Medical Imaging and Health Informatics. 8(6):1266-1273. DOI: 10.1166/jmihi.2018.2296. Aug 2018.

Abstract

Mobile phones operate by communicating with a base station or cellular antennas. As mobile phone and its base station is a two way radio, they emit radio frequency radiation as a means of communication and hence can expose people near them to these radiations. Several research studies have found a link between cellular antennas and health effects on people living near antennas. These include cardiovascular problems, skin complaints, fatigue, sleep disturbance, memory loss, irritability, visual disruptions, hearing problems, depression, and dizziness. An extensive literature review was done to study the effect of mobile antennas on health including cancer. These studies concluded that incidence of cancer cases was remarkably higher among people who resided in 400 meters from mobile antennas, in comparison to those who lived further away. Females reported statistically more health complaints than males. Inhabitants living close to cellular antennas are also at increased risk for developing neuropsychiatric complaints. There are many proposed national and international criteria, for regulating and approving safety guidelines. All telecommunication companies should follow these safety standards.

http://www.ingentaconnect.com/contentone/asp/jmihi/2018/00000008/00000006/art00023

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Individual variation in temporal relationships between RF exposure & physical symptoms: A new approach in studying 'electrosensitivity'

Bogers RP, van Gils A, Clahsen SCS, Vercruijsse W, van Kamp I, Baliatsas C, Rosmalen JGM, Bolte JFB. Individual variation in temporal relationships between exposure to radiofrequency electromagnetic fields and non-specific physical symptoms: A new approach in studying 'electrosensitivity'. Environ Int. 2018 Sep 15;121(Pt 1):297-307. doi: 10.1016/j.envint.2018.08.064.

Abstract

BACKGROUND: Everyday exposure to radiofrequency electromagnetic fields (RF-EMF) emitted from wireless devices such as mobile phones and base stations, radio and television transmitters is ubiquitous. Some people attribute non-specific physical symptoms (NSPS) such as headache and fatigue to exposure to RF-EMF. Most previous laboratory studies or studies that analyzed populations at a group level did not find evidence of an association between RF-EMF exposure and NSPS.

OBJECTIVES: We explored the association between exposure to RF-EMF in daily life and the occurrence of NSPS in individual self-declared electrohypersensitive persons using body worn exposimeters and electronic diaries.

METHODS: We selected seven individuals who attributed their NSPS to RF-EMF exposure. The level of and variability in personal RF-EMF exposure and NSPS were determined during a three-week period. Data were analyzed using time series analysis in which exposure as measured and recorded in the diary was correlated with NSPS.

RESULTS: We found statistically significant correlations between perceived and actual exposure to wireless internet (WiFi - rate of change and number of peaks above threshold) and base stations for mobile telecommunications (GSM + UMTS downlink, rate of change) and NSPS scores in four of the seven participants. In two persons a higher EMF exposure was associated with higher symptom scores, and in two other persons it was associated with lower scores. Remarkably, we found no significant correlations between

NSPS and time-weighted average power density, the most commonly used exposure metric.

CONCLUSIONS: RF-EMF exposure was associated either positively or negatively with NSPS in some but not all of the selected self-declared electrohypersensitive persons.

https://www.ncbi.nlm.nih.gov/pubmed/30227317

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A 3D human body blockage model for outdoor millimeter-wave cellular communication

Han B. Wang L, Schotten HD. A 3D human body blockage model for outdoor millimeter-wave cellular communication. Physical Communication, 25(Part 2):502-510. Dec 2017.

Blocking is one of the most important challenges in exploiting millimeter-wave for fifth-generation (5G) cellular communication systems. Compared to blockages caused by buildings or terrains, human body blockage exhibits a higher complexity due to the mobility and dynamic statistics of humans. To support development of outdoor millimeter-wave cellular systems, in this paper we present a novel 3D physical model of human body blockage. Based on the proposed model, the impact of human body blockage on frame-based data transmission is discussed, with respect to the system specifications and environment conditions.

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Mobile Phone Distance from Head and Temperature Changes of Radio Frequency Waves on Brain Tissue

Forouharmajd F, Ebrahimi H, Pourabdian S. Mobile Phone Distance from Head and Temperature Changes of Radio Frequency Waves on Brain Tissue. Int J Prev Med. 2018 Jul 20;9:61. doi: 10.4103/ijpvm.IJPVM_70_17.

Abstract

Background: Analyzing the possible negative effects of using cell phones on the users' health is an important and vital affair due to rapid growth and extensive use of these devices on human communications and interactions. The aim of this study was to determine the effect of increasing the distance of cell phones to brain tissue on the temperature of the central and gray matters of brain due to the heat generated by radio frequency waves.

Methods:This study was an experimental study. A cow's brain tissue was analyzed in a compartment with three thicknesses of 2, 12, and 22 mm, in the distances of 4 mm and 4 cm from a cell phone for 15 min. Lutron thermometer was used to measure the tissue temperature, and the data analysis were done by Lutron and MATLAB software packages.

Results: The tissue temperature was increased while confronting with a cell phone in distances of 4 mm and 4 cm in all the three thicknesses of 2, 12, and 22 mm. The tissue temperature was higher after removing the confrontation at 4 mm distance as compared to the distance of 4 cm.

Conclusions: During confrontation and after that with the cell phone, reducing the distance of brain tissue and the cell phone increased the tissue temperature intensely. In fact, by increasing the cell phone distance from brain tissue, the thermal effect of radiofrequency waves was reduced.

Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6071445/

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The effects of radiofrequency radiation on mice fetus weight, length and tissues

Alimohammadi I, Ashtarinezhad A, Asl BM, Masruri B, Moghadasi N. The effects of radiofrequency radiation on mice fetus weight, length and tissues. Data Brief. 2018 Jun 30;19:2189-2194. doi: 10.1016/j.dib.2018.06.107.

Abstract

The public concern of harmful effects of radiofrequency radiation exposure, especially with rapid increase in the use of wireless and telecommunication devices, is increasing. Some studies show fetal and developmental abnormalities as the result of radiofrequency radiationexposure. We aimed to investigate possible teratogenic effects of radiofrequency in 915 MHz on mice fetus and protective role of vitamin C. 21 pregnant mice were divided into 3 groups. Control group was in normal condition without any stressor agent. Exposure group was exposed to 915 MHz RFR (8 h/day for 10 days) and 0.045 μw/cm2 power density. The exposure plus vitamin C group received 200 mg/kg vitamin C by gavage and was exposed to 915 MHz RFR (8 h/day for 10 days) and 0.045 μw/cm2 power density. The fetus weight, C-R length were measured by digital balance and caliper. Tissues were assessed after staining with H & E. Our results showed significant increase in fetus weight and C-R length and also enlarged liver, tail deformation in mice fetus in exposure group. Although usage of vitamin C caused significant decrease in mentioned parameters. The outcome of this study confirms the effects of radiofrequency radiation on growth parameters such as body weight, length and some tissues in mice fetuses and protective effect of vitamin C. However more studies on non-ionization radiation in different frequencies and severity, during pregnancy are needed to clarify the exact mechanisms of these changes and better protection.

Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6141437/

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Effect of exposure to 1800 MHz RFR on epidermal growth factor, caspase-3, Hsp27 and p38MAPK gene expressions in the rat eye

Eker ED, Arslan B, Yildirim M, Akar A, Aras N. The effect of exposure to 1800 MHz radiofrequency radiation on epidermal growth factor, caspase-3, Hsp27 and p38MAPK gene expressions in the rat eye. Bratisl Lek Listy. 2018;119(9):588-592. doi: 10.4149/BLL_2018_106.

Abstract

OBJECTIVE: Radiofrequency electromagnetic fields (RF-EMF) may induce DNA damage and oxidative stress in human lens epithelial cells (LECs). We aimed to investigate the expression levels of heat shock protein 27 (Hsp27), p38 mitogen-activated protein kinase (p38MAPK), epidermal growth factor receptor (EGFR) and caspase-3 gene expression levels in rat eye that was exposed to 1800 MHz RF-EMF.

METHODS: Thirty-seven female Wistar albino rats were divided into three groups. The rats in the study group (n = 9) were exposed to 1800 MHz RF-EMF at an electric field 6.8 ± 0.1 V/m and 0.06 W/kg specific absorption rate (SAR) for 2 hours per day for eight weeks. Sham group (n = 9) was kept under similar conditions as the exposed group without exposure to RF-EMF. The rats in all three groups were sacrificed and their eyes were removed. Hsp27, p38MAPK, EGFR, caspase-3 gene expression levels were investigated in detail with real-time polymerase chain reactions (Real-Time PCR).

RESULTS: caspase-3 and p38MAPK gene expression were significantly upregulated in the ocular tissues following exposure to RF-EMF ($p < 0.05$).

CONCLUSION: According to our findings, eye cells recognize EMF as a stress factor, and in response, activate caspase-3 and p38MAPK gene expressions. These results confirm that RF-EMF can cause cellular damage in rat ocular cells (Tab. 2, Fig. 3, Ref. 37).

Open access paper: http://bit.ly/2xBGnpu

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Physiopathological effects of quercetin on oxidative stress from 4.5 g mobile phone radiation exposed to liver tissue of rat

Postaci I, Coskun O, Senol N, Aslankoc R, Comlekci S. The physiopathological effects of quercetin on oxidative stress in radiation of 4.5 g mobile phone exposed liver tissue of rat. Bratisl Lek Listy. 2018;119(8):481-489. doi: 10.4149/BLL_2018_088.

Abstract

OBJECTIVE: The study was aimed to evaluate the physiopathological consideration of the effects of electromagnetic field (EMF) from the radiation of 4.5 G mobile phones on the liver tissue of rats and quercetin (Qu) applied as an antioxidant for reducing these effects.

METHODS: Male Wistar-Albino rats were divided into four groups with 8 rats in each group. Group 1 (control group), Group 2 (sham group), Group 3 (EMF group) and Group 4 (EMF + Qu). From the animals sacrificed at the end of the 30th day; liver tissues were taken for histopathological and immunohistochemical examinations.

RESULTS: In the liver tissue of the electromagnetic field group; dilatation of sinusitis was determined to be higher than in the sham group. It was concluded that the concentration of caspase-3 and TNF-α immunopositive cells was in the EMF group (+3) level and also the immunostaining was stronger, it caused an increase in malondialdehyde level, the difference between the groups was statistically significant, in terms of superoxide dismutase, catalase activities, the difference was not significant.

CONCLUSION: It was determined that 2600 MHz EMF exposure caused damage to the liver, 100 mg/kg/day quercetin was not sufficient to prevent this damage (Tab. 5, Fig. 15, Ref. 27).

http://bit.ly/2Q311FY

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Modulatory effect of 900 MHz radiation on biochemical and reproductive parameters in rats

Narayanan SN, Lukose ST, Arun G, Mohapatra N, Pamala J, Concessao PL, Jetti R, Kedage V, Nalini K, Bhat PG. Modulatory effect of 900 MHz radiation on biochemical and reproductive parameters in rats. Bratisl Lek Listy. 2018;119(9):581-587. doi: 10.4149/BLL_2018_105.

Abstract

In the present study, the effect of 900 MHz radiation exposure on blood biochemical and reproductive parameters was evaluated in adolescent rats. Male albino Wistar rats (8-10 weeks of age) were exposed to 900 MHz radiation (1hr/day, power density - 146.60 µW/cm2) from a mobile phone for 28 days. On 29th day the animals were euthanized and malondialdehyde (MDA), total antioxidants (TA) levels and Glutathione-S transferase (GST) activity were studied in the blood. Reproductive parameters such as total sperm count, percentage of non-motile sperms, and sperm morphology were determined. Testes sections were stained with H(et)E staining and their cellular integrity was evaluated. Caspase-3 activity in the testes was also determined. MDA concentration was increased but TA levels and GST activity were not found to be different in 900 MHz group compared to controls. Sperm motility was found to be slightly reduced in 900 MHz group. Percentage of abnormal sperm was significantly elevated in 900 MHz group. Additionally, loss of germ cells particularly spermatocytes and spermatids was found in the testes of 900 MHz group. Testes caspase-3 activity was slightly elevated in 900 MHz exposed rats. Chronic 900 MHz exposure induced oxidative damage in the blood and lead to alterations in reproductive parameters in rats (Fig. 4, Ref. 33).

Open access paper: http://bit.ly/2pxJx9B

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Exposure to non-ionizing electromagnetic radiation of public risk prevention instruments threatens the quality of spermatozoids

Tirpak F, Slanina T, Tomka M, Zidek R, Halo M Jr, Ivanic P, Gren A, Formicki G, Stachanczyk K, Lukac N, Massanyi P. Exposure to non-ionizing electromagnetic radiation of public risk prevention instruments threatens the quality of spermatozoids. Reprod Domest Anim. 2018 Sep 7. doi: 10.1111/rda.13338.

Abstract

The use of artificial insemination in cattle breeding has evolved to global extent and insemination doses are often shipped via air transport which requires strict radiation-based examinations. For the determination of effect of non-ionizing radiation (NIR), to which are beings frequently exposed due to protection of airport or cultural event security, freshly ejaculated and cryopreserved bovine spermatozoa were used as experimental model. Following radiation with hand-held metal detector in various exposition times (0, 10 seconds, 15, 30 and 60 minutes - groups FR, FR10, FR15, FR30 and FR60) the spermatozoa underwent motility and DNA fragmentation analyses. Study on cryoconserved semen treated with NIR was performed in time intervals 0, 10 seconds, 1 and 5 minutes (insemination doses radiated before cryoconservation - CB, CB10, CB1, CB5; samples radiated after freezing - CA, CA10, CA1 and CA5). Fresh semen and insemination doses radiated after cryoconservation showed significantly lower total and progressive motility. No effect on motility parameters was detected in semen extended with cryopreservative medium and radiated prior to freezing. Surprisingly, NIR showed a potential to stimulate spermatozoa velocity; however the effect was modulated throughout the post-thawing incubation. Based on the DNA fragmentation assay, sperm DNA stayed intact. Present study underlines the potential harm of NIR, which is frequently used in everyday life, with overall

adverse impact on human and animal reproduction. Current study also points out on interesting short-term spermatozoa stimulation induced by NIR.

https://www.ncbi.nlm.nih.gov/pubmed/30192989

The aim of the present study, carried out on the bovine spermatozoa, was to evaluate the possible risk of 93 kHz non-ionizing radiation associated with decreased fertilizing properties (sperm motility traits) of fresh and cryopreserved spermatozoa.

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Genotoxicity of intermediate frequency magnetic fields in vitro and in vivo

Herrala M, Kumari K, Koivisto H, Luukkonen J, Tanila H, Naarala J, Juutilainen J. Genotoxicity of intermediate frequency magnetic fields in vitro and in vivo. Environ Res. 2018 Sep 8. pii: S0013-9351(18)30494-8. doi: 10.1016/j.envres.2018.09.009.

Abstract

We assessed genotoxic effects of intermediate frequency magnetic fields (MF) in vitro and in vivo. Rat primary astrocytes were exposed for 24 h to a 7.5 kHz MF at a magnetic flux density of 30 or 300 μT. Male C57BL/6 J mice were exposed continuously for 5 weeks to a 7.5 kHz MF at 12 or 120 μT, and blood samples were collected for the genotoxicity assays. To evaluate possible co-genotoxicity, the in vitro experiments included combined exposure with menadione (an agent that induces mitochondrial superoxide production and DNA damage) and methyl methanesulfonate (an alkylating agent). DNA damage and DNA repair (in vitro) were measured using the alkaline Comet assay and formation of micronuclei was assessed microscopically (in vivo) or using flow cytometry (in vitro). The results did not support genotoxicity or co-genotoxicity of 7.5 kHz MFs at magnetic flux densities up to 300 μT in vitro or in vivo. On the contrary, there was some evidence that exposure to 7.5 kHz MFs might reduce the level of genetic damage. Strongest indication of any biological effects was obtained from measurements of relative cell number, which was significantly and consistently increased after MF exposure in all in vitro experiments. Health implications of this finding are unclear, but it suggests that 7.5 kHz MFs may stimulate cell proliferation or suppress cell death.

https://www.ncbi.nlm.nih.gov/pubmed/30243651

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Characterization of Children's Exposure to Extremely Low Frequency Magnetic Fields by Stochastic Modeling

Bonato M, Parazzini M, Chiaramello E, Fiocchi S, Le Brusquet L, Magne I, Souques M, Röösli M, Ravazzani P. Characterization of Children's Exposure to Extremely Low Frequency Magnetic Fields by Stochastic Modeling. Int J Environ Res Public Health. 2018 Sep 8;15(9). pii: E1963. doi: 10.3390/ijerph15091963.

Abstract

In this study, children's exposure to extremely low frequency magnetic fields (ELF-MF, 40⁻800 Hz) is investigated. The interest in this thematic has grown due to a possible correlation between the increased risk of childhood leukemia and a daily average exposure above 0.4 μT, although the causal relationship is still

uncertain. The aim of this paper was to present a new method of characterizing the children's exposure to ELF-MF starting from personal measurements using a stochastic approach based on segmentation (and to apply it to the personal measurements themselves) of two previous projects: the ARIMMORA project and the EXPERS project. The stochastic model consisted in (i) splitting the 24 h recordings into stationary events and (ii) characterizing each event with four parameters that are easily interpretable: the duration of the event, the mean value, the dispersion of the magnetic field over the event, and a final parameter characterizing the variation speed. Afterward, the data from the two databases were divided in subgroups based on a characteristic (i.e., children's age, number of inhabitants in the area, etc.). For every subgroup, the kernel density estimation (KDE) of each parameter was calculated and the p-value histogram of the parameters together was obtained, in order to compare the subgroups and to extract information about the children's exposure. In conclusion, this new stochastic approach allows for the identification of the parameters that most affect the level of children's exposure.

Open access paper: http://www.mdpi.com/1660-4601/15/9/1963

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Demystifying Monarch Butterfly Migration

Reppert SM, de Roode JC. Demystifying Monarch Butterfly Migration. Curr Biol. 2018 Sep 10;28(17):R1009-R1022. doi: 10.1016/j.cub.2018.02.067.

Abstract

Every fall, millions of North American monarch butterflies undergo a stunning long-distance migration to reach their overwintering grounds in Mexico. Migration allows the butterflies to escape freezing temperatures and dying host plants, and reduces infections with a virulent parasite. We discuss the multigenerational migration journey and its evolutionary history, and highlight the navigational mechanisms of migratory monarchs. Monarchs use a bidirectional time-compensated sun compass for orientation, which is based on a time-compensating circadian clock that resides in the antennae, and which has a distinctive molecular mechanism. Migrants can also use a light-dependent inclination magnetic compass for orientation under overcast conditions. Additional environmental features, e.g., atmospheric conditions, geologic barriers, and social interactions, likely augment navigation. The publication of the monarch genome and the development of gene-editing strategies have enabled the dissection of the genetic and neurobiological basis of the migration. The monarch butterfly has emerged as an excellent system to study the ecological, neural, and genetic basis of long-distance animal migration.

https://www.ncbi.nlm.nih.gov/pubmed/30205052

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Exposure to 50 Hz Magnetic Fields in Homes and Areas Surrounding Urban Transformer Stations in Silla (Spain)

Navarro-Camba EA, Segura-García J, Gomez-Perretta C. Exposure to 50 Hz Magnetic Fields in Homes and Areas Surrounding Urban Transformer Stations in Silla (Spain): Environmental Impact Assessment. Sustainability 2018, 10(8), 2641; doi:10.3390/su10082641

Abstract

Exposure to extremely low frequency electromagnetic fields (ELFs) is almost inevitable almost anywhere in the world. An ELF magnetic field (ELF-MF) of around 1 mG = 0.1 μT is typically measured in any home of the world with a certain degree of development and well-being. There is fear and concern about exposure to electromagnetic fields from high- and medium-voltage wiring and transformer stations, especially internal transformer stations (TSs), which in Spain are commonly located inside residential buildings on the ground floor. It is common for neighbors living near these stations to ask for stations to be moved away from their homes, and to ask for information about exposure levels and their effects. Municipality is the closest administration to the citizens that must solve this situation, mediating between the citizens, the utility companies and the national administration. In this case, the municipality of Silla (València, Spain) wanted to know the levels of exposure in the dwellings annexed to the TSs, to compare them with Spanish legislation and the recommendations coming from epidemiological studies. This article presents the first systematic campaign of ELF-MF measurements from TSs carried out in a Spanish city. Many measurements were carried out in the rooms of the apartments doing spatial averages of spatial grid measurements. Measurements are made in the bed and bedrooms and a weighted average and an environmental impact indicator were obtained for each location. We found that old TSs usually provide the highest peak exposure levels. A notable result of this work is that approximately one quarter of the population living above or next to a TS would be exposed to a weighted MF level greater than 0.3 μT, and that about a 10% of this population would not be able to relocate their bedroom or living room to minimize the level of exposure.

Open access paper: http://www.mdpi.com/2071-1050/10/8/2641

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Investigating the role of internal layout of magnetic field-generating equipment on workers' exposure at power substations

Hosseini M, Farhang Matin L, Monazzam MR, Khosroabadi H. Investigating the role of internal layout of magnetic field-generating equipment on workers' exposure at power substations. Int J Occup Saf Ergon. 2018 Sep 12:1-7. doi: 10.1080/10803548.2018.1475927.

Abstract

INTRODUCTION: This research is an attempt to show the role of interior layout of equipment in generating magnetic fields.

MATERIALS AND METHODS: The levels of an extremely low-frequency magnetic field were measured in accordance with Standard No. IEEE 644:1994 in three substations and a control building in a petrochemical power plant in southern Iran. Then, workers' occupational exposure (time-weighted average [TWA]) was calculated and the sources of maximum magnetic field generation at each place were identified. Their interior design was changed to achieve the optimal layout of equipment subsequently; the workers' TWA was recalculated for the new situation.

RESULTS: The obtained results showed that electrical engineers and technicians were exposed to the maximum TWA of 10.14 μT. The operators in the control room were exposed to the lowest TWA of 0.84 μT. The results also showed that after the change of interior design and proper layout design of the equipment in the substations, the TWA was reduced by 0.73 μT.

CONCLUSION: The research findings revealed that the most harmonious arrangement of equipment in an industrial unit plays a major role in reducing the exposure of workers to magnetic fields and ultimately increases the level of their health in the workplace.

https://www.ncbi.nlm.nih.gov/pubmed/30205763

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Study of Electrical Stimulation with Different Electric Field Intensities in Regulating Differentiation of PC12 Cells

Jing W, Zhang Y, Cai Q, Chen G, Wang L, Yang X, Zhong W. Study of Electrical Stimulation with Different Electric Field Intensities in Regulating Differentiation of PC12 Cells. ACS Chem Neurosci. 2018 Sep 13. doi: 10.1021/acschemneuro.8b00286.

Abstract

The strategy of using electrical stimulation (ES) to promote neural differentiation and regeneration of injured nerves is proven feasible. The study on the possible molecular mechanisms in relation to this ES promotion effect should be helpful to understand the phenomenon. In this study, it was identified the neuronal differentiation of PC12 cells was enhanced when the electric field intensity was in the range of 30-80 mV/mm, lower or higher electric field intensity displayed inferior effect. Under ES, however, levels of intracellular reactive oxygen species (ROS), intracellular Ca2+ dynamics and expression of TREK-1 were measured gradually increasing alongside higher electric field intensity. Trying to understand the relationship between the ES enhancement on differentiation and these variations in cell activities, parallel experiments were conducted by introducing exogeneous H2O2 into culture systems at different concentrations. Similarly, the effects of H2O2 concentration on neuronal differentiation of PC12 cells, intracellular ROS and Ca2+ levels, and TREK-1 expression were systematically characterized. In comparative studies, it was found the two cases that ES of 50 mV/mm for 2 h/day and H2O2 of 5 μM in culture medium shared comparable results in intracellular ROS and Ca2+ levels, and TREK-1 expression. Higher H2O2 concentration (e.g. 10 μM and 20 μM) demonstrated adverse effect on cell differentiation and caused DNA damage. A stronger ES (e.g. 100 mV/mm), being associated with higher intracellular ROS level, also resulted in weaker enhancement on the neuronal differentiation of PC12 cells. These facts suggested that the intracellular ROS generated under ES might be an intermediate signal transducer involved in cascade reactions relative to cell differentiation.

https://www.ncbi.nlm.nih.gov/pubmed/30212623

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Diplomats' Mystery Illness and Pulsed Radiofrequency/Microwave Radiation

Golomb B. Diplomats' mystery illness and pulsed radiofrequency/microwave radiation. Neural Comput. 2018 Sep 5. doi: 10.1162/neco_a_01133.

Abstract

IMPORTANCE: A "mystery" illness striking US and Canadian diplomats to Cuba (and now China) "has confounded the FBI, the State Department and US intelligence agencies." Sonic explanations for the so-called "health attacks" have long dominated media reports, propelled by peculiar sounds heard and auditory symptoms experienced. Sonic mediation was justly rejected by experts. We assessed whether pulsed

radiofrequency/microwave radiation (RF/MW) exposure can accommodate reported facts in diplomats, including unusual ones.

OBSERVATIONS: 1. Noises: Chirping, ringing or grinding noises were heard at night, during episodes reportedly triggering health problems, by many diplomats. Pulsed RF/MW engenders just these "sounds" via the "Frey effect." Ability to hear the sounds depends on high frequency hearing and low ambient noise. "Sounds" differ by head dimensions. 2. Signs/symptoms: Hearing loss and tinnitus are prominent in affected diplomats - and in RF/MW-affected individuals. Each of protean symptoms that diplomats report, also affect persons reporting symptoms from RF/MW: Sleep problems, headaches, and cognitive problems dominate in both groups. Sensations of pressure or vibration figure in each. Both encompass vision, balance and speech problems, and nosebleeds. Brain injury and brain swelling are reported in both. 3. Mechanisms: Oxidative stress provides a documented mechanism of RF/MW injury compatible with reported signs and symptoms; sequelae of endothelial dysfunction (yielding blood flow compromise), membrane damage, blood brain barrier disruption, mitochondrial injury, apoptosis, and autoimmune triggering afford downstream mechanisms, of varying persistence, that merit investigation. 4. Of note, microwaving of the US embassy in Moscow is historically documented.

CONCLUSIONS AND RELEVANCE: Reported facts appear consistent with RF/MW as the source of injury in Cuba diplomats. Non-diplomats citing symptoms from RF/MW, often with an inciting pulsed-RF/MW exposure, report compatible health conditions. Under the RF/MW hypothesis, lessons learned for diplomats and for RF/MW-affected "civilians" may each aid the other.

https://www.ncbi.nlm.nih.gov/pubmed/30183509

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Selected Health and Law Issues Regarding Mobile Communications with Respect to 5G

Mandl P, Pezzei P, Leitgeb E. Selected Health and Law Issues Regarding Mobile Communications with Respect to 5G. Presented at 2018 International Conference on Broadband Communications for Next Generation Networks and Multimedia Applications (CoBCom). Graz, Austria. July 11-13, 2018.

Abstract

Over the next years the demand of wireless communication will increase tremendously. More and more mobile end devices require a high data rate connection e.g. to a smart home (Internet of Things, IoT) or to the internet. The radiation power pattern of base stations and mobile end devices will completely change for the 5G Next Generation Mobile Network technology which will use frequency bands up to 100 GHz. Therefore the electromagnetic exposure especially to human body will increase in the future, because most of the wireless connections are realized in RF technology. In this contribution two different measurement setups are presented. The first shows the electromagnetic radiation regarding a base station powered by a mobile phone provider over a timespan of a number of days. The second figures out the electromagnetic radiation of a handheld mobile end device to a human head in an area with very poor reception values. The results of those measurements where compared with legal and health limits. All measured and calculated results regarding the base stations were within the legal exposure limits. The calculated legal exposure limits of mobile devices were exceeded twice in areas within very poor reception values. Regarding the expected higher bandwidth and corresponding higher electromagnetic exposure to human bodies in future there have to be periodic measurements to comply with radiation limits.

Conclusions

It has been shown that there is currently no overshooting of legal limits in the transmission of base stations. The presented measurement campaign regarding the base station showed that the E-Field reached a maximum of 0.673 *V/m* (legal limit: *47.631 V/m*) and the H-Field a maximum of 2 *mA/m* (legal limit: 128 *mA/m*). However, the coming mobile radio standards like 5G is expected to use frequency bands up to 100 GHz, a much higher density of base stations and 100 times higher bandwidths than nowadays which subsequently causes higher transmission power of base stations. Regarding the above mentioned circumstances **it will be necessary to measure the radiation exposure of base stations in the future on a regular basis in order to ensure the legal limits and to reduce possible health hazards. It also will be necessary to develop new measurement strategies and/or technologies regarding the large frequency spectrum 5G will use up to 100 GHz.**

When measuring directly on a mobile phone (simulating the use of an end device directly on the human head), it was found that the calculated SAR of 3.834 *W/kg* exceeds the legal limit of 2 W/ *kg*. This shows clearly that the legal limit values can be exceeded significantly in areas with very poor reception values ...

Increasing the distance between a mobile end device and the head, e.g. by using a hands-free set or a headset can significantly reduce the human exposure to electromagnetic radiation when such a device is used in badly supplied areas and transmits with maximum power.

https://ieeexplore.ieee.org/document/8443980/

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Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102)

Miller AB, Morgan LL, Udasin I, Davis DL. Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102). Available online Sep 6, 2018. https://doi.org/10.1016/j.envres.2018.06.043

Highlights

• Increased risk of brain, vestibular nerve and salivary gland tumors are associated with mobile phone use.
• Nine studies (2011–2017) report increased risk of brain cancer from mobile phone use.
• Four case-control studies (3 in 2013, 1 in 2014) report increased risk of vestibular nerve tumors.
• Concern for other cancers: breast (male & female), testis, leukemia, and thyroid.
• Based on the evidence reviewed it is our opinion that IARC's current categorization of RFR as a possible human carcinogen (Group 2B) should be upgraded to Carcinogenic to Humans (Group 1).

Abstract

Epidemiology studies (case-control, cohort, time trend and case studies) published since the International Agency for Research on Cancer (IARC) 2011 categorization of radiofrequency radiation (RFR) from mobile phones and other wireless devices as a possible human carcinogen (Group 2B) are reviewed and summarized. Glioma is an important human cancer found to be associated with RFR in 9 case-control studies conducted in Sweden and France, as well as in some other countries. Increasing glioma incidence trends have

been reported in the UK and other countries. Non-malignant endpoints linked include acoustic neuroma (vestibular Schwannoma) and meningioma. Because they allow more detailed consideration of exposure, case-control studies can be superior to cohort studies or other methods in evaluating potential risks for brain cancer. When considered with recent animal experimental evidence, the recent epidemiological studies strengthen and support the conclusion that RFR should be categorized as carcinogenic to humans (IARC Group 1). Opportunistic epidemiological studies are proposed that can be carried out through cross-sectional analyses of high, medium, and low mobile phone users with respect to hearing, vision, memory, reaction time, and other indicators that can easily be assessed through standardized computer-based tests. As exposure data are not uniformly available, billing records should be used whenever available to corroborate reported exposures.

Synthesis and conclusions

The Epidemiological studies reported since the 2011 IARC Working Group meeting are adequate to consider RFR as a probable human carcinogen (Group 2 A). However, they must be supplemented with the recently reported animal data as performed at the Ramazzini Institute and the US National Toxicology Program as well as by mechanistic studies. These experimental findings together with the epidemiology reviewed here are sufficient in our opinion, to upgrade the IARC categorization of RFR to Group 1, carcinogenic to humans.

It would be useful to know more about the association of additional tumor types such as parotid gland, testicular, breast, hematopoietic malignancies and multiple primaries with RFR. Case studies should continue to be conducted in the absence of a better exposure assessment system to increase awareness and understand the relationship between exposure to RFR and disease causation, as well as trial-error experiments and interventions.

In light of the evolving science concerning mobile phone and screen time exposures and the longer-term risk of cancer established by both epidemiological and toxicological studies, current evidence is strong enough to go from precaution concerning possible risk to prevention of known risks. Although the benefits of connectivity are extremely important, safety considerations demand reconciling use of information vs. risk of perceived rare outcomes. Thus, a concerted program of public and health professional education should be undertaken throughout society explaining current knowledge and devising policies to promote safer technology in partnership with designers of software and hardware. In addition, methods should be developed and validated to reduce exposures in schools, workplaces, hospitals and other workplaces. The precautionary principle should be applied now and suitable warning messages provided to adults and critically to children and their parents. Until technology has been devised that substantially lowers exposures, special efforts should be advanced to ensure that the exposures of children are limited to those deemed essential. Children should be encouraged to text to reduce their exposure to RFR, while every attempt should be made to reduce exposure to RFR in schools, as well as homes.

Research has so far been performed on technologies that have already been introduced, but is critically needed on new, untested technology prior to its use. Epidemiological studies necessarily confirm the impact of past exposures, while experimental studies provide indications of future risk. Thus, experimental evaluations and modeling are essential before distributing newer systems (e.g. 5 G) for which no safety data have been obtained. The absence of systematic testing of such technologies should not be confused with proof of safety. Better modeling through anatomically based systems, such as the Virtual Family, should be encouraged.

In the meantime, the evidence amassed thus far from epidemiology strengthens the case for instituting the precautionary principle with respect to exposures to RFR, especially to young children and men and women that wish to reproduce. The lack of detailed studies at this point reflects a myopic attitude toward the

technology that may well prove to be wishful and dangerous thinking. Where studies have been carried out on human sperm quantity and quality there are increasing indications of serious human health impacts. To ignore those findings and subject humans to unevaluated novel RFR frequencies places current and future generations at risk.

https://www.sciencedirect.com/science/article/pii/S0013935118303475

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Clear evidence of cell-phone RF radiation cancer risk

Lin JC. Clear evidence of cell-phone RF radiation cancer risk. IEEE Microwave Magazine. 19(6):16-24. Sep/Oct 2018. DOI: 10.1109/MMM.2018.2844058.

Abstract

During 26-28 March 2018, the National Institute of Environmental Health Sciences (NIEHS) National Toxicology Program (NTP), a part of the U.S. National Institutes of Health, convened a three-day technical reports peer-review panel meeting in Research Triangle Park, North Carolina, to review the NTP's draft reports on its carcinogenesis studies of cell-phone RF radiation in mice and rats.

https://ieeexplore.ieee.org/document/8425056/

A summary and excerpts from the paper: **http://bit.ly/NTPcellphonestudies**

In a new paper, “Clear evidence of cell-phone RF radiation cancer risk” published in the journal *IEEE Microwave Magazine*, Dr. James C. Lin states that the results of the National Toxicology Program (NTP) cell phone radiation study suggest that current radio frequency (RF) exposure guidelines are inadequate to protect human health (1). Furthermore, the paper recommends that the International Agency for Research on Cancer (IARC) re-assess the research and consider upgrading the classification of RF radiation from "possibly carcinogenic to humans" (Group 2B) to probably carcinogenic (i.e., Group 2A).

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Peer Review of the Draft NTP Technical Reports on Cell Phone Radiofrequency Radiation

National Toxicology Program (NTP). Peer Review of the Draft NTP Technical Reports on Cell Phone Radiofrequency Radiation. National Institute of Environmental Health Sciences. 2018. pp. 1-51.

No abstract.

Open access paper: https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/peerreview20180328_508.pdf

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Editorial: Effects of Combined EMF Exposures and Co-exposures

Mattsson M-O, Zeni O, Simkó M, Scarfì MR.Editorial: Effects of Combined EMF Exposures and Co-exposures. Frontiers in Public Health. 20 August 2018. https://doi.org/10.3389/fpubh.2018.00230.

No Abstract

Excerpt

The very complex exposure situation in real-life environments has been well illustrated in this Research Topic, and the need for better understanding of basic biological interaction mechanisms is obvious from the analyses presented here. The area is very much under-investigated, and the full impact and potential of EMF exposures for both possible adverse and beneficial effects cannot be realized without substantial additional research efforts.

Open access: https://www.frontiersin.org/articles/10.3389/fpubh.2018.00230/full

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Effects of mobile phone exposure on biochemical parameters of cord blood: A preliminary study

Bektas H, Bektas MS, Dasdag S. Effects of mobile phone exposure on biochemical parameters of cord blood: A preliminary study. Electromagn Biol Med. 2018 Aug 29:1-8. doi: 10.1080/15368378.2018.1499033.

Abstract

The purpose of this study is to investigate foetal impact of radiofrequencies (RFs) emitted from mobile phones in postnatal cord blood. The study carried on 149 pregnant women divided into four groups such as nonusers of mobile phone (n: 37; control group), 2-15 min/d (n: 39; group 1), 15-60 min/d (n: 37; group 2) and participants using mobile phone for more than 60 min/d (n: 36; group 3). Cord blood of the infants was taken in all groups for biochemical analyses immediately after birth. The results of the study showed that the biggest foetal impact was observed in the third study group which was pregnant exposed RFRs (RF radiation) more than 1 h/d (1 hour per day). AST (aspartat aminotransferaz), ALT (alanine aminotransferase), LDH (lactate dehydrogenase), CK (creatine kinase), CK-MB (creatine kinase-miyocardial band), CRP (c-reactive protein), PCT (procalcitonin), TnT (troponin T), uric acid and lactate levels of third group were found higher than the other groups ($p < 0.001$). However, Mean platelet volume values of third group were found lower than the other groups ($p < 0.001$). Finally, this is the first human study which was performed on pregnant and infants because there is no previous work in this area. However, the results of this study revealed that long-term RFR exposure of pregnant may result in some biochemical changes in the infants. Therefore, our suggestion to pregnant is to avoid from RFR exposure emitted from mobile phones at least during pregnancy.

https://www.ncbi.nlm.nih.gov/pubmed/30156944

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Comments regarding: "Occupational exposure to high-frequency EMF & brain tumor risk in INTEROCC study: An individualized assessment approach"

Mortazavi SMJ. Comments regarding: "Occupational exposure to high-frequency electromagnetic fields and brain tumor risk in the INTEROCC study: An individualized assessment approach". Environ Int. 2018 Aug 24. pii: S0160-4120(18)31561-7. doi: 10.1016/j.envint.2018.08.008.

Abstract

This commentary addresses the paper by Vila et al. entitled "Occupational exposure to high-frequency electromagnetic fields and brain tumor risk in the INTEROCC study: An individualized assessment approach" that is published in Environment International. The authors have examined the link between occupational exposures to radiofrequency (RF) and intermediate frequency (IF) electromagnetic fields (EMF) and glioma

and meningioma brain tumor risk in the INTEROCC multinational population-based case-control study. This study showed no clear association with exposure to RF or IF EMFs and the risk of glioma or meningioma brain tumors. Recent studies show that in many cases there are large errors and/or major shortcomings in the studies claiming no link between mobile phone and brain cancer. Although the paper by Vila et al. is well-structured and can be considered as a significant contribution to this field, there are several items that merit further attention and are not fully addressed. These include the selection bias, confounding factors other than age, sex, region and country, and criteria used in this study for considering exposures as occupational.

https://www.ncbi.nlm.nih.gov/pubmed/30146273

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Statistical approach for human EMF exposure assessment in future wireless ATTO-cell networks

Shikhantsov S, Thielens A, Vermeeren G, Demeester P, Martens L, Torfs G, Joseph W. Statistical approach for human electromagnetic exposure assessment in future wireless ATTO-cell networks. Radiat Prot Dosimetry. 2018 Jul 30. doi: 10.1093/rpd/ncy120.

Abstract

In this article, we study human electromagnetic exposure to the radiation of an ultra dense network of nodes integrated in a floor denoted as ATTO-cell floor, or ATTO-floor. ATTO-cells are a prospective 5 G wireless networking technology, in which humans are exposed by several interfering sources. To numerically estimate this exposure we propose a statistical approach based on a set of finite difference time domain simulations. It accounts for variations of antenna phases and makes use of a large number of exposure evaluations, based on a relatively low number of required simulations. The exposure was expressed in peak-spatial 10-g SAR average (psSAR10g). The results show an average exposure level of ~4.9 mW/kg and reaching 7.6 mW/kg in 5% of cases. The maximum psSAR10g value found in the studied numerical setup equals around 21.2 mW/kg. Influence of the simulated ATTO-floor size on the resulting exposure was examined. All obtained exposure levels are far below 4 W/kg ICNIRP basic restriction for general public in limbs (and 20 W/kg basic restriction for occupational exposure), which makes ATTO-floor a potential low-exposure 5 G candidate.

https://www.ncbi.nlm.nih.gov/pubmed/30085262

Excerpt

The ATTO-floor is a new concept for ultra-high capacity wireless networking, designed to provide wireless access to robots that can freely move around the floor surface. ATTO-cells are integrated into the floor and cover its entire area. According to the current design[(1)] (Figure 1) an ATTO-cell has dimensions of 15-by-15 cm^2 and an antenna is supplied with a maximum power of 1 mW. It operates at a center frequency of 3.5 GHz. Possible applications of the ATTO technology include industrial warehouses or factories of the future, where multitudes of mobile robots and human workers operate simultaneously. Robots, being equipped with an antenna featuring downward-pointing pattern, are the target users. Due to the provisioned fast handover system, at any time instance a robot is only connected to the closest antenna, thus, it is unlikely for humans to be exposed by the ATTO-floor directly. In other words, most of the time humans will be exposed to the scattered fields of antennas serving surrounding robots.

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Study of the Correlation between Outdoor and Indoor Electromagnetic Exposure near Cellular Base Stations in Leuven, Belgium

NkemIyare R, Volskiy V, Vandenbosch G. Study of the Correlation between Outdoor and Indoor Electromagnetic Exposure near Cellular Base Stations in Leuven, Belgium. Environmental Research. Publ online 22 Aug 2018. https://doi.org/10.1016/j.envres.2018.08.025

Highlights

• GSM 900 is the dominating source of exposure
• Exposure levels meet international recommendations and local legislation
• In absolute levels the outdoor field exposure is ca. the double of the indoor field exposure
• EM exposure levels are reproducible over a time span of ca. one month

Abstract

A measuring campaign for the assessment of electromagnetic radiation near base stations in the city center of Leuven, Belgium, has been carried out. The main objective of this assessment is to study the correlation between the outdoor and the indoor exposure produced by cellular base stations and to investigate the changes of electromagnetic exposure within a typical day and over 1 month in the vicinity of these base stations. The study was also carried out as a function of location and time using highly precise measurement equipment. The measurements were performed in both public and private areas in sixty (30 indoor and 30 outdoor) different locations in Leuven. The measurement was focused on mobile communication networks: GSM (Global System for Mobile Communication, 900 MHz and 1800 MHz) and UMTS (Universal Mobile Telecommunications System, 2110 MHz) were the frequency bands of interest. The data at these frequencies were extracted from raw measurements in the 824 MHz to 2170 MHz frequency band. The results show that all analyzed locations are in compliance with the exposure limits recommended by ICNIRP (International Commission on Non-Ionizing Radiation Protection) and that the (maximum) indoor exposure correlates to the outdoor exposure with a factor of about 0.5.

Conclusions

The electromagnetic radiation exposure of the general public generated by base stations in Leuven, Belgium, was duly assessed using spectrum analyzer measurements at 60 locations and at several moments during the day. All measured values are considerably below norm levels for Flanders, which means that they are far below the ICNIRP exposure limits for the general public. The average levels over time and over the whole city center are: outdoors about 0.64 V/m for GSM 900, 0.53 for GSM 1800, and 0.33 for UMTS, and indoors about 0.32 V/m for GSM 900, 0.26 for GSM 1800, and 0.17 for UMTS. To the average, the outdoor exposure levels are thus a factor of two higher than the indoor levels. In general, the dominating source of exposure is GSM 900. The maximum field value measured was equal to 1.80 V/m, due to the GSM 900 signal. In this study, the average effect of absorption and reflection, typically used to explain the lower values indoors, is in agreement with the average attenuation through walls used in propagation models.

https://www.sciencedirect.com/science/article/pii/S0013935118304651

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On the effects of glasses on the SAR in human head resulting from wireless eyewear devices at phone call stat

Lan JQ, Liang X, Hong T, Du GH. On the effects of glasses on the SAR in human head resulting from wireless eyewear devices at phone call state. Progress in Biophysics and Molecular Biology. 136:29-36. Aug 2018.

Abstract

This paper evaluates the effects of glasses on the specific absorption rates (SAR) in the human head resulting from wireless eyewear device at phone call state. We mainly concentrate on the SAR in the eyes since their sensitivity to electromagnetic fields (EMF). We find wearing glasses obviously alters the distribution and magnitude of the SAR. The maximal SAR in the ocular tissues with glasses is even 6 times more than that without glasses. Wearing glasses also induce the new hotspot in the eyes which may cause the biggest SAR increment in the ocular tissues. Moreover, calculated results indicate that the maximal SAR is sensitive to the size of glasses and radiation frequency. Because of this, we believe wearing glasses may possibly increase the risk of health hazard to eyes of wireless eyewear device user. These calculated results could be a valuable reference for the glasses designer to reduce the SAR in the eyes.

https://www.sciencedirect.com/science/article/pii/S0079610717300822

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Subjective symptoms, onset/trigger factors, allergic diseases, & exposures in Japanese patients with multiple chemical sensitivity

Hojo S, Mizukoshi A, Azuma K, Okumura J, Ishikawa S, Miyata M, Mizuki M, Ogura H, Sakabe K. Survey on changes in subjective symptoms, onset/trigger factors, allergic diseases, and chemical exposures in the past decade of Japanese patients with multiple chemical sensitivity. Int J Hyg Environ Health. 2018 Aug 13. pii: S1438-4639(18)30271-2. doi: 10.1016/j.ijheh.2018.08.001.

Abstract

BACKGROUND: Recently, with rapid changes in the Japanese lifestyle, the clinical condition of patients with multiple chemical sensitivity (MCS) may also have undergone change. Thus, we conducted a new survey for subjective symptoms, ongoing chemical exposures, the prevalence of allergic diseases, and presumed onset/trigger factors in patients with MCS and compared results with those of an old survey from ten years ago.

METHODS: The new survey was conducted from 2012 to 2015 and the old survey was independently conducted from 1999 to 2003, meaning it was not a follow-up study. Patients were initially diagnosed by physicians at five medical institutions with MCS specialty outpatient services, with 111 and 103 patients participating in the new and old surveys, respectively. The controls were a general population living in Japan, with 1313 and 2382 participants in the new and old surveys, respectively. Subjective symptoms and ongoing chemical exposure were evaluated using a quick environmental exposure sensitivity inventory. Additionally, from clinical findings recorded by an attending physician, the prevalence of allergic diseases and presumed onset/trigger factors were evaluated. Differences between new and old surveys were analyzed using logistic regression analyses and significance tests.

RESULTS: Compared with ten years ago: (1) Regarding factors affecting patients with ongoing chemical exposures, the proportion of patients affected decreased significantly for two items only (insecticides and

second-hand smoke). The proportion of controls showing ongoing exposure to 8 out of 10 items changed significantly. (2) In patients, scores for chemical intolerances, other intolerances, and life impacts increased significantly. (3) In terms of the prevalence of allergic diseases among patients with MCS, bronchial asthma (adjusted odds ratio [AOR]: 5.19), atopic dermatitis (AOR: 3.77), allergic rhinitis (AOR: 5.34), and food allergies (AOR: 2.63) increased significantly, while hay fever (AOR: 0.38) and drug allergies (AOR: 0.40) decreased significantly. (4) With regard to construction and renovation, which was the presumed predominant onset/trigger factor for MCS 10 years ago, this decreased from 68.9% to 35.1%; in contrast, electromagnetic fields (0.0%-26.1%), perfume (0.0%-20.7%), and medical treatment (1.9%-7.2%) increased significantly, confirming the diversification of onset/trigger factors.

CONCLUSION: Compared to ten years ago, for patients with MCS, an increase in avoidance behavior toward chemical substance exposures, which were presumed to be aggravating factors for symptoms, was confirmed. It has been suggested that the ongoing chemical exposure of the general population in Japan has largely changed. In addition, for patients with MCS, chemical intolerances and life impacts have become severe, the prevalence of the main allergic diseases has increased, and onset/trigger factors have become diversified.

https://www.ncbi.nlm.nih.gov/pubmed/30115513

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Design and Calibration of a mm-Wave Personal Exposure Meter for 5G Exposure Assessment in Indoor Diffuse Environments

Aminzadeh R, Khadir Fall A, Sol J, Thielens A, Besnier P, Zhadobov M, De Geeter N, Vasudevan PP, Dupré L, Van Holen R, Martens L, Wout J. Design and Calibration of a mm-Wave Personal Exposure Meter for 5G Exposure Assessment in Indoor Diffuse Environments. Journal of Infrared, Millimeter, and Terahertz Waves. pp 1–19. Published Online: 23 August 2018.

Abstract

For the first time, a mm-wave personal exposure meter (mm-PEM) for the 5th generation of mobile networks (5G) exposure assessment in indoor diffuse fields is presented. The design is based on simulations and on-phantom calibration measurements in a mm-wave reverberation chamber (RC) at 60 GHz. The mm-PEM consists of an array of nine antennas on the body. Using the mm-PEM, the incident power density (IPD) is measured in the unloaded RC, for the antenna(s) on the phantom and RC loaded with phantom. The uncertainty of the mm-PEM is then determined in terms of its response, which is defined as the ratio of antenna aperture for the above measurement scenarios. Using nine antennas, the designed meter has a response of 1.043 (0.17 dB) at 60 GHz, which is very close to 1 (0 dB), the desired ideal response value. The mm-PEM measured an IPD of 96.6 $W\,m^{-2}$ at 60 GHz in the RC, for an input power of 1 W. In addition, the average absorption cross-section of the phantom is determined as 225 cm^2, which is an excellent agreement with its physical dimensions.

Conclusion

A mm-wave personal exposure meter (mm-PEM) is designed for assessment of personal exposure to 5G in indoor diffuse environments. The mm-PEM is calibrated on a skin-equivalent phantom in a reverberation chamber (RC) in the range of 59.5 to 60.5 GHz. We showed that increasing the number of antennas up to nine, a response of 1.043 at 60 GHz is obtained. This response is very close to 1, which is the desired response of the mm-PEM; so, the mm-PEM can measure the IPD in free space but in the presence of human body. The response of the mm-PEM in diffuse fields is also determined in terms of numerical simulations using the FDTD. Good agreement between measurements and simulations is achieved. According to the results, we

recommend to calibrate the mm-PEM in the loaded RC. The average absorption cross-section of the skin phantom is determined as 225 cm^2 from the measurements, which is in excellent agreement with the physical geometry of the phantom. Future research includes design of acquisition nodes (antenna and receiver electronics) for the mm-PEM to measure the IPD directly. Additionally, the calibrations will be performed on a cylindrical or spherical phantom to study the effect of body shadowing on the response of the designed mm-PEM and to design a distributed exposure meter for the mm-waves.

https://link.springer.com/article/10.1007/s10762-018-0533-z

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The Effect of a Single 30-Min Long Term Evolution Mobile Phone-Like Exposure on Thermal Pain Threshold of Young Healthy Volunteers

Vecsei Z, Thuróczy G, Hernádi I. The Effect of a Single 30-Min Long Term Evolution Mobile Phone-Like Exposure on Thermal Pain Threshold of Young Healthy Volunteers. Int J Environ Res Public Health. 2018 Aug 27;15(9). pii: E1849. doi: 10.3390/ijerph15091849.

Abstract

Although the majority of mobile phone (MP) users do not attribute adverse effects on health or well-being to MP-emitted radiofrequency (RF) electromagnetic fields (EMFs), the exponential increase in the number of RF devices necessitates continuing research aimed at the objective investigation of such concerns. Here we investigated the effects of acute exposure from Long Term Evolution (LTE) MP EMFs on thermal pain threshold in healthy young adults. We use a protocol that was validated in a previous study in a capsaicin-induced hyperalgesia model and was also successfully used to show that exposure from an RF source mimicking a Universal Mobile Telecommunications System (UMTS) MP led to mildly stronger desensitization to repeated noxious thermal stimulation relative to the sham condition. Using the same experimental design, we did not find any effects of LTE exposure on thermal pain threshold. The present results, contrary to previous evidence obtained with the UMTS modulation, are likely to originate from placebo/nocebo effects and are unrelated to the brief acute LTE EMF exposure itself. The fact that this is dissimilar to our previous results on UMTS exposure implies that RF modulations might differentially affect pain perception and points to the necessity of further research on the topic.

Open access paper: http://www.mdpi.com/1660-4601/15/9/1849

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Exposure levels of ELF magnetic fields in the residential areas of Mangaung Metropolitan Municipality

Rathebe P, Weyers C, Raphela F. Exposure levels of ELF magnetic fields in the residential areas of Mangaung Metropolitan Municipality. Environ Monit Assess. 2018 Aug 23;190(9):544. doi: 10.1007/s10661-018-6916-8.

Abstract

The aim of this study was to evaluate the exposure levels of ELF magnetic fields in the residential areas of Mangaung metropolitan municipality. Fifteen residential sites were randomly selected in Bloemfontein, nine in Botshabelo and six in Thaba Nchu areas of Mangaung. Measurements were collected at the distances of 3 m, 6 m and 9 m outside electrical substations, near every corner, using a Trifield meter model XE 100. Measurements were also collected from four different corners inside substations, near barrier screening and

were referred to as a distance of 0 m (reference point). The results indicated a non-significant difference among 15 residential areas; BRE1 to BRE15 and six areas; TNRE1 to TRNE6. The exposure levels were significantly high in one residential area BORE1 (0.55 μT) as compared to other residential sites in Botshabelo ($p < 0.001$). The results obtained from the measurements also show a significant difference between the residential areas BORE4 and BORE8 ($p < 0.01$) as well as BORE4 and BORE9 ($p < 0.006$). The four distance interims also demonstrated a highly significant difference ($p < 0.0001$) when compared to one another. The t test showed a statistically significant difference for exposure levels recorded at 3 m, 6 m and 9 m in comparison to 0 m ($p < 0.01$). The exposure levels recorded at 3 m were also significantly different to those recorded at 6 m ($p < 0.05$) and 9 m ($p < 0.01$). The exposure levels measured at all distances are below the ICNIRP guidelines and the fields decrease rapidly with an increased distance from the source.

https://www.ncbi.nlm.nih.gov/pubmed/30140955

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Association between parental occupational exposure to ELF magnetic fields and childhood nervous system tumors risk: A meta-analysis

Su L, Zhao C, Jin Y, Lei Y, Lu L, Chen G. Association between parental occupational exposure to extremely low frequency magnetic fields and childhood nervous system tumors risk: A meta-analysis. Sci Total Environ. 2018 Nov 15;642:1406-1414.

Highlights

• A meta-analysis identified 22 studies on parental occupational ELF-MF exposure and risk of childhood nervous system tumors.
• Parental occupational ELF-MF exposure was associated with increased risk of childhood CNS tumors but not neuroblastoma.
• Maternal but not paternal occupational ELF-MF exposure significantly increased risk of childhood CNS tumors.

Abstract

BACKGROUND AND OBJECTIVE: Previous epidemiological studies suggested association between parental occupational exposure to extremely low frequency magnetic fields (ELF-MF) and risk of childhood nervous system tumors, but the results were inconsistent. We conducted a meta-analysis of case-control and cohort studies to re-evaluate this association.

METHODS: Relevant studies were identified by searching PubMed and Web of Science databases as well as by manual searching. Summary odds ratio (OR) with 95% confidence interval (CI) were pooled with a fixed-effects or random-effects model.

RESULTS: A total of 22 eligible articles (21 case-control studies and 1 cohort study) were included for the quantitative analysis. The results showed that parental occupational ELF-MF exposure was significantly associated with an increased risk of childhood nervous system tumors (OR = 1.11, 95% CI = 1.02-1.21), and this association remained in studies on central nervous system (CNS) tumors (OR = 1.13, 95% CI = 1.02-1.27) but not neuroblastoma (OR = 1.02, 95% CI = 0.92-1.14). Furthermore, maternal (OR = 1.14, 95% CI = 1.05-1.23) but not paternal (OR = 1.05, 95% CI = 0.98-1.13) occupational ELF-MF exposure significantly increased

risk of childhood nervous system tumors. Increased risk of childhood CNS tumors was significant associated with maternal (OR = 1.16, 95% CI = 1.06-1.26) but not paternal (OR = 1.15, 95% CI = 0.98-1.34) occupational ELF-MF exposure.

CONCLUSION: In conclusion, our results provide limited evidence for the association between maternal occupational exposure to ELF-MF and increased risk of childhood CNS tumors, which should be explained with cautions. Future studies are needed to further evaluate the association of paternal occupational ELF-MF exposure with risk of childhood CNS tumors.

https://www.ncbi.nlm.nih.gov/pubmed/30045521

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The human skin as a sub-THz receiver - Does 5G pose a danger to it or not?

Betzalel N, Ben Ishai P, Feldman Y. The human skin as a sub-THz receiver - Does 5G pose a danger to it or not? Environ Res. 2018 May;163:208-216. doi: 10.1016/j.envres.2018.01.032.

Highlights

• The sweat duct is regarded as a helical antenna in the sub-THz band, reflectance depends on perspiration.
• We outline the background for non-thermal effects based on the structure of sweat ducts.
• We have introduced a realistic skin EM model and found the expected SAR for the 5G standard.

Abstract

In the interaction of microwave radiation and human beings, the skin is traditionally considered as just an absorbing sponge stratum filled with water. In previous works, we showed that this view is flawed when we demonstrated that the coiled portion of the sweat duct in upper skin layer is regarded as a helical antenna in the sub-THz band. Experimentally we showed that the reflectance of the human skin in the sub-THz region depends on the intensity of perspiration, i.e. sweat duct's conductivity, and correlates with levels of human stress (physical, mental and emotional). Later on, we detected circular dichroism in the reflectance from the skin, a signature of the axial mode of a helical antenna. The full ramifications of what these findings represent in the human condition are still unclear. We also revealed correlation of electrocardiography (ECG) parameters to the sub-THz reflection coefficient of human skin. In a recent work, we developed a unique simulation tool of human skin, taking into account the skin multi-layer structure together with the helical segment of the sweat duct embedded in it. The presence of the sweat duct led to a high specific absorption rate (SAR) of the skin in extremely high frequency band. In this paper, we summarize the physical evidence for this phenomenon and consider its implication for the future exploitation of the electromagnetic spectrum by wireless communication. Starting from July 2016 the US Federal Communications Commission (FCC) has adopted new rules for wireless broadband operations above 24 GHz (5 G). This trend of exploitation is predicted to expand to higher frequencies in the sub-THz region. One must consider the implications of human immersion in the electromagnetic noise, caused by devices working at the very same frequencies as those, to which the sweat duct (as a helical antenna) is most attuned. We are raising a warning flag against the unrestricted use of sub-THz technologies for communication, before the possible consequences for public health are explored.

https://www.ncbi.nlm.nih.gov/pubmed/29459303

Excerpt

The need for high data transmission rates, coupled with advances in semiconductor technology, is pushing the communications industry towards the sub-THz frequency spectrum. While the promises of a glorious future, resplendent with semi-infinite data streaming, may be attractive, there is a price to pay for such luxury. We shall find our cities, workspace and homes awash with 5 G base stations and we shall live though an unprecedented EM smog. The benefits to our society of becoming so wired cannot ignore possible health concerns, as yet unexplored. There is enough evidence to suggest that the combination of the helical sweat duct and wavelengths approaching the dimensions of skin layers could lead to non-thermal biological effects. Such fears should be investigated and these concerns should also effect the definition of standards for the application of 5G communications.

Prior study:

Betzalel N, Feldman Y, Ishai PB. The Modeling of the Absorbance of Sub-THz Radiation by Human Skin. IEEE Transactions on Terahertz Science and Technology 7(5):521-528. Sep 2017.

Abstract

In the near future, applications will come online that require data transmission in ultrahigh rates of 100 Gbit per second and beyond. In fact, the planning for new industry regulations for the exploitation of the sub-THz band are well advanced under the auspices of IEEE 802.15 Terahertz Interest Group. One aspect of this endeavor is to gauge the possible impact on human health by the expected explosion in commercial use of this band. It is, therefore, imperative to estimate the respective specific absorption rates of human tissues. In the interaction of microwave radiation and human beings, the skin is traditionally considered as just an absorbing sponge stratum filled with water. This approach is justified when the impinging wavelength is greater than the dimensions of the skin layer. However, in the sub-THz band this condition is violated. In 2008, we demonstrated that the coiled portion of the sweat duct in upper skin layer could be regarded as a helical antenna in the sub-THz band. The full ramifications of what these findings represent in the human condition are still very unclear, but it is obvious that the absorption of electromagnetic energy is governed by the topology for the skin and its organelles, especially the sweat duct.

Conclusion

The need for high data transmission rates, coupled with advances in semiconductor technology, is pushing the communications industry toward the sub-THz frequency spectrum. While this is a relatively underutilized area of the EM spectrum, it does come with a price. The affinity of atmospheric absorption in this band means that many small short range and relatively powerful transmitters will be required for decent coverage. The results of our study emphasize that rather than gallop toward these solutions with abandon, the human health implications must be considered first, as wavelengths approach the dimensions of skin-based features. The results point to the dominant role of the sweat duct in EM skin absorbance. We can conclude and say that if the new regime of WLAN communication, the 5G standard, will happen in the next years, the concern regarding biological influence on the human body should be considered.

https://ieeexplore.ieee.org/document/8016593/

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Effects of EMF exposure on the antioxidant defense system

Kıvrak EG, Yurt KK, Kaplan AA, Alkan I, Altun G. Effects of electromagnetic fields exposure on the antioxidant defense system. J Microsc Ultrastruct. 2017 Oct-Dec;5(4):167-176.

Abstract

Technological devices have become essential components of daily life. However, their deleterious effects on the body, particularly on the nervous system, are well known. Electromagnetic fields (EMF) have various chemical effects, including causing deterioration in large molecules in cells and imbalance in ionic equilibrium. Despite being essential for life, oxygen molecules can lead to the generation of hazardous by-products, known as reactive oxygen species (ROS), during biological reactions. These reactive oxygen species can damage cellular components such as proteins, lipids and DNA. Antioxidant defense systems exist in order to keep free radical formation under control and to prevent their harmful effects on the biological system. Free radical formation can take place in various ways, including ultraviolet light, drugs, lipid oxidation, immunological reactions, radiation, stress, smoking, alcohol and biochemical redox reactions. Oxidative stress occurs if the antioxidant defense system is unable to prevent the harmful effects of free radicals. Several studies have reported that exposure to EMF results in oxidative stress in many tissues of the body. Exposure to EMF is known to increase free radical concentrations and traceability and can affect the radical couple recombination. The purpose of this review was to highlight the impact of oxidative stress on antioxidant systems.

Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6025786/

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Non-ionizing EMF hazard in the 21th century

Koh WJ, Moochhala SM. Non-ionizing EMF hazard in the 21th century. 2018 IEEE International Symposium on Electromagnetic Compatibility and 2018 IEEE Asia-Pacific Symposium on Electromagnetic Compatibility (EMC/APEMC).

Abstract

With the fast advancement in technologies and the heavy reliance on wireless devices, we are exposed to ever increasing electromagnetic field (EMF) radiation from home to office to public places. The two most widely referenced standards for non-ionizing EMF radiation protection - IEEE C95.1 and ICNIRP - were last updated in 2005 and 1998 respectively. A comparison of the two standards with the Russian standard shows that the Russian maximum permissible exposure (MPE) is 41 and 5.8 times lower in terms of electric field strength at 1MHz respectively. Despite numerous tests showing potential hazards to humans from radiation levels below the MPE levels stated in ICNIRP guidelines and C95.1, ICNIRP and IEEE continue to ignore calls by scientists to review their MPE levels. This paper addresses the current and future trends in communication and wireless technologies and their impact on the EMF radiation level that the general public will be exposed to. Studies on biological effects due to EMF radiation carried out over the last 20+ years will also be discussed. Based on the effects of these studies from radiation levels well below the MPE in C95.1 and ICNIRP guidelines, this paper recommends a review of the current safety levels.

Conclusion

With the fast advancement in telecommunication and wireless technologies and the heavy reliance on AC and DC power supplies, we will be constantly and increasingly exposed to EMF everywhere we go, including where we sleep. Based on the findings from numerous EM-Bio effect studies, it is evident that non-thermal and low

radiation level (below MPE levels specified in C95.1 and ICNIRP guidelines) EMF could have significant effects on human body. it should be mentioned here that very specific exposure conditions may trigger biological response in one individual, but not in others. And some may take longer time than others for the symptoms to appear. Any health safety standard must protect not just those who are healthy but include those in poor health, the young and the pregnant women.

WHO's decision to classify mobile phone radiation as possibly carcinogenic came more than 20 years after mobile phones were introduced. Should we wait another 20 years for severe biological effects to show up and then regret that we did not do something earlier? We hope IEEE and ICNIRP can seriously consider potential effects from long term exposure of EMF radiation and review their MPE levels as soon as possible. If the committees still think that the results are inconclusive, then they may want to define a set of objective specific testing protocols so scientists and researchers can work on it to produce clear and definitive results.

https://ieeexplore.ieee.org/document/8393832/

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Longitudinal associations between risk appraisal of base stations for mobile phones, radio or television and non-specific symptoms

Martens AL, Slottje P, Smid T, Kromhout H, Vermeulen RCH, Timmermans DRM. Longitudinal associations between risk appraisal of base stations for mobile phones, radio or television and non-specific symptoms. Journal of Psychosomatic Research. 112:81-89. Sep 2018.https://doi.org/10.1016/j.jpsychores.2018.07.008

Highlights

• We studied longitudinal associations in a general population cohort.
• Risk appraisal of base stations was associated with higher symptom scores.

• The results indicate the presence of bidirectional longitudinal associations.

• Female sex, younger age, higher education, were associated with high risk appraisal.

Abstract

Introduction: Studies found that higher risk appraisal of radiofrequency electromagnetic fields is associated with reporting more non-specific symptoms such as headache and back pain. There is limited data available on the longitudinal nature of such associations and what aspects of risk appraisal and characteristics of subjects are relevant.

Objective: To examine cross-sectional and longitudinal associations between risk appraisal measures and non-specific symptoms, and assess the role of subject characteristics (sex, age, education, trait negative affect) in a general population cohort.

Methods: This study was nested in the Dutch general population AMIGO cohort that was established in 2011/2012, when participants were 31–65 years old. We studied a sample of participants (n = 1720) who filled in two follow-up questionnaires in 2013 and 2014, including questions about perceived exposure, perceived risk, and health concerns as indicators of risk appraisal of base stations, and non-specific symptoms.

Results: Perceived exposure, perceived risk, and health concerns, respectively, were associated with higher symptom scores in cross-sectional and longitudinal analyses. Only health concerns (not perceived exposure and perceived risk) temporally preceded high symptom scores and vice versa. Female sex, younger age, higher education, and higher trait negative affect were associated with higher risk appraisal of mobile phone base stations.

Discussion: The findings in this study strengthen the evidence base for cross-sectional and longitudinal associations between higher risk appraisal and non-specific symptoms in the general population. However, the directionality of potential causal relations in non-sensitive general population samples should be examined further in future studies, providing information to the benefit of risk communication strategies.

https://www.sciencedirect.com/science/article/pii/S0022399918302058

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Exposure to GSM 900-MHz mobile radiation impaired inhibitory avoidance memory consolidation in rat: Involvements of opioidergic and nitrergic systems

Ahmadi S, Alavi SS, Jadidi M, Ardjmand A. Exposure to GSM 900-MHz mobile radiation impaired inhibitory avoidance memory consolidation in rat: Involvements of opioidergic and nitrergic systems. Brain Research. 1701:36-45. Dec 2018. https://doi.org/10.1016/j.brainres.2018.07.016.

Highlights

• Four weeks of exposure to GSM radiation impaired IA memory performance.\
• Post-training i.c.v. injections of naloxone recovered the impairment of IA memory.
• Pre-test i.c.v. injections of L-NAME impaired the positive effect of naloxone
• Pre-test co-administration of L-arginine and L-NAME recovered the impairment.
• Opioid and NO systems are involved in the effects of GSM exposure on IA memory.

Abstract

The use of mobile phones is increasing, and the main health concern is the possible deleterious effects of radiation on brain functioning. The present study aimed to examine the effects of exposure to a global system for mobile communication (GSM) with mobile phones on inhibitory avoidance (IA) memory performance as well as the involvement of endogenous opioids and nitric oxide (NO) in this task. Male Wistar rats, 10–12 weeks old, were used. The results showed that four weeks of mobile phone exposure impaired IA memory performance in rats. The results also revealed that post-training, but not pre-training, as well as pre-test intracerebroventricular (i.c.v.) injections of naloxone (0.4, 4 and 40 ng/rat), dose-dependently recovered the impairment of IA memory performance induced by GSM radiation. Additionally, the impairment of IA memory performance was completely recovered in the exposed animals with post-training treatment of naloxone (40 ng/rat) plus pre-test i.c.v. injections of L-arginine (100 and 200 nmol/rat). However, pre-test i.c.v. injections of L-NAME (10 and 20 nmol/rat), impaired IA memory performance in the animals receiving post-training naloxone (40 ng/rat). In the animals receiving post-training naloxone treatment, the impairment of IA memory performance due to pre-test i.c.v. injections of L-NAME was recovered by the pre-test co-administration of L-arginine. It was concluded that the recovery from impairment of IA memory in GSM-exposed animals with post-training naloxone treatment was the result of blockade of the opioidergic system in early memory consolidation as well as activation of the nitrergic system in the retrieval phase of memory.

https://www.sciencedirect.com/science/article/pii/S0006899318304001

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Evaluating temperature changes of brain tissue due to induced heating of cell phone waves

Forouharmajd F, Pourabdian S, Hossein E. Evaluating temperature changes of brain tissue due to induced heating of cell phone waves. Intl J Prev Med. 9:40. Apr 2018

Background: Worries have recently been increased in the absorption of radiofrequency waves and their destructing effects on human health by increasing use of cell phones (mobile phones). This study performed to determine the thermal changes due to mobile phone radio frequency waves in gray and white brain tissue. Methods: This study is an empirical study, where the thermal changes of electromagnetic waves resulted from cell phones (900 MHZ, specific absorption rate for head 1.18 w/kg) on the 15 brain tissue of a cow were analyzed in a compartment with three different thickness of 2 mm, 12 mm, and 22 mm, for 15 min. The Lutron thermometer (model: MT-917) with 0.01 degrees C precision was used for measuring the tissue temperature. For each thickness was measured three times. Data analysis is done by Lutron and MATLAB software packages. Results: In confronting of the tissue with the cell phone, the temperature was increased by 0.53 degrees C in the 2 mm thickness that is the gray matter of the brain, increased by 0.99 degrees C in the 12 mm thickness, and also increased by 0.92 degrees C in the 22 mm thickness. Brain temperature showed higher rates than the base temperature after 15 min of confrontation with cell phone waves in all the three thicknesses. Conclusions: Cell phone radiated radio frequency waves were effective on increasing brain tissue temperature, and this temperature increase has cumulative effect on the tissue, being higher, for some time after the confrontation than the time with no confrontation.

Open access paper: http://www.ijpvmjournal.net/article.asp?issn=2008-7802;year=2018;volume=9;issue=1;spage=40;epage=40;aulast=Forouharmajd

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Modeling tissue heating from exposure to RF energy & relevance of tissue heating to exposure limits

Foster, KR, Ziskin MC, Balzano Q; Bit-Babik G. Modeling Tissue Heating From Exposure to Radiofrequency Energy and Relevance of Tissue Heating to Exposure Limits: Heating Factor. Health Physics: 115(2):295-307. Aug 2018

Abstract

This review/commentary addresses recent thermal and electromagnetic modeling studies that use image-based anthropomorphic human models to establish the local absorption of radiofrequency energy and the resulting increase in temperature in the body. The frequency range of present interest is from 100 MHz through the transition frequency (where the basic restrictions in exposure guidelines change from specific absorption rate to incident power density, which occurs at 3–10 GHz depending on the guideline). Several detailed thermal modeling studies are reviewed to compare a recently introduced dosimetric quantity, the heating factor, across different exposure conditions as related to the peak temperature rise in tissue that would be permitted by limits for local body exposure. The present review suggests that the heating factor is a robust quantity that is useful for normalizing exposures across different simulation models. Limitations include lack of information about the location in the body where peak absorption and peak temperature increases occur in each exposure scenario, which are needed for careful assessment of potential hazards. To the limited extent that comparisons are possible, the thermal model (which is based on Pennes' bioheat equation) agrees reasonably well with experimental data, notwithstanding the lack of theoretical rigor of the model and uncertainties in the model parameters. In particular, the blood flow parameter is both variable with physiological condition and largely determines the steady state temperature rise. We suggest an approach to

define exposure limits above and below the transition frequency (the frequency at which the basic restriction changes from specific absorption rate to incident power density) to provide consistent levels of protection against thermal hazards. More research is needed to better validate the model and to improve thermal dosimetry in general. While modeling studies have considered the effects of variation in thickness of tissue layers, the effects of normal physiological variation in tissue blood flow have been relatively unexplored.

https://www.ncbi.nlm.nih.gov/pubmed/29957690

Conclusion

Advances in computational dosimetry and thermal modeling, reviewed in this paper, have filled in many details about the relation between psSAR and peak increase in temperature. These studies show that the heating factor is a robust measure of this relation. However, additional information is needed to assess potential thermal hazards of RF exposure, including the location and magnitude of the temperature increases in the body.

This present and two previous reviews in this series (Foster et al. 2016, 2017) show that thermal models can be useful for revising and updating RF exposure limits. While the theory that underlies the models, Pennes' BHTE, is generally reliable, it is not exact. Thermal models for RF heating of tissue require additional experimental validation including effects of variability in tissue blood perfusion, possible thermoregulatory responses of the body to RF heating, and other factors. Finally, more experimental data are needed for thermal hazards of RF energy at frequencies above the threshold. Apart from thermal hazards, a comprehensive review of all reported biological effects of RF energy above the transition frequency in the standards is also needed.

Q.B., K.R.F, and M.Z. were supported in this project by Mobile and Wireless Forum, which did not review and had no control over preparation of this manuscript. The authors thank A. Hirata, Nagoya Institute of Technology, Japan, for providing results used to prepare Fig. 3, and Dr. Vitas Anderson and Dr. C-K Chou for helpful discussion of earlier drafts of this paper. The views and opinions expressed herein are solely those of the authors and are not to be attributed to Motorola Solutions or any of its operating companies.

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900 MHz GSM Cell Phone Radiation Alters Human MCF-7 Cells & Stem Cells

Shahbazi-Gahrouei D, Hashemi-Beni B, Moradi A, Aliakbari M, Shahbazi-Gahrouei S. Exposure to Global System for Mobile Communication 900 MHz Cellular Phone Radiofrequency Alters Growth, Proliferation and Morphology of Michigan Cancer Foundation-7 Cells and Mesenchymal Stem Cells. Int J Prev Med. 2018 Jun 19;9:51.

Abstract

Background: Today, using cellular phone and its harmful effects in human life is growing. The aim of this study is to investigate the effect of the global system for mobile communication (GSM) 900 MHz cellular phone radiofrequency waves on growth, morphology, and proliferation rate of mesenchymal stem cells and Michigan Cancer Foundation (MCF-7) cells within the specific distance and intensity.

Methods: MCF-7 and human adipose-derived stem cells (HADSCs) were exposed to GSM cellular phones 900 MHz frequency with intensity of 354.6 μW/cm2 during different exposure times 6, 21, 51, and 101 min/day with

an interval of 10 min for each subsequent radiation exposure for 3 and 5 days at 10 and 20 cm distances from antenna. 3-(4,5-dimethythiazol- 2-yl)-2,5-diphenyl tetrazolium bromide assay and trypan blue test were used to determine the growth of cells and cell viability, respectively. Statistical analyses were carried out using three-way ANOVA. Differences were significant when $P < 0.05$.

Results: The proliferation rates of both MCF-7 and HADSCs cells in all exposure groups were significantly lower than controls ($P < 0.05$). There was a significant effect on the percentage of cell survival with increase the period of time from 3 to 5 days for MCF-7 ($P < 0.01$) and HADSCs ($P = 0.02$), respectively. Variations in distance had no significant effect on the percentage of cell survival ($P = 0.35$) on MCF-7 ($P = 0.02$) and HADSCs ($P = 0.09$) cells, respectively.

Conclusions: The results showed that radiation of GSM 900 MHz cellular phone may be reduced cell viability and proliferation rates of both cells. It is recommended to reduce exposure time, increase distance from antenna, and reserve the use of cell phones for shorter conversations to prevent its biological and harmful effects. Further studies with other intensities and frequencies on different cells are recommended.

Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6028991/

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What is adverse effect of Wireless Local Area Network, using 2.45 GHz, on the reproductive system?

Bilgici B, Gun S, Avci B, Akar A, Engiz BK. What is adverse effect of Wireless Local Area Network, using 2.45 GHz, on the reproductive system? Int J Radiat Biol. 2018 Jul 20:1-25.

Abstract

PURPOSE: To investigate the inflammatory effect and testicular damage on rats exposed to low level of electromagnetic fields (EMF) at 2.45 GHz microwave radiation.

METHODS: Twenty two Wistar rats were divided into two groups. Group 1 was the control group and not exposed to EMF. Group 2 was exposed to low level EMF (average E-field 3.68± 0.36 V/m, whole body average SAR, 0.0233W/kg, in 10g tissue) at 2.45 GHz for 1 hour/day for 30 consecutive days. At the end of the study, interleukin-6 (IL-6), interleukin-10 (IL-10), interleukin-32 (IL-32), C-reactive protein (CRP) were measured in rat serum and IL-6, IL-10, IL-32 were measured in rat testis tissue. Furthermore, testicular tissues were evaluated histopathologically in terms of spermatogenesis and coagulation necrosis.

RESULTS: Serum IL-6 and CRP levels were found to be significantly different in the study group compared to the control group ($p < 0.05$), but no significant difference was found in serum IL-10, IL-32 levels and testis tissue IL-6, IL-10, IL-32 levels compared to the control group ($p > 0.05$). On the other hand, histopathological evaluation of testicular tissue revealed a significant difference in necrosis and spermatogenesis when compared with the control group ($p < 0.05$) Conclusions: It may be concluded that low level EMF at 2.45 GHz increases inflammation and testicular damage and negative impact on male reproductive system function.

https://www.ncbi.nlm.nih.gov/pubmed/30028652

Excerpt:

In this study, Microwave system with monopole antenna (2004X-RF, Everest Co., Adapazari, Turkey) was used to produce the low level EMF at 2.45 GHz. Microwave radiation generator can radiate at 2.45 GHz frequency, with a range of 0-1 Watt output power, and produce continuous or pulsed (modulated at 217 Hz) radiation.

My note: This study did not test Wi-Fi.

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DNA electromagnetic properties and interactions - An investigation on intrinsic bioelectromagnetism within DNA

Bukhari MH, Batool S, Raza Y, Bagasra O, Rizvi A, Shah A.DNA electromagnetic properties and interactions - An investigation on intrinsic bioelectromagnetism within DNA. Electromagnetic Biology & Medicine. Jul 19, 2018. https://doi.org/10.1080/15368378.2018.1499032.

Abstract

The question whether intrinsic bioelectromagnetism exists within DNA or not is an important and so far unexplored area of biology. We carried out a study of isolated genetic material, utilizing both prokaryotic and eukaryotic DNA, to measure any possible intrinsic electromagnetic effects or fields emanated within the molecules. Studies were carried out with extremely sensitive ultra-low-noise trans-impedance amplifiers and a high-precision data acquisition system to record any possible faintest electromagnetic signals from the concentrated, as well as diluted DNA, in vitro. Some experiments were performed to investigate any possible electromagnetic effects of high-frequency (HF) RF fields on the DNA under test. However, after extensive testing and careful measurements, we failed to detect any possible intrinsic or induced electromagnetic activity from the DNA as compared to simple water or empty chambers. We reached a conclusion that there does not seem to be any measurable intrinsic electromagnetic activity or fields present in the DNA material, whether in concentrated or diluted form, and if there were, any such activity or fields would be extremely minuscule to be detected with scientific precision by current human measurement methods.

https://www.tandfonline.com/doi/full/10.1080/15368378.2018.1499032

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Exposure to 50 Hz Magnetic Fields in Homes and Areas Surrounding Urban Transformer Stations in Silla (Spain): Environmental Impact Assessment

Enrique A. Navarro-Camba EA , Segura-García J, Gomez-Perretta C. Exposure to 50 Hz Magnetic Fields in Homes and Areas Surrounding Urban Transformer Stations in Silla (Spain): Environmental Impact Assessment.
Sustainability 2018, 10(8), 2641; 27 July 2018. (This article belongs to the Special Issue Electromagnetic Waves Pollution)

Abstract

Exposure to extremely low frequency electromagnetic fields (ELFs) is almost inevitable almost anywhere in the world. An ELF magnetic field (ELF-MF) of around 1 mG = 0.1 μT is typically measured in any home of the world with a certain degree of development and well-being. There is fear and concern about exposure to

electromagnetic fields from high- and medium-voltage wiring and transformer stations, especially internal transformer stations (TSs), which in Spain are commonly located inside residential buildings on the ground floor. It is common for neighbors living near these stations to ask for stations to be moved away from their homes, and to ask for information about exposure levels and their effects. Municipality is the closest administration to the citizens that must solve this situation, mediating between the citizens, the utility companies and the national administration. In this case, the municipality of Silla (València, Spain) wanted to know the levels of exposure in the dwellings annexed to the TSs, to compare them with Spanish legislation and the recommendations coming from epidemiological studies. This article presents the first systematic campaign of ELF-MF measurements from TSs carried out in a Spanish city. Many measurements were carried out in the rooms of the apartments doing spatial averages of spatial grid measurements. Measurements are made in the bed and bedrooms and a weighted average and an environmental impact indicator were obtained for each location. We found that old TSs usually provide the highest peak exposure levels. A notable result of this work is that approximately one quarter of the population living above or next to a TS would be exposed to a weighted MF level greater than 0.3 μT, and that about a 10% of this population would not be able to relocate their bedroom or living room to minimize the level of exposure.

Open access paper: http://www.mdpi.com/2071-1050/10/8/2641

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Measurement and analysis of power-frequency magnetic fields in residences: Results from a pilot study

Halgamuge MN, McLean L. Measurement and analysis of power-frequency magnetic fields in residences: Results from a pilot study. Measurement. 125:415-424. Sep 2018.

Highlights

• Exposure to high magnetic fields in residential situations occurs in proximity to appliances.
• Emissions from some appliances exceeded the general public exposure levels of the ICNIRP limits.
• Taking precautions, such as reducing distance from sources can significantly reduce exposures.
• Collected data can be useful as an additional data base for future epidemiological studies.

Abstract

Aim Extremely low-frequency magnetic fields (ELF-MFs) are emitted by electrical household appliances, wiring, meter boxes, conductive plumbing, power lines and transformers. Some of the studies investigating the link between ELF-MFs and health problems have not adequately characterized the magnetic field exposure of subjects, as they did not always measure residential magnetic fields or measure in locations where residents are most exposed. Considering this, there is a need for good quality assessments of residential ELF-MFs in different geographical regions to collect general public exposure data and to identify high sources of magnetic fields. Such studies have the potential to add significant scientific knowledge about residential exposure and appropriate precautions to reduce exposure, improve the quality of life and substantially reduce health care costs.

Subject and methods In this work, we analyzed the ELF-MFs from 3163 datasets collected from 100 houses in Australia. Measurements were carried out in different geographical locations and were assessed for compliance with the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines. Then we compared our measurements with another twenty-three peer-reviewed studies, published 1987–2015,

reporting magnetic field measurements in residences.

Results The observed average (geometric mean) magnetic field values were; bed 0.85, bedroom 1.39 mG, baby cot 0.39 mG, children's play area 0.47 mG, and family room 0.30 mG. Our results show considerable variation in the fields to which residents are typically exposed, particularly in beds (21.83%) and bedrooms (33.33%) where the percentage of measurements greater than 4 mG was considerable. Some emissions exceeded the general public exposure levels of the ICNIRP Guidelines, with the potential for residents to be exposed above these levels. However, away from electrical appliances, the average field in all rooms was 0.30–1.39 mG. We show that simple precautions can be applied to reduce exposure to ELF-MFs in residences and thereby minimize potential risks to health and wellbeing.

Conclusion Our investigation provides a new data collection model for future surveys, which could be conducted with larger samples to verify our observations. Additionally, this data could be useful as a reference for researchers and those members of the general public who do not have access to the necessary measuring equipment.

Conclusion

Exposure to high magnetic fields in residential situations occurs in proximity to appliances, especially microwave ovens, conductive water pipes, meter boxes, and wiring, as well as external sources such as power lines, transformers and substations. Emissions of some appliances exceeded the general public exposure levels of the ICNIRP exposure guideline. However, there is no conclusive proof that electromagnetic fields cause health problems. Taking precautions, such as increasing distance from sources can significantly reduce exposures. In this work, we analyzed the power frequency magnetic fields using 3163 datasets from 100 houses in Australia. Our work provides a model for future surveys, especially for epidemiological studies. This work also will be useful to householders to understand the typical magnetic field strength to which they are exposed everyday. Future surveys could be conducted with larger samples, to verify our observations and to correlate these exposures with symptoms experienced by householders. Future studies could also consider measurements of radiofrequency radiation from wireless devices in the home.

https://www.sciencedirect.com/science/article/pii/S0263224118303920?via%3Dihub

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Millitesla magnetic field effects on the photocycle of an animal cryptochrome

Sheppard DM, Li J, Henbest KB, Neil SR, Maeda K, Storey J, Schleicher E, Biskup T, Rodriguez R, Weber S, Hore PJ, Timmel CR, Mackenzie SR. Millitesla magnetic field effects on the photocycle of an animal cryptochrome. Sci Rep. 2017 Feb 8;7:42228. doi: 10.1038/srep42228.

Abstract

Drosophila have been used as model organisms to explore both the biophysical mechanisms of animal magnetoreception and the possibility that weak, low-frequency anthropogenic electromagnetic fields may have biological consequences. In both cases, the presumed receptor is cryptochrome, a protein thought to be responsible for magnetic compass sensing in migratory birds and a variety of magnetic behavioural responses in insects. Here, we demonstrate that photo-induced electron transfer reactions in Drosophila melanogaster cryptochrome are indeed influenced by magnetic fields of a few millitesla. The form of the protein containing flavin and tryptophan radicals shows kinetics that differ markedly from those of closely related members of the

cryptochrome-photolyase family. These differences and the magnetic sensitivity of Drosophila cryptochrome are interpreted in terms of the radical pair mechanism and a photocycle involving the recently discovered fourth tryptophan electron donor.

Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5296725/

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6-mT 0-120-Hz magnetic fields differentially affect cellular ATP levels

Wang D, Zhang L, Shao G, Yang S, Tao S, Fang K, Zhang X. 6-mT 0-120-Hz magnetic fields differentially affect cellular ATP levels. Environ Sci Pollut Res Int. 2018 Aug 3. doi: 10.1007/s11356-018-2868-3.

Abstract

Adenosine triphosphate (ATP), an indispensable molecule that provides energy for essentially all cellular processes, has been shown to be affected by some magnetic fields (MFs). Although people are frequently exposed to various static and power frequency MFs in their daily lives, the exact effects of these MFs of different frequencies have not been systematically investigated. Here, we tested 6-mT MFs with 0, 50, and 120 Hz for their effects on cellular ATP levels in 11 different cell lines. We found that the 6-mT static magnetic field (SMF) either does not affect or increase cellular ATP levels, while 6-mT 50-Hz MF either does not affect or decrease cellular ATP levels. In contrast, 6-mT 120-Hz MF has variable effects. We examined the mitochondrial membrane potential (MMP) as well as reactive oxygen species (ROS) in four different cell lines, but did not find their direct correlation with ATP levels. Although none of the ATP level changes induced by these three different frequencies of 6-mT MFs are dramatic, these results may be used to explain some differential cellular responses of various cell lines to different frequency MFs.

https://www.ncbi.nlm.nih.gov/pubmed/30074140

Excerpt

In conclusion, although the ATP level changes induced by 6-mT MFs are not dramatic, the exact effects are cell type-, MF frequency-, and time-dependent. These may help to explain some observed cellular phenomenon of low-frequency MFs. Given the prevalence of power frequency and SMF exposure for human bodies, such as the MFs generated by electric power lines, home appliance, and household items, people should be aware of their potential effects on cellular ATP, which is the foundation of many cellular processes.

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

Belpomme D, Hardell, L, Belyaev I, Burgio E, Carpenter DO. Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective. Environ Pollut. 2018 Jul 6;242(Pt A):643-658. doi: 10.1016/j.envpol.2018.07.019.

Highlights

- Exposure to electromagnetic fields has increased dramatically.
- Electromagnetic fields at low and non-thermal intensities increase risk of cancer in animals and humans.

• Some individuals are particularly sensitive and develop a syndrome of electrohypersensitivity.
• There is an urgent need to recognize hazards associated with excessive exposure to non-thermal levels of electromagnetic fields.

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

Final section of the paper:

Public Health Implications of Human Exposure to EMFs

The incidence of brain cancer in children and adolescents has increased between 2000 and 2010 (Ostrom et al., 2015). Gliomas are increasing in the Netherlands (Ho et al., 2014), glioblastomas are increasing in Australia (Dobes et al., 2011) and England (Philips et al., 2018) and all brain cancers are increasing in Spain (Etxeberrua et al., 2015) and Sweden (Hardell and Carlberg, 2017). The latency period between initial exposure and clinical occurrence of brain cancer is not known but is estimated to be long. While not all reports of brain cancer rates show an increase, some do. The continually increasing exposure to EMFs from all sources may contribute to these increases. The prevalence of EHS is unknown, but various reports suggest that it is between 1 and 10% of the population (Hallberg and Oberfeld, 2006; Huang et al., 2018). Male fertility has been declining (Geoffroy-Siraudin et al., 2012; Levine et al., 2017). EMFs increase the risk of each of these diseases and others. Alzheimer's disease is increasing in many countries worldwide and its association with ELF-EMF occupational exposure has been clearly demonstrated through several independent epidemiological studies (Davanipour and Sobel, 2009; Sobel et al., 1996; Qiu et al., 2004) and a meta-analysis of these studies (García et al., 2008). A recent meta-analysis (Huss et al., 2018) has reported an increased risk of amyotrophic lateral sclerosis in workers occupationally exposure to ELF-EMFs.

Safety limits for RF exposure have been based (until today) on the thermal effects of EMFs. But these standards do not protect people, particularly children, from the deleterious health effects of non-thermal EMFs (Nazıroğlu et al., 2013; Mahmoudabadi et al., 2015). Each of these diseases is associated with decrements in health and quality of life. Brain cancer patients often die is spite of some improvement in treatment, while EHS patients present with increased levels of distress, inability to work, and progressive social withdrawal. The

ability for humans to reproduce is fundamental for the maintenance of our species.

The scientific evidence for harm from EMFs is increasingly strong. We do not advocate going back to the age before electricity or wireless communication, but we deplore the present failure of public health international bodies to recognize the scientific data showing the adverse effects of EMFs on human health. It is encouraging that some governments are taking action. France has removed WiFi from pre-schools and ordered Wi-Fi to be shut off in elementary schools when not in use (http://www.telegraph.co.uk.news/2017/12/11/france-ipose-total-ban-mobile-phones-schools/). The State of California Department of Public Health has issued a warning on use of mobile phones and offered advice on how to reduce exposure (State of California, 2017). There are many steps that are neither difficult nor expensive that can be taken to use modern technology but in a manner that significally reduces threats to human health.

It is urgent that national and international bodies, particularly the WHO, take this significant public health hazard seriously and make appropriate recommendations for protective measures to reduce exposures. This is especially urgently needed for children and adolescents. It is also important that all parts of society, especially the medical community, educators, and the general public, become informed about the hazards associated with exposure to EMFs and of the steps that can be easily taken to reduce exposure and risk of associated disease.

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

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Cohort study of adolescents' memory performance & brain dose of microwave radiation from wireless EMF

Foerster M., Thielens A., Joseph W., Eeftens M., Röösli M. (2018) A prospective cohort study of adolescents' memory performance and individual brain dose of microwave radiation from wireless communication. Environmental Health Perspectives. https://ehp.niehs.nih.gov/ehp2747

Abstract

BACKGROUND: The potential impact of microwave radiofrequency electromagnetic fields (RF-EMF) emitted by wireless communication devices on neurocognitive functions of adolescents is controversial. In a previous analysis, we found changes in figural memory scores associated with a higher cumulative RF-EMF brain dose in adolescents.

OBJECTIVE: We aimed to follow-up our previous results using a new study population, dose estimation, and approach to controlling for confounding from media usage itself.

METHODS: RF-EMF brain dose for each participant was modeled. Multivariable linear regression models were fitted on verbal and figural memory score changes over 1 y and on estimated cumulative brain dose and RF-EMF related and unrelated media usage (n=669–676). Because of the hemispheric lateralization of memory, we conducted a laterality analysis for phone call ear preference. To control for the confounding of media use behaviors, a stratified analysis for different media usage groups was also conducted.

RESULTS: We found decreased figural memory scores in association with an interquartile range (IQR)

increase in estimated cumulative RF-EMF brain dose scores: −0:22 (95% CI: −0:47, 0.03; IQR: 953 mJ=kg per day) in the whole sample, −0:39 (95% CI: −0:67, −0:10; IQR: 953 mJ=kg per day) in right-side users (n=532), and −0:26 (95% CI: −0:42, −0:10; IQR: 341 mJ=kg per day) when recorded network operator data were used for RF-EMF dose estimation (n=274). Media usage unrelated to RF-EMF did not show significant associations or consistent patterns, with the exception of consistent (nonsignificant) positive associations between data traffic duration and verbal memory.

CONCLUSIONS: Our findings for a cohort of Swiss adolescents require confirmation in other populations but suggest a potential adverse effect of of RF-EMF brain dose on cognitive functions that involve brain regions mostly exposed during mobile phone use. https://doi.org/10.1289/EHP2427

Conclusion

We found preliminary evidence suggesting that RF-EMF may affect brain functions such as figural memory in regions that are most exposed during mobile phone use. Our findings do not provide conclusive evidence of causal effects and should be interpreted with caution until confirmed in other populations. Associations with media use parameters with low RF-EMF exposures did not provide clear or consistent support of effects of media use unrelated to RF-EMF (with the possible exception of consistent positive associations between verbal memory and data traffic duration). It is not yet clear which brain processes could be potentially affected and what biophysical mechanism may play a role. Potential long-term risk can be minimized by avoiding high brain-exposure situations as occurs when using a mobile phone with maximum power close to the ear because of, for example, bad network quality.

Original study from 2015:

Schoeni A., Roser K., Röösli M. (2015) Memory performance, wireless communication and exposure to radiofrequency electromagnetic fields: a prospective cohort study in adolescents. Environmental International. 85: 343-351.

Highlights

• This is a prospective cohort study with approx. one year of follow-up.
• Self-reported and operator recorded mobile phone use data were collected.
• The cumulative RF-EMF dose for the brain and for the whole body was calculated.
• Associations were stronger for RF-EMF dose than for use of wireless devices.
• RF-EMF exposure might impair memory performance in adolescents.

Abstract

BACKGROUND: The aim of this study is to investigate whether memory performance in adolescents is affected by radiofrequency electromagnetic fields (RF-EMF) from wireless device use or by the wireless device use itself due to non-radiation related factors in that context.

METHODS: We conducted a prospective cohort study with 439 adolescents. Verbal and figural memory tasks at baseline and after one year were completed using a standardized, computerized cognitive test battery. Use of wireless devices was inquired by questionnaire and operator recorded mobile phone use data was obtained for a subgroup of 234 adolescents. RF-EMF dose measures considering various factors affecting RF-EMF

exposure were computed for the brain and the whole body. Data were analysed using a longitudinal approach, to investigate whether cumulative exposure over one year was related to changes in memory performance. All analyses were adjusted for relevant confounders.

RESULTS: The kappa coefficients between cumulative mobile phone call duration and RF-EMF brain and whole body dose were 0.62 and 0.67, respectively for the whole sample and 0.48 and 0.28, respectively for the sample with operator data. In linear exposure-response models an interquartile increase in cumulative operator recorded mobile phone call duration was associated with a decrease in figural memory performance score by -0.15 (95% CI: -0.33, 0.03) units. For cumulative RF-EMF brain and whole body dose corresponding decreases in figural memory scores were -0.26 (95% CI: -0.42, -0.10) and -0.40 (95% CI: -0.79, -0.01), respectively. No exposure-response associations were observed for sending text messages and duration of gaming, which produces tiny RF-EMF emissions.

CONCLUSIONS: A change in memory performance over one year was negatively associated with cumulative duration of wireless phone use and more strongly with RF-EMF dose. This may indicate that RF-EMF exposure affects memory performance.

https://www.sciencedirect.com/science/article/pii/S0160412015300659?via%3Dihub

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Occupational exposure to high-frequency EMF and brain tumor risk in INTEROCC study

Vila J, Turner MC, Gracia-Lavedan E, Figuerola J, Bowman JD, Kincl L, Richardson L, Benke G, Hours M, Krewski D, McLean D, Parent ME, Sadetzki S, Schlaefer K, Schlehofer B, Schüz J, Siemiatycki J, van Tongeren M, Cardis E, INTEROCC Study Group.Occupational exposure to high-frequency electromagnetic fields and brain tumor risk in the INTEROCC study: An individualized assessment approach. Environ Int. 2018 Jul 8;119:353-365. doi: 10.1016/j.envint.2018.06.038.

Introduction: In 2011, the International Agency for Research on Cancer classified radiofrequency (RF) electromagnetic fields (EMF) as possibly carcinogenic to humans (group 2B), although the epidemiological evidence for the association between occupational exposure to RF-EMF and cancer was judged to be inadequate, due in part to limitations in exposure assessment. This study examines the relation between occupational RF and intermediate frequency (IF) EMF exposure and brain tumor (glioma and meningioma) risk in the INTEROCC multinational population-based case-control study (with nearly 4000 cases and over 5000 controls), using a novel exposure assessment approach.

Methods: Individual indices of cumulative exposure to RF and IF-EMF (overall and in specific exposure time windows) were assigned to study participants using a source-exposure matrix and detailed interview data on work with or nearby EMF sources. Conditional logistic regression was used to investigate associations with glioma and meningioma risk.

Results: Overall, around 10% of study participants were exposed to RF while only 1% were exposed to IF-EMF. There was no clear evidence for a positive association between RF or IF-EMF and the brain tumors studied, with most results showing either no association or odds ratios (ORs) below 1.0. The largest adjusted ORs were obtained for cumulative exposure to RF magnetic fields (as A/m-years) in the highest exposed category (≥90th percentile) for the most recent exposure time window (1-4 years before the diagnosis or reference date) for both glioma, OR = 1.62 (95% confidence interval (CI): 0.86, 3.01) and meningioma (OR = 1.52, 95% CI: 0.65, 3.55).

Conclusion: Despite the improved exposure assessment approach used in this study, no clear associations were identified. However, the results obtained for recent exposure to RF electric and magnetic fields are suggestive of a potential role in brain tumor promotion/progression and should be further investigated.

https://www.ncbi.nlm.nih.gov/pubmed/29996112

Excerpt

In conclusion, despite the improved quantitative exposure assessment used in this study, the results do not support a positive association between occupational exposure to high-frequency EMF and either glioma or meningioma risk. However, given our limited statistical power, due to the small number of exposed participants, and despite our results´ lack of significance (Greenland et al., 2016; Rothman, 2016; Smith and Kriebel, 2010), our findings foster the need for further research focusing on RF magnetic fields and tumor promotion, as well as possible interactions with other frequencies and with chemicals. Moreover, since most RF studies until now have focused on the effects of electric fields, more studies of RF magnetic fields are needed, particularly looking at differences between near-field (e.g. walkie-talkies) and far-field exposures (e.g. radars). Furthermore, the development of biology-based dose metrics which take into account both electric and magnetic fields from various sources (Hansson Mild and Mattson, 2017) may provide further insights on the potential biophysical mechanism(s), other than heating and nerve electro-stimulation (ICNIRP, 1998; IEEE, 2006), by which long-term exposure to high-frequency EMF may damage health.

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"Biological effects of non-ionizing electromagnetic fields: Two sides of a coin".

Saliev T, Begimbetova D, Masoud AR, Matkarimov B. "Biological effects of non-ionizing electromagnetic fields: Two sides of a coin.". Prog Biophys Mol Biol. 2018 Jul 17. pii: S0079-6107(18)30100-7. doi: 10.1016/j.pbiomolbio.2018.07.009.

Abstract

Controversial, sensational and often contradictory scientific reports have triggered active debates over the biological effects of electromagnetic fields (EMFs) in literature and mass media the last few decades. This could lead to confusion and distraction, subsequently hampering the development of a univocal conclusion on the real hazards caused by EMFs on humans. For example, there are lots of publications indicating that EMF can induce apoptosis and DNA strand-breaks in cells. On the other hand, these effects could rather be beneficial, in that they could be effectively harnessed for treatment of various disorders, including cancer. This review discusses and analyzes the results of various in vitro, in vivo and epidemiological studies on the effects of non-ionizing EMFs on cells and organs, including the consequences of exposure to the low and high frequencies EM spectrum. Emphasis is laid on the analysis of recent data on the role of EMF in the induction of oxidative stress and DNA damage. Additionally, the impact of EMF on the reproductive system has been discussed, as well as the relationship between EM radiation and blood cancer. Apart from adverse effects, the therapeutic potential of EMFs for clinical use in different pathologies is also highlighted.

https://www.ncbi.nlm.nih.gov/pubmed/30030071

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Effect of RF EMF from mobile phones on nickel release from orthodontic brackets: An in vitro study

Seyed Mohammad S, Mortazavi J, Paknahad M, Khaleghi I, Eghlidospour M. Effect of radiofrequency electromagnetic fields (RF-EMFS) from mobile phones on nickel release from orthodontic brackets: An in vitro study. International Orthodontics, Available online 12 July 2018.

Summary

Background The worldwide dramatic increase in the use of cell phones has generated great concerns about their potential adverse health effects.

Objective The aim of the present study was to evaluate the effects of radiofrequency electromagnetic fields (RF-EMFs) emitted from mobile phones on the level of nickel release from orthodontic brackets.

Methods Twenty stainless steel brackets were divided randomly into experimental and control groups (n = 10). Brackets were immersed in artificial saliva at 37 °C for 6 months. Experimental group were exposed to GSM 900 MHz RF-EMFs emitted from a mobile phone stimulator for 4 hours. The specific absorption rate (SAR) was 2.287 W/kg. The concentration of nickel in the artificial saliva in both groups was evaluated by using the cold-vapour atomic absorption spectrometry. The Mann-Whitney test was used to assess significant differences in nickel release between the exposed and non-exposed groups.

Results The mean nickel levels in the exposed and non-exposed groups were 11.95 and 2.89 μg/l, respectively. This difference between the concentrations of nickel in the artificial saliva of these groups was statistically significant (P = 0.001).

Conclusion Exposure to RF-EMFs emitted from mobile phones can lead to human exposure to higher levels of nickel in saliva in patients with orthodontic appliances. As nickel exposure can lead to allergic reaction in humans and considering this point that about 10–20% of the population can be hypersensitive to nickel, further studies are needed to evaluate the effects of radiofrequency electromagnetic fields (RF-EMFs) emitted from common devices such as mobile phones or Wi-Fi routers on the level of nickel release from orthodontic brackets.

https://www.sciencedirect.com/science/article/pii/S1761722718300962?via%3Dihub

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Mobile phone chips reduce increases in EEG brain activity induced by mobile phone EMF

Henz D, Schöllhorn WI, Poeggeler B. Mobile Phone Chips Reduce Increases in EEG Brain Activity Induced by Mobile Phone-Emitted Electromagnetic Fields. Front Neurosci. 2018 Apr 4;12:190. doi: 10.3389/fnins.2018.00190.

Abstract

Recent neurophysiological studies indicate that exposure to electromagnetic fields (EMFs) generated by mobile phone radiation can exert effects on brain activity. One technical solution to reduce effects of EMFs in mobile phone use is provided in mobile phone chips that are applied to mobile phones or attached to their surfaces. To date, there are no systematical studies on the effects of mobile phone chip application on brain activity and the underlying neural mechanisms. The present study investigated whether mobile phone chips that are applied to mobile phones reduce effects of EMFs emitted by mobile phone radiation on

electroencephalographic (EEG) brain activity in a laboratory study. Thirty participants volunteered in the present study. Experimental conditions (mobile phone chip, placebo chip, no chip) were set up in a randomized within-subjects design. Spontaneous EEG was recorded before and after mobile phone exposure for two 2-min sequences at resting conditions. During mobile phone exposure, spontaneous EEG was recorded for 30 min during resting conditions, and 5 min during performance of an attention test (d2-R). Results showed increased activity in the theta, alpha, beta and gamma bands during EMF exposure in the placebo and no chip conditions. Application of the mobile phone chip reduced effects of EMFs on EEG brain activity and attentional performance significantly. Attentional performance level was maintained regarding number of edited characters. Further, a dipole analysis revealed different underlying activation patterns in the chip condition compared to the placebo chip and no chip conditions. Finally, a correlational analysis for the EEG frequency bands and electromagnetic high-frequency (HF) emission showed significant correlations in the placebo chip and no chip condition for the theta, alpha, beta, and gamma bands. In the chip condition, a significant correlation of HF with the theta and alpha bands, but not with the beta and gamma bands was shown. We hypothesize that a reduction of EEG beta and gamma activation constitutes the key neural mechanism in mobile phone chip use that supports the brain to a degree in maintaining its natural activity and performance level during mobile phone use.

Conclusion

The findings of this study are mainly in line with previous studies to date in the field of neuroscience investigating the effects of EMF exposure from mobile phone use on brain activity. Increases in EEG activations were obtained by exposure to EMFs from mobile phone in all tested frequency bands. A reduction of these EMF induced activations is observed when a mobile phone chip is applied, particularly in the high-frequency ranges (beta and gamma bands). The observation is made both in resting as well as in working conditions. A deeper analysis of the EEG signals indicates that when applying the mobile phone chip less activation sources are found in the brain when exposed to mobile phone-emitted EMFs compared to the experimental conditions when a placebo chip is applied, or when no chip is applied. The findings of this study encourage further investigations on the long-term effects of mobile phone chip use in mobile phones in working settings as beneficial effects are shown for the short-term use of mobile phone chips on brain activity.

Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5893900/

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Extremely High Frequency EMF Facilitate Electrical Signal Propagation by Increasing Transmembrane Potassium Efflux in Artificial Axon Model

D'Agostino S, Della Monica C, Palizzi E, Di Pietrantonio F, Benetti M, Cannatà D, Cavagnaro M, Sardari D, Stano P, Ramundo-Orlando A. Extremely High Frequency Electromagnetic Fields Facilitate Electrical Signal Propagation by Increasing Transmembrane Potassium Efflux in an Artificial Axon Model. Sci Rep. 2018 Jun 18;8(1):9299. doi: 10.1038/s41598-018-27630-8.

Abstract

Among the many biological effects caused by low intensity extremely high frequency electromagnetic fields (EHF-EMF) reported in the literature, those on the nervous system are a promising area for further research. The mechanisms by which these fields alter neural activity are still unclear and thus far there appears to be no frequency dependence regarding neuronal responses. Therefore, proper in vitro models for preliminary screening studies of the interaction between neural cells with EMF are needed. We designed an artificial axon

model consisting of a series of parallel RC networks. Each RC network contained an aqueous solution of lipid vesicles with a gradient of potassium (K+) concentration as the functional element. We investigated the effects of EHF-EMF (53.37 GHz-39 mW) on the propagation of the electric impulse. We report that exposure to the EHF-EMF increases the amplitude of electrical signal by inducing a potassium efflux from lipid vesicles. Further, exposure to the EHF-EMF potentiates the action of valinomycin - a K+ carrier - increasing the extent of K+ transport across the lipid membrane. We conclude that exposure to the EHF-EMF facilitates the electrical signal propagation by increasing transmembrane potassium efflux, and that the model presented is promising for future screening studies of different EMF frequency spectrum bands.

Open access paper: https://www.nature.com/articles/s41598-018-27630-8

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

Masoumi A, Karbalaei N, Mortazavi SMJ, Shabani M. Radiofrequency radiation emitted from Wi-Fi (2.4 GHz) causes impaired insulin secretion and increased oxidative stress in rat pancreatic islets.Int J Radiat Biol. 2018 Jun 18:1-20. doi: 10.1080/09553002.2018.1490039.

Abstract

PURPOSE: There is a great concern regarding the possible adverse effects of electromagnetic radiation (EMR). This study investigated the effects of EMR induced by Wi-Fi (2.45GHz) on insulin secretion and antioxidant redox systems in the rat pancreas.

MATERIALS AND METHODS: Adult male Sprague-Dawley rats in the weight range of 230 to 260 g were divided into control, sham, Wi-Fi exposed groups. After long term exposure (4 h/day for 45 days) to Wi-Fi electromagnetic radiation, plasma levels of glucose and insulin during intraperitoneal glucose tolerance test were measured. Islet insulin secretion and content, lipid peroxidation and antioxidant status in pancreas of rats were determined.

RESULTS: Our data showed that the weight gain in the WI-FI exposed group was significantly lower than the control group ($p<0.05$). Wi-Fi (2.45 GHz) exposed group showed hyperglycemia. Plasma insulin level and glucose-stimulated insulin secretion from pancreatic islet were significantly reduced in the Wi-Fi exposed group. EMR emitted from Wi-Fi caused a significant increase in lipid peroxidation and a significant decrease in GSH level, SOD and GPx activities of the pancreas.

CONCLUSION: these data showed that EMR of Wi-Fi leads to hyperglycemia, increased oxidative stress and impaired insulin secretion in the rat pancreatic islets.

https://www.ncbi.nlm.nih.gov/pubmed/29913098

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2450 MHz exposure causes cognition deficit with mitochondrial dysfunction & activation of intrinsic pathway of apoptosis in rats

Gupta SK, Mesharam MK, Krishnamurthy S. Electromagnetic radiation 2450 MHz exposure causes cognition

deficit with mitochondrial dysfunction and activation of intrinsic pathway of apoptosis in rats. J Biosci. 2018 Jun;43(2):263-276.

Abstract

Electromagnetic radiation (EMR) can induce or modulate several neurobehavioral disorders. Duration and frequency of exposure of EMR is critical to develop cognitive disorders. Even though EMR-2450 is widely used, its effects on cognition in relation to mitochondrial function and apoptosis would provide better understanding of its pathophysiological effects. Therefore, a comparative study of different frequencies of EMR exposure would give valuable information on effects of discrete frequencies of EMR on cognition. Male rats were exposed to EMR (900, 1800 and 2450 MHz) every day for 1 h for 28 consecutive days. The cognitive behavior in terms of novel arm entries in Y-maze paradigm was evaluated every week after 1 h to last EMR exposure. Animals exposed to EMR-2450 MHz exhibited significant cognitive deficits. EMR- 2450 MHz caused loss of mitochondrial function and integrity, an increase in amyloid beta expression. There was release of cytochrome-c and activation of apoptotic factors such as caspase-9 and -3 in the hippocampus. Further, there was decrease in levels of acetylcholine, and increase in activity of acetyl cholinesterase, indicating impairment of cholinergic system. Therefore, exposure of EMR-2450 in rats caused cognitive deficit with related pathophysiological changes in mitochondrial and cholinergic function, and amyloidogenesis.

Excerpts

The animals after being exposed to 900, 1800 and 2450 MHz EMR, the average power density was found to be 0.1227 W/m2. While the overall value of whole body average SAR was found to be approximately, 0.0227, 0.030 and 0.0616 W/kg for 900, 1800 and 2450 MHz respectively.

Experimental rats (n=6) were subjected to continuous modulated electromagnetic radiation exposure of 900, 1800 and 2450 MHz (for modulation: modulating signal 217 Hz, modulation index 0.1%), for daily 1 h for each group for 28 days between 10.00 AM to 1.00 PM. Control group was placed in anechoic chamber without any exposure.

In summary, EMR at 2450 MHz induced cognitive behavioral deficit with concomitant loss in mitochondrial function. Alteration in the activity of mitochondrial complex enzyme systems caused oxidative stress and decrease in MMP, which ultimately lead to loss of mitochondrial integrity. Further, mitochondrial stress as observed from increasesin cytochrome-c activated the expression of caspase-9 and caspase-3, indicating mitochondrial-linked apoptosis. Furthermore, exposure with EMR-2450 increased expression of hippocampal Ab and decreased cholinergic neurotransmission in the hippocampus, which are considered to be important factors for development of cognitive dysfunction

Open access paper: https://www.ias.ac.in/article/fulltext/jbsc/043/02/0263-0276

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Aloe prevents EMF-induced oxidative stress and protects male reproductive system in vitro

Solek P, Majchrowicz L, Koziorowski M. Aloe arborescens juice prevents EMF-induced oxidative stress and thus protects from pathophysiology in the male reproductive system in vitro. Environ Res. 2018 Jun 7;166:141-149.

Abstract

More and more studies suggest that prolonged exposure to EMF may cause adverse biological effects and point directly to a significantly negative correlation between EMF and human health, especially men fertility. In our previous study, we reported that this could be related to the EMF-induced reactive oxygen species formation, followed by DNA damage, cell cycle arrest and apoptosis induction. In this study, we decided to expand our research by the search for substances which would prevent EMF-induced damage in spermatogenic cells. Such an agent seems to be Aloe arborescens Mill. juice, which was shown to possess a wide range of protective properties. The administration of aloe extract helps among others to prevent the formation of free radicals by various biochemical pathways. Therefore, the main aim of our study was to provide a significant knowledge concerning the mechanism involved in the multi-pathway cytoprotective response of aloe juice against EMF. The study was carried out in an in vitro mouse spermatogenesis pathway cell lines (GC-1 spg and GC-2 spd). Our results suggest that the aloe juice has many positive effects, especially for the cellular antioxidant systems by reducing the intracellular reactive oxygen species pool induced by EMF. In consequence, aloe juice prevents DNA damage, cell cycle arrest and therefore the viability and metabolic activity of both cell line tested are preserved. In conclusion, our study provides new insight into the underlying mechanisms through which aloe juice prevents spermatogenic cells from cytotoxic and genotoxic events.

https://www.ncbi.nlm.nih.gov/pubmed/29886390

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Understanding effects of EMF emissions from Marine Renewable Energy Devices on commercially important edible crab

Scott K, Harsanyi P, Lyndon AR. Understanding the effects of electromagnetic field emissions from Marine Renewable Energy Devices (MREDs) on the commercially important edible crab, Cancer pagurus (L.). Mar Pollut Bull. 2018 Jun;131(Pt A):580-588.

Abstract

The effects of simulated electromagnetic fields (EMF), emitted from sub-sea power cables, on the commercially important decapod, edible crab (Cancer pagurus), were assessed. Stress related parameters were measured (l-Lactate, d-Glucose, Haemocyanin and respiration rate) along with behavioural and response parameters (antennular flicking, activity level, attraction/avoidance, shelter preference and time spent resting/roaming) during 24-h periods. Exposure to EMF had no effect on Haemocyanin concentrations, respiration rate, activity level or antennular flicking rate. EMF exposure significantly disrupted haemolymph l-Lactate and d-Glucose natural circadian rhythms. Crabs showed a clear attraction to EMF exposed shelter (69%) compared to control shelter (9%) and significantly reduced their time spent roaming by 21%. Consequently, EMF emitted from Marine Renewable Energy Devices (MREDs) will likely affect edible crabs both behaviourally and physiologically, suggesting that the impact of EMF on crustaceans must be considered when planning MREDs.

https://www.ncbi.nlm.nih.gov/pubmed/29886985

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Duration-dependent effect of exposure to static electric field on learning and memory ability in mice

Xu Y, Gu X, Di G. Duration-dependent effect of exposure to static electric field on learning and memory ability in mice. Environ Sci Pollut Res Int. 2018 Jun 7.

Abstract

With the rapid development of ultra-high-voltage direct-current (UHVDC) transmission, the strength of environmental static electric field (SEF) around UHVDC transmission lines increased substantially, which has aroused widely public attention on the potential health effects of SEF. In this study, the effect of SEF exposure on learning and memory ability was investigated. Institute of Cancer Research mice were exposed to 56.3 kV/m SEF for a short term (7 days) or long term (49 days). Behaviors in the Morris water maze (MWM) test, hippocampal neurotransmitter contents, and oxidative stress indicators were examined. Results showed that short-term SEF exposure significantly prolonged escape latency and decreased the number of platform-site crossovers, as well as decreased the time spent in the target quadrant in the MWM test. Meanwhile, serotonin level and the ratio of glutamate level to γ-aminobutyric acid level changed significantly. Besides, malondialdehyde content and glutathione peroxidase activity increased significantly, while superoxide dismutase activity decreased significantly. After long-term SEF exposure, all indices above showed no significant differences between the SEF and sham exposure groups. These data indicated that short-term exposure to 56.3 kV/m SEF could cause abnormal neurotransmitter levels and oxidative stress in the hippocampus, which led to the decline in learning and memory ability. Under the condition of long-term exposure, the SEF-induced disturbances in neurotransmitter contents and redox balance were offset by the compensatory responses of mice, and thus, the learning and memory ability returned to normal level. The temporary and reversible decline in learning and memory ability was only a common biological effect of SEF rather than a health hazard.

https://www.ncbi.nlm.nih.gov/pubmed/29881961

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Gating currents

Bezanilla F. Gating currents. J Gen Physiol. 2018 Jun 25. pii: jgp.201812090. doi: 10.1085/jgp.201812090.

Abstract

Many membrane proteins sense the voltage across the membrane where they are inserted, and their function is affected by voltage changes. The voltage sensor consists of charges or dipoles that move in response to changes in the electric field, and their movement produces an electric current that has been called gating current. In the case of voltage-gated ion channels, the kinetic and steady-state properties of the gating charges provide information of conformational changes between closed states that are not visible when observing ionic currents only. In this *Journal of General Physiology* Milestone, the basic principles of voltage sensing and gating currents are presented, followed by a historical description of the recording of gating currents. The results of gating current recordings are then discussed in the context of structural changes in voltage-dependent membrane proteins and how these studies have provided new insights on gating mechanisms.

https://www.ncbi.nlm.nih.gov/pubmed/29941430

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Solutions for EM exposure assessment of 5G wireless devices

Douglas MG, Pfeifer S, Kuehn S, Neufeld E, Pokovic K, et al. Solutions for EM exposure assessment of 5G wireless devices. IEEE International Symposium on Electromagnetic Compatibility and 2018 IEEE Asia-Pacific Symposium on Electromagnetic Compatibility (EMC/APEMC), 2018. IEEE, 2018, ISBN 9781509039555: 92-94. doi:10.1109/ISEMC.2018.8394066

Abstract

A novel measurement system and a 3D field reconstruction method are described for determining the power density in the close near field of wireless devices transmitting at frequencies from 6–110 GHz. Measurements are compared against simulated results. The accuracy is better than 0.5 dB for distances greater than λ/5 from the radiating source.

https://ieeexplore.ieee.org/document/8394066/

Excerpts

Fifth generation wireless communication systems enable mobile devices to transmit at millimeter wave frequencies. For electromagnetic (EM) exposure assessment, this poses a challenge for wireless device manufacturers and regulatory agencies. At frequencies above 10 GHz, ICNIRP [1] defines limits on power density, which is measured in air at the location of the body. Power density is not correlated with the induced fields in the body. Moreover, it is poorly defined at very close distances of the source to the body because the electric and magnetic fields are not orthogonal and because the body interacts with the reactive near field. In the far field, power density is only a surrogate for induced exposure. On the other hand, power density is easier to measure than induced field, which is concentrated at the skin surface [2]. Therefore, reliable equipment is needed to measure the power density of millimeter wave devices. Another problem is that the prescribed averaging area can be too large compared to the exposed area and is inconsistent between different standards [3].

A novel measurement system and field reconstruction algorithm are presented that enable power density to be measured with an accuracy better than 0.5 dB for distances greater than lambda/5 from the radiating source.

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Database of bio-effects from non-ionizing radiation

Leach V, Weller S, Redmayne M. A novel database of bio-effects from non-ionizing radiation. Rev Environ Health. 2018 Jun 6. pii: /j/reveh.ahead-of-print/reveh-2018-0017/reveh-2018-0017.xml.

Abstract

A significant amount of electromagnetic field/electromagnetic radiation (EMF/EMR) research is available that examines biological and disease associated endpoints. The quantity, variety and changing parameters in the available research can be challenging when undertaking a literature review, meta-analysis, preparing a study design, building reference lists or comparing findings between relevant scientific papers. The Oceania Radiofrequency Scientific Advisory Association (ORSAA) has created a comprehensive, non-biased, multi-categorized, searchable database of papers on non-ionizing EMF/EMR to help address these challenges. It is regularly added to, freely accessible online and designed to allow data to be easily retrieved, sorted and analyzed. This paper demonstrates the content and search flexibility of the ORSAA database. Demonstration searches are presented by Effect/No Effect; frequency-band/s; in vitro; in vivo; biological effects; study type;

and funding source.

As of September 15, 2017, the clear majority of 2653 papers captured in the database examine outcomes in the 300 MHz-3 GHz range. There are 3 times more biological "Effect" than "No Effect" papers; nearly a third of papers provide no funding statement; industry-funded studies more often than not find "No Effect", while institutional funding commonly reveal "Effects". Country of origin where the study is conducted/funded also appears to have a dramatic influence on the likely result outcome.

> The Oceania Radiofrequency Science Advisory Association
>
> The Oceania Radiofrequency Science Advisory Association (ORSAA) Database is a searchable database on peer-reviewed scientific studies and articles on bioeffect research of electromagnetic fields. The database is designed to enable detailed independent searches invaluable to researchers and scientists. It requires some training on how to use it most effectively.
> http://www.orsaa.org/orsaa-database.html

Discussion and Conclusions

ORSAA's new database provides a highly flexible way of searching a wide, and increasing, range of the EMF literature. It can be used to search for papers according to frequency range, power, SAR, tested endpoints, reported outcomes and study type, amongst others. Furthermore, the data can be exported to create graphs to identify trends in research as well as biological effect outcomes based on frequency and/or exposure duration.

Our method of selecting papers for inclusion is intended to minimize bias and we anticipate that the resulting library is representative of the spread of peer-reviewed papers being published.

Nearly a third of the studies do not declare research funding in the papers so they are marked as funding source unknown in the ORSAA database. Maisch discusses this problem [5]. It may be that these are generally funded by the institution or department where the work was performed, but without a declaration the reader cannot know. Although we have not included NESS studies in the funding chart (Figure 2), it should be borne in mind that the choice of papers selected for reviews and meta-analyses may be related to the funding source and may ultimately affect the paper conclusions. ORSAA considers funding declarations are of critical importance to ensure transparency and to help identify potential biases. ORSAA also encourages all journals to insist on providing this, even when there is no specific funder to declare. Requiring full disclosure of income affiliations is vital, especially in the latter circumstance.

Although animal studies cannot provide direct evidence of human biological effects, animal models can provide a strong indication of likely risks to humans. The ORSAA database can be used to enumerate and compare the many instances where both animal and human studies have found the same biological effect outcomes.

Our demonstration tables also indicate that although there are studies that report no effect on the tested parameters, there are in many cases significantly more that do find an effect. Closer examination suggests that this inconsistency can be explained in large part by the lack of replication between studies.

The evolving database cannot be used as a sole source of reference for a systematic review on any particular end-point, and can only reflect the status quo with reference to the included papers. However, it provides many benefits to the general public and researchers alike.

https://www.ncbi.nlm.nih.gov/pubmed/29874195

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Genomic effects of cell phone exposure on the reproductive system

Yahyazadeh A, Deniz OG, Kaplan AA, Altun G, Yurt KK, Davis D. The genomic effects of cell phone exposure on the reproductive system. Environmental Research. Available online 5 June 2018.

Abstract

Humans are exposed to increasing levels of electromagnetic fields (EMF) at various frequencies as technology advances. In this context, improving understanding of the biological effects of EMF remains an important, high priority issue. Although a number of studies in this issue and elsewhere have focused on the mechanisms of the oxidative stress caused by EMF, the precise understanding of the processes involved remains to be elucidated. Due to unclear results among the studies, the issue of EMF exposure in the literature should be evaluated at the genomic level on the reproductive system. Based on this requirement, a detail review of recently published studies is necessary. The main objectives of this study are to show differences between negative and positive effect of EMF on the reproductive system of animal and human. Extensive review of literature has been made based on well known data bases like Web of Science, PubMed, MEDLINE, Google Scholar, Science Direct, Scopus. This paper reviews the current literature and is intended to contribute to a better understanding of the genotoxic effects of EMF emitted from mobile phones and wireless systems on the human reproductive system, especially on fertility. The current literature reveals that mobile phones can affect cellular functions via non-thermal effects. Although the cellular targets of global system for mobile communications (GSM)-modulated EMF are associated with the cell membrane, the subject is still controversial. Studies regarding the genotoxic effects of EMF have generally focused on DNA damage. Possible mechanisms are related to ROS formation due to oxidative stress. EMF increases ROS production by enhancing the activity of nicotinamide adenine dinucleotide (NADH) oxidase in the cell membrane. Further detailed studies are needed to elucidate DNA damage mechanisms and apoptotic pathways during oogenesis and spermatogenesis in germ cells exposed to EMF.

Conclusion

This paper reviews the current literature and is intended to contribute to a better understanding of the genotoxic effects of EMF emitted from mobile phones and wireless systems on the human reproductive system, especially on fertility. The current literature reveals that mobile phones can affect cellular functions via non-thermal effects (Diem et al., 2005; Hanci et al., 2013 ; Odaci et al., 2016a). Although the cellular targets of GSM-modulated EMF are associated with the cell membrane, the subject is still controversial (Eberhardt et al., 2008). Studies regarding the genotoxic effects of EMF have generally focused on DNA damage (Mortelmans and Rupa, 2004; Young, 2002; Zeiger, 2004; Panagopoulos, 2012 ; Turedi et al., 2016). Possible mechanisms are related to ROS formation due to oxidative stress (Moustafa et al., 2004; Hanukoglu et al., 2006). EMF increases ROS production by enhancing the activity of NADH oxidase in the cell membrane (Friedman et al., 2007b). In this context, EMF affected spermatozoa may have a high degree rate of infertilization. It seems that previous genomic studies do not show definitive evidence regarding EMF affected cells in the fertilization. Although we evaluated broadly the genomic effects of cell phone exposure on the reproductive system using both animal and human studies, one of the weaknesses of this work is insufficient review of human studies. This may come from limited number of EMF based human studies in the literature. Further detailed studies are needed to elucidate DNA damage mechanisms and apoptotic pathways during oogenesis and spermatogenesis in germ cells that are exposed to EMF.

https://www.sciencedirect.com/science/article/pii/S0013935118302639

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Effects of mobile phone exposure on metabolomics in the male and female reproductive systems

Altun G, Deniz OG, Yurt KK, Davis D, Kaplan S. Effects of mobile phone exposure on metabolomics in the male and female reproductive systems. Environmental Research. Available online 5 June 2018.

Highlights

• Long-term exposure to EMF decreases sperm motility and fertilization.
• Effects of EMF emitted from mobile phones are related to protein synthesis.
• Oxidative stress based EMF exposure modulates nitric oxide level in the germ cells.
• Oxidative stress based EMF exposure inhibits antioxidant mechanisms in the germ cells.

Abstract

With current advances in technology, a number of epidemiological and experimental studies have reported a broad range of adverse effects of electromagnetic fields (EMF) on human health. Multiple cellular mechanisms have been proposed as direct causes or contributors to these biological effects. EMF-induced alterations in cellular levels can activate voltage-gated calcium channels and lead to the formation of free radicals, protein misfolding and DNA damage. Because rapidly dividing germ cells go through meiosis and mitosis, they are more sensitive to EMF in contrast to other slower-growing cell types. In this review, possible mechanistic pathways of the effects of EMF exposure on fertilization, oogenesis and spermatogenesis are discussed. In addition, the present review also evaluates metabolomic effects of GSM-modulated EMFs on the male and female reproductive systems in recent human and animal studies. In this context, experimental and epidemiological studies which examine the impact of mobile phone radiation on the processes of oogenesis and spermatogenesis are examined in line with current approaches.

Conclusion

EMF emitted by mobile phones has a number of well-documented adverse metabolomic effects on the male and female reproductive systems and can lead to infertility by increasing ROS production and reducing GSH and other antioxidants. The primary target of the EMF emitted by mobile phones may be the cell membrane (Pall in press, this volume). This then results in accelerated activity of membrane NADH oxidase and, consequently, greater rates of ROS formation that cannot be easily conjugated or detoxified. Although many studies have reported morphological and functional deteriorations in testis and ovary following EMF exposures, as well both structural and functional deficits in reproductive health, the underlying mechanisms have not been fully elucidated. To assist in further clarification of these processes and mechanisms, Table 1 summarizes key studies on the metabolomic effects of EMF on reproductive systems. Future studies will benefit greatly from standardized exposure protocols and evaluations of key metabolomic indicators.

https://www.sciencedirect.com/science/article/pii/S0013935118300999

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Effect of cell-phone RF on angiogenesis and cell invasion in human head and neck cancer cells

Alahmad YM, Aljaber M, Saleh AI, Yalcin HC, Aboulkassim T, Yasmeen A, Batist G, Moustafa AA**.** Effect of cell-phone radiofrequency on angiogenesis and cell invasion in human head and neck cancer cells. Head Neck. 2018 May 13. doi: 10.1002/hed.25210.

Abstract

BACKGROUND: Today, the cell phone is the most widespread technology globally. However, the outcome of cell-phone radiofrequency on head and neck cancer progression has not yet been explored.

METHODS: The chorioallantoic membrane (CAM) and human head and neck cancer cell lines, FaDu and SCC25, were used to explore the outcome of cell-phone radiofrequency on angiogenesis, cell invasion, and colony formation of head and neck cancer cells, respectively. Western blot analysis was used to investigate the impact of the cell phone on the regulation of E-cadherin and Erk1/Erk2 genes.

RESULTS: Our data revealed that cell-phone radiofrequency promotes angiogenesis of the CAM. In addition, the cell phone enhances cell invasion and colony formation of human head and neck cancer cells; this is accompanied by a downregulation of E-cadherin expression. More significantly, we found that the cell phone can activate Erk1/Erk2 in our experimental models.

CONCLUSION: Our investigation reveals that cell-phone radiofrequency could enhance head and neck cancer by stimulating angiogenesis and cell invasion via Erk1/Erk2 activation.

https://www.ncbi.nlm.nih.gov/pubmed/29756334

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Cancers of the brain and CNS: Global patterns and trends in incidence

Mortazavi SMJ, Mortazavi SAR,, Paknahad M. Cancers of the brain and CNS: Global patterns and trends in incidence. J Biomed Phys Eng. 2018 Mar 1;8(1):151-152.

Abstract

Miranda-Filho et al. in their recently published paper entitled "Cancers of the brain and CNS: global patterns and trends in incidence" provided a global status report of the geographic and temporal variations in the incidence of brain and CNS cancers in different countries across continents worldwide. While the authors confirm the role of genetic risk factors and ionizing radiation exposures, they claimed that no firm conclusion could be drawn about the role of exposure to non-ionizing radiation. The paper authored by Miranda-Filho et al. not only addresses a challenging issue, it can be considered as a good contribution in the field of brain and CNS cancers. However, our correspondence addresses a basic shortcoming of this paper about the role of electromagnetic fields and cancers and provides evidence showing that exposure to radiofrequency electromagnetic fields (RF-EMFs), at least at high levels and long durations, can increases the risk of cancer.

Open access letter: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5928307/

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Wireless radiation absorption in child vs adult brain & eye from cell phone conversation or virtual reality

Fernandez C, de Salles AA, Sears ME, Morris RD, Davis DL. Absorption of wireless radiation in the child versus adult brain and eye from cell phone conversation or virtual reality. Environmental Research. Jun 5, 2018. https://doi.org/10.1016/j.envres.2018.05.013

Highlights

• More cell phone radiation is absorbed by children's inner brain tissues than adults'.
• Children's radiofrequency radiation exposure should be reduced.
• Further research to evaluate the risks to the eye from use of VR is urgently needed.
• It is biologically relevant and feasible to reduce the standards' averaging volume.
• Current methods to determine wireless device compliance should be revised.

Abstract

Children's brains are more susceptible to hazardous exposures, and are thought to absorb higher doses of radiation from cell phones in some regions of the brain. Globally the numbers and applications of wireless devices are increasing rapidly, but since 1997 safety testing has relied on a large, homogenous, adult male head phantom to simulate exposures; the "Standard Anthropomorphic Mannequin" (SAM) is used to estimate only whether tissue temperature will be increased by more than 1 Celsius degree in the periphery. The present work employs anatomically based modeling currently used to set standards for surgical and medical devices, that incorporates heterogeneous characteristics of age and anatomy. Modeling of a cell phone held to the ear, or of virtual reality devices in front of the eyes, reveals that young eyes and brains absorb substantially higher local radiation doses than adults'. Age-specific simulations indicate the need to apply refined methods for regulatory compliance testing; and for public education regarding manufacturers' advice to keep phones off the body, and prudent use to limit exposures, particularly to protect the young.

Excerpts

In summary, compared with adult models, children experience two- to three-fold higher RF doses to: 1) localized areas of the brain when a cell phone is positioned next to the ear; and 2) the eyes and frontal lobe when a cell phone is used to view virtual reality. These findings raise serious questions about the current approach to certify cell phones; particularly the use of the SAM.

Our modeling demonstrates clearly that localized psSAR varies significantly for critical components of the brain. Younger models absorb proportionally more radiation in the eyes and brain – grey matter, cerebellum and hippocampus—and the local dose rate varies inversely with age. This reflects the fact that the head is not homogeneous. Indeed, localized heating up to 5 Centigrade degrees has been detected as a result of mobile phone radiation studied *ex vivo* in cow brain using Nuclear Magnetic Resonance thermometry (Gultekin and Moeller, 2013).

Our findings support reexamination of methods to determine regulatory compliance for wireless devices, and highlight the importance of precautionary advice such as that of American Academy of Pediatrics (2016). The Academy recommends that younger children should not use cell phones, and that prudent measures should be taken to eliminate exposure (e.g. using devices for amusement or education only when all wireless features are turned off – in "airplane mode") or to minimize exposure (e.g. texting or using speakerphone), and that cell phones should not be kept next to the body. Use of wires/cables in schools and homes circumvents needless exposures of children to radiation from both devices and Wi-Fi routers. There is also an urgent need for research to evaluate the risks to the eye from use of cell phones in virtual reality applications.

https://www.sciencedirect.com/science/article/pii/S0013935118302561

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Children's exposure assessment of radiofrequency fields: Comparison between spot and personal measurements

Gallastegi M, Huss A, Santa-Marina L, Aurrekoetxea JJ, Guxens M, Birks LE, Ibarluzea J, Guerra D, Röösli M. Children's exposure assessment of radiofrequency fields: Comparison between spot and personal measurements. Environment International. 118:60-69. Sep 2018.

Highlights

• Children's radiofrequency field levels and contribution of sources were assessed.
• We contrasted exposure assessment based on spot and personal measurements.
• Median exposures range: 29.73–236.31 μW/m2; broadcast and downlink contributed most.
• Proportional bias between assessment based on spot and personal measurements.
• No systematic differences when classifying subjects in exposure-dependent groups.

Abstract

Introduction Radiofrequency (RF) fields are widely used and, while it is still unknown whether children are more vulnerable to this type of exposure, it is essential to explore their level of exposure in order to conduct adequate epidemiological studies. Personal measurements provide individualized information, but they are costly in terms of time and resources, especially in large epidemiological studies. Other approaches, such as estimation of time-weighted averages (TWAs) based on spot measurements could simplify the work.

Objectives The aims of this study were to assess RF exposure in the Spanish INMA birth cohort by spot measurements and by personal measurements in the settings where children tend to spend most of their time, i.e., homes, schools and parks; to identify the settings and sources that contribute most to that exposure; and to explore if exposure assessment based on spot measurements is a valid proxy for personal exposure.

Methods When children were 8 years old, spot measurements were conducted in the principal settings of 104 participants: homes (104), schools and their playgrounds (26) and parks (79). At the same time, personal measurements were taken for a subsample of 50 children during 3 days. Exposure assessment based on personal and on spot measurements were compared both in terms of mean exposures and in exposure-dependent categories by means of Bland-Altman plots, Cohen's kappa and McNemar test.

Results Median exposure levels ranged from 29.73 (in children's bedrooms) to 200.10 μW/m2 (in school playgrounds) for spot measurements and were higher outdoors than indoors. Median personal exposure was 52.13 μW/m2 and median levels of assessments based on spot measurements ranged from 25.46 to 123.21 μW/m2. Based on spot measurements, the sources that contributed most to the exposure were FM radio, mobile phone downlink and Digital Video Broadcasting-Terrestrial, while indoor and personal sources contributed very little (altogether <20%). Similar distribution was observed with personal measurements.

There was a bias proportional to power density between personal measurements and estimates based on spot measurements, with the latter providing higher exposure estimates. Nevertheless, there were no systematic differences between those methodologies when classifying subjects into exposure categories. Personal measurements of total RF exposure showed low to moderate agreement with home and bedroom spot

measurements and agreed better, though moderately, with TWA based on spot measurements in the main settings where children spend time (homes, schools and parks; Kappa = 0.46).

Conclusions Exposure assessment based on spot measurements could be a feasible proxy to rank personal RF exposure in children population, providing that all relevant locations are being measured.

https://www.sciencedirect.com/science/article/pii/S0160412017319724

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Exposure to radiation from single or combined radio frequencies provokes macrophage dysfunction in the RAW 264.7 cell line

López-Furelos A, Salas-Sánchez AA, Ares-Pena FJ, Leiro-Vidal JM, López-Martín E. Exposure to radiation from single or combined radio frequencies provokes macrophage dysfunction in the RAW 264.7 cell line. Int J Radiat Biol. 2018 Apr 30:1-12. doi: 10.1080/09553002.2018.1465610.

Abstract

PURPOSE: The aim of this study was to determine whether exposure to radiation from single or multiple radio-frequency (RF) signals at 900 and 2450 MHz would induce effects in the RAW 264.7 cell line.

MATERIALS AND METHODS: Cell cultures were exposed to single or combined RF for 4, 24, 48, or 72 h in a GTEM electromagnetic test chamber. At the end of the radiation exposure time, viability and cell growth were analyzed by flow cytometry, nitric oxide (NO) production was measured by colorimetry, the expression of HSP70 and TNF-α was ascertained by qPCR, and the phagocytic activity was observed by microscopy.

RESULTS: NO production increased after 48 h exposure at 2450 MHz, compared with controls. The group subjected to the combined interaction of two RFs showed an increase of HSP70 after 48 h exposure and a significant increase of NO and TNF-α after 72 h. The phagocytic activity of macrophages decreased in all groups as exposure time increased.

CONCLUSIONS: Our results indicated a decrease in phagocytic activity and an increase in inflammatory, cytoprotective, and cytotoxic responses in macrophages after continuous and combined exposure of multiple RF signals. Multiple RF interact in everyday life, the immune response in humans is unknown.

https://www.ncbi.nlm.nih.gov/pubmed/29659305

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Cellular stress & caspase-3 resulting from combined two-frequency signal in brains of Sprague-Dawley rats

López-Furelos A, Leiro-Vidal JM, Salas-Sánchez AÁ, Ares-Pena FJ, López-Martín ME. Evidence of cellular stress and caspase-3 resulting from a combined two-frequency signal in the cerebrum and cerebellum of sprague-dawley rats. Oncotarget. 2016 Oct 4;7(40):64674-64689. doi: 10.18632/oncotarget.11753.

Abstract

Multiple simultaneous exposures to electromagnetic signals induced adjustments in mammal nervous systems. In this study, we investigated the non-thermal SAR (Specific Absorption Rate) in the cerebral or cerebellar hemispheres of rats exposed in vivo to combined electromagnetic field (EMF) signals at 900 and 2450 MHz.Forty rats divided into four groups of 10 were individually exposed or not exposed to radiation in a GTEM chamber for one or two hours. After radiation, we used the Chemiluminescent Enzyme-Linked Immunosorbent Assay (ChELISA) technique to measure cellular stress levels, indicated by the presence of heat shock proteins (HSP) 90 and 70, as well as caspase-3-dependent pre-apoptotic activity in left and right cerebral and cerebellar hemispheres of Sprague Dawley rats.Twenty-four hours after exposure to combined or single radiation, significant differences were evident in HSP 90 and 70 but not in caspase 3 levels between the hemispheres of the cerebral cortex at high SAR levels. In the cerebellar hemispheres, groups exposed to a single radiofrequency (RF) and high SAR showed significant differences in HSP 90, 70 and caspase-3 levels compared to control animals. The absorbed energy and/or biological effects of combined signals were not additive, suggesting that multiple signals act on nervous tissue by a different mechanism.

Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5323107/

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Biological effects of cell-phone radiofrequency waves exposure on fertilization in mice; an in vivo and in vitro study

Fatehi D, Anjomshoa M, Mohammadi M, Seify M, Rostamzadeh A. Biological effects of cell-phone radiofrequency waves exposure on fertilization in mice; an in vivo and in vitro study. Middle East Fertility Society Journal, 23(2):148-153. June 2018.

Abstract

Increasing use of cell-phone is one of the most important risk factors for population health. We designed an experimental study aimed at evaluating the effects of cell-phone radiofrequency (RF) waves exposure on fertilization in mice. Two hundred male and female NMRI-mice were used. One hundred males divided in five groups (n = 20) as control and exposed groups. Those irradiated with cell-phone RF in “Standby-mode” 1, 5 and 10 h daily named groups II, III and IV; respectively. Group V irradiated with cell-phone on “Active-mode” one hour daily. After 30 days irradiation, 50 males and 50 females were kept 24 h to assess their embryos. Fifty males were scarified to evaluate both in vitro and in vivo parameters, and 50 females received PMSG & HCG for both quantitative and qualitative evaluation. Comparing groups III, IV and V with control-group showed significantly decreased in the number of two-cell embryos (p = .000); however, a significant increase was found in the number of dead embryos (p = .000). Furthermore, 5 h daily irradiation significantly decreased grade-A embryos (p = .015); while, it significantly increased grade-B, C and D embryos (p-values = 0.026, 0.007, 0.006; respectively). Moreover, comparing groups IV and V to control-group, significant increase was found in pregnancy duration (p = .005, p = .009; respectively). However, in the mentioned groups a significant decrease was seen in number of newborn mice (p = .001, p = .004; respectively). In conclusion our findings showed that the cell-phone radiation can affect development of embryos as well as the number of newborn and pregnancy duration in NMRI-mouse, which might be a significant cause of reproductive failure.

Open access paper: https://www.sciencedirect.com/science/article/pii/S1110569017301875

The applied frequency of the waves was 900 MHz irradiated from a Nokia cell-phone (Nokia 1100, Finland). In case of irradiation, the distance between cell-phone and mouse was 10 cm.

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Proximity to overhead power lines and childhood leukaemia: an international pooled analysis

Amoon AT, Crespi CM, Ahlbom A, Bhatnagar M, Bray I, Bunch KJ, Clavel J, Feychting M, Hémon D, Johansen C, Kreis C, Malagoli C, Marquant F, Pedersen C, Raaschou-Nielsen O, Röösli M, Spycher BD, Sudan M, Swanson J, Tittarelli A, Tuck DM, Tynes T, Vergara X, Vinceti M, Wünsch-Filho V, Kheifets L. Proximity to overhead power lines and childhood leukaemia: an international pooled analysis. Br J Cancer. 2018 May 29. doi: 10.1038/s41416-018-0097-7.

Abstract

BACKGROUND: Although studies have consistently found an association between childhood leukaemia risk and magnetic fields, the associations between childhood leukaemia and distance to overhead power lines have been inconsistent. We pooled data from multiple studies to assess the association with distance and evaluate whether it is due to magnetic fields or other factors associated with distance from lines.

METHODS: We present a pooled analysis combining individual-level data (29,049 cases and 68,231 controls) from 11 record-based studies.

RESULTS: There was no material association between childhood leukaemia and distance to nearest overhead power line of any voltage. Among children living < 50 m from 200 + kV power lines, the adjusted odds ratio for childhood leukaemia was 1.33 (95% CI: 0.92-1.93). The odds ratio was higher among children diagnosed before age 5 years. There was no association with calculated magnetic fields. Odds ratios remained unchanged with adjustment for potential confounders.

CONCLUSIONS: In this first comprehensive pooled analysis of childhood leukaemia and distance to power lines, we found a small and imprecise risk for residences < 50 m of 200 + kV lines that was not explained by high magnetic fields. Reasons for the increased risk, found in this and many other studies, remains to be elucidated.

https://www.ncbi.nlm.nih.gov/pubmed/29808013

In conclusion, we found a small, imprecise association between childhood leukaemia and residence located within 50 m of 200 + kV lines, which was stronger for younger children, in our individual-data pooled analysis of 11 studies. This association was not explained by exposure to high MF levels or by other measured confounders. We found no evidence for bias as a potential explanation and in particular, we only included record-based studies, making selection bias unlikely. Although exposure misclassification is likely to be present, the risk of bias due to distance misclassification is quite small. The previous UK findings of risk estimates for distances beyond 200 m are not supported by the pooled data from other countries. The decrease in effect over time are not clearly supported by the pooled data from other countries, although numbers of exposed cases and controls for the earlier time period are small for both the United Kingdom and for other countries combined. Although pooled analysis is a powerful approach to integrating data, it is only as good as the underlying data. Reasons for the small yet fairly consistent increase in the risk of childhood leukaemia in relation to proximity to power lines found in many studies remain to be elucidated.

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Measurement and analysis of power-frequency magnetic fields in residences: Results from a pilot study

Halgamuge MN, McLean L.Measurement and analysis of power-frequency magnetic fields in residences: Results from a pilot study. Measurement. 125:415-424. Sep 2018.
https://doi.org/10.1016/j.measurement.2018.05.007

Highlights

• Exposure to high magnetic fields in residential situations occurs in proximity to appliances.
• Emissions from some appliances exceeded the general public exposure levels of the ICNIRP limits.
• Taking precautions, such as reducing distance from sources can significantly reduce exposures.
• Collected data can be useful as an additional data base for future epidemiological studies.

Abstract

Aim Extremely low-frequency magnetic fields (ELF-MFs) are emitted by electrical household appliances, wiring, meter boxes, conductive plumbing, power lines and transformers. Some of the studies investigating the link between ELF-MFs and health problems have not adequately characterized the magnetic field exposure of subjects, as they did not always measure residential magnetic fields or measure in locations where residents are most exposed. Considering this, there is a need for good quality assessments of residential ELF-MFs in different geographical regions to collect general public exposure data and to identify high sources of magnetic fields. Such studies have the potential to add significant scientific knowledge about residential exposure and appropriate precautions to reduce exposure, improve the quality of life and substantially reduce health care costs.

Subject and methods In this work, we analyzed the ELF-MFs from 3163 datasets collected from 100 houses in Australia. Measurements were carried out in different geographical locations and were assessed for compliance with the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines. Then we compared our measurements with another twenty-three peer-reviewed studies, published 1987–2015, reporting magnetic field measurements in residences.

Results The observed average (geometric mean) magnetic field values were; bed 0.85, bedroom 1.39 mG, baby cot 0.39 mG, children's play area 0.47 mG, and family room 0.30 mG. Our results show considerable variation in the fields to which residents are typically exposed, particularly in beds (21.83%) and bedrooms (33.33%) where the percentage of measurements greater than 4 mG was considerable. Some emissions exceeded the general public exposure levels of the ICNIRP Guidelines, with the potential for residents to be exposed above these levels. However, away from electrical appliances, the average field in all rooms was 0.30–1.39 mG. We show that simple precautions can be applied to reduce exposure to ELF-MFs in residences and thereby minimize potential risks to health and wellbeing.

Conclusion Our investigation provides a new data collection model for future surveys, which could be conducted with larger samples to verify our observations. Additionally, this data could be useful as a reference for researchers and those members of the general public who do not have access to the necessary measuring equipment.

Excerpts

The fields most likely to impact residents are those near beds, where people spend long periods of time daily. In our study, these included fields from clock radios, meter boxes, wiring and conductive plumbing.

In most cases, the kitchen appliance with the highest magnetic field was the microwave oven, whether or not it was operating, indicating that especial care needs to be taken when positioning it. Our study considered only the magnetic fields from the microwave oven and not the microwave radiation that it also emits. Many other kitchen appliances also had high magnetic fields – including ovens, cook tops, range hoods, kettles, dishwashers and toasters.

Magnetic fields varied from 2.9 to 167 mG for washing machines and 0.3 to 373 mG for clothes dryers, however, residents do not usually spend long periods of time close to these machines while they are operating. We measured highest magnetic fields from irons during the period when they were heating up to the desired setting and observed that, once they had done so, magnetic fields at the handle were generally less than 0.01 mG. A surprise finding was the very high magnetic fields from hairdryers, which are used in close proximity to the body.

https://www.sciencedirect.com/science/article/pii/S0263224118303920

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Magnetocarcinogenesis: is there a mechanism for carcinogenic effects of weak magnetic fields?

Juutilainen J, Herrala M, Luukkonen J, Naarala J, Hore PJ. Magnetocarcinogenesis: is there a mechanism for carcinogenic effects of weak magnetic fields? Proceedings of the Royal Society B: Biological Sciences. May 23, 2018.

Abstract

Extremely low-frequency (ELF) magnetic fields have been classified as possibly carcinogenic, mainly based on rather consistent epidemiological findings suggesting a link between childhood leukaemia and 50–60 Hz magnetic fields from power lines. However, causality is not the only possible explanation for the epidemiological associations, as animal and in vitro experiments have provided only limited support for carcinogenic effects of ELF magnetic fields. Importantly, there is no generally accepted biophysical mechanism that could explain such effects. In this review, we discuss the possibility that carcinogenic effects are based on the radical pair mechanism (RPM), which seems to be involved in magnetoreception in birds and certain other animals, allowing navigation in the geomagnetic field. We review the current understanding of the RPM in magnetoreception, and discuss cryptochromes as the putative magnetosensitive molecules and their possible links to cancer-relevant biological processes. We then propose a hypothesis for explaining the link between ELF fields and childhood leukaemia, discuss the strengths and weaknesses of the current evidence, and make proposals for further research.

http://rspb.royalsocietypublishing.org/content/285/1879/20180590

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Cytotoxicity of carboplatin on human glioblastoma cells is reduced by exposure to ELF EMF (50 Hz, 70 G)

Amiri M, Basiri M, Eskandary H, Akbarnejad Z, Esmaeeli M, Masoumi-Ardakani Y, Ahmadi-Zeidabadi M. Cytotoxicity of carboplatin on human glioblastoma cells is reduced by the concomitant exposure to an extremely low-frequency electromagnetic field (50 Hz, 70 G). Electromagn Biol Med. 2018 May 30:1-8. doi: 10.1080/15368378.2018.1477052.

Abstract

Glioblastoma multiforme (GBM) is a malignant brain cancer that causes high mortality in patients. GBM responds weakly to the common cancer treatments such as chemotherapy and radiotherapy and even surgery. Carboplatin is an alkylating agent widely used to treat cancer. However, resistance to this drug is a common problem in its use in cancer treatment. Concomitant exposure to extremely low-frequency electromagnetic fields (ELF-EMFs) and carboplatin is one unexplored possibility for overcoming this resistance. Indeed, many lines of evidence show that EMF affects cancer cells and drug action. In this study, we evaluated the effect of concomitant administration of carboplatin and EMF (50 Hz, 70 G) and also concomitant administration of carboplatin and static magnetic field (SMF) (70 G) on human glioma cell line (U-87). The results showed that cotreatment reduced the efficiency of carboplatin in U-87 cells, by decreasing caspase-3 in comparison to drug groups. Overall, EMF reduced the apoptotic effect of carboplatin, possibly through a redox regulation mechanism. Therefore, we have to avoid coadministration of magnetic field (MF) and carboplatin in tumor area, because the MF decreased the toxicity of the drug. However, further studies are needed to reveal the action mechanism of this combination therapeutic method.

https://www.ncbi.nlm.nih.gov/pubmed/29846098

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Reanalysis of risks of childhood leukemia with distance from overhead power lines in the UK

Swanson J, Bunch K. Reanalysis of risks of childhood leukaemia with distance from overhead power lines in the UK. J Radiol Prot. 2018 May 30. doi: 10.1088/1361-6498/aac89a.

Abstract

Our previous study of childhood leukaemia and distance to high-voltage overhead power lines in the UK has been included in an international pooled analysis. That pooled analysis used different distance categories to us, which has focussed attention on the effect of that choice. We re-analyse our previous subjects, using finer distance categories. In the 1960s and 1970s, when we principally found an elevated risk, the risk did not fall monotonically with distance from the power line but had a maximum at 100-200 m. This weakens the evidence that any elevated risks are related to magnetic fields, and slightly strengthens the evidence for a possible effect involving residential mobility or other socioeconomic factors.

https://www.ncbi.nlm.nih.gov/pubmed/29844249

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<u>Radiofrequency Radiation</u>

Spatial and temporal variability of personal environmental exposure to RF EMF in children in Europe

Birks LE, Struchen B, Eeftens M, van Wel L, Huss A, Gajšek P, Kheifets L, Gallastegi M, Dalmau-Bueno A, Estarlich M, Fernandez MF, Meder IK, Ferrero A, Jiménez-Zabala A, Torrent M, Vrijkotte TGM, Cardis E, Olsen J, Valič B, Vermeulen R, Vrijheid M, Röösli M, Guxens M. Spatial and temporal variability of personal environmental exposure to radio frequency electromagnetic fields in children in Europe. Environ Int. 117:204-214. 2018 May 10.

Highlights

• We describe personal environmental RF-EMF exposure from mobile communication in European children.
• 529 children carried personal exposure meters for up to 3 days during 2014–2016.
• Median personal environmental RF-EMF exposure was 75.5 μW/m2.
• Downlink was largest contributor to total environmental exposure (median 27.2 μW/m2).
• Urban environment was most important determinant of total environmental exposure.

Abstract

BACKGROUND: Exposure to radiofrequency electromagnetic fields (RF-EMF) has rapidly increased and little is known about exposure levels in children. This study describes personal RF-EMF environmental exposure levels from handheld devices and fixed site transmitters in European children, the determinants of this, and the day-to-day and year-to-year repeatability of these exposure levels.

METHODS: Personal environmental RF-EMF exposure (μW/m2, power flux density) was measured in 529 children (ages 8-18 years) in Denmark, the Netherlands, Slovenia, Switzerland, and Spain using personal portable exposure meters for a period of up to three days between 2014 and 2016, and repeated in a subsample of 28 children one year later. The meters captured 16 frequency bands every 4 seconds and incorporated a GPS. Activity diaries and questionnaires were used to collect children's location, use of handheld devices, and presence of indoor RF-EMF sources. Six general frequency bands were defined: total, digital enhanced cordless telecommunications (DECT), television and radio antennas (broadcast), mobile phones (uplink), mobile phone base stations (downlink), and Wireless Fidelity (WiFi). We used adjusted mixed effects models with region random effects to estimate associations of handheld device use habits and indoor RF-EMF sources with personal RF-EMF exposure. Day-to-day and year-to-year repeatability of personal RF-EMF exposure were calculated through intraclass correlations (ICC).

RESULTS: Median total personal RF-EMF exposure was 75.5 μW/m2. Downlink was the largest contributor to total exposure (median: 27.2 μW/m2) followed by broadcast (9.9 μW/m2). Exposure from uplink (4.7 μW/m2) was lower. WiFi and DECT contributed very little to exposure levels. Exposure was higher during day (94.2 μW/m2) than night (23.0 μW/m2), and slightly higher during weekends than weekdays, although varying across regions. Median exposures were highest while children were outside (157.0 μW/m2) or traveling (171.3 μW/m2), and much lower at home (33.0 μW/m2) or in school (35.1 μW/m2). Children living in urban environments had higher exposure than children in rural environments. Older children and users of mobile phones had higher uplink exposure but not total exposure, compared to younger children and those that did not use mobile phones. Day-to-day repeatability was moderate to high for most of the general frequency bands (ICCs between 0.43 and 0.85), as well as for total, broadcast, and downlink for the year-to-year repeatability (ICCs between 0.49 and 0.80) in a small subsample.

CONCLUSION: The largest contributors to total personal environmental RF-EMF exposure were downlink and broadcast, and these exposures showed high repeatability. Urbanicity was the most important determinant of total exposure and mobile phone use was the most important determinant of uplink exposure. It is important to continue evaluating RF-EMF exposure in children as device use habits, exposure levels, and main contributing sources may change.

https://www.ncbi.nlm.nih.gov/pubmed/29754001

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Radiofrequency radiation from nearby base stations gives high levels in an apartment in Stockholm, Sweden: A case report.

Hardell L, Carlberg M, Hedendahl LK. Radiofrequency radiation from nearby base stations gives high levels in an apartment in Stockholm, Sweden: A case report. Oncol Lett. 15(5):7871-7883. 2018 May. doi: 10.3892/ol.2018.8285.

Abstract

Exposure to radiofrequency (RF) radiation was classified in 2011 as a possible human carcinogen, Group 2B, by the International Agency for Research on Cancer of the World Health Organisation. Evidence of the risk of cancer risk has since strengthened. Exposure is changing due to the rapid development of technology resulting in increased ambient radiation. RF radiation of sufficient intensity heats tissues, but the energy is insufficient to cause ionization, hence it is called non-ionizing radiation. These non-thermal exposure levels have resulted in biological effects in humans, animals and cells, including an increased cancer risk. In the present study, the levels of RF radiation were measured in an apartment close to two groups of mobile phone base stations on the roof. A total of 74,531 measurements were made corresponding to ~83 h of recording. The total mean RF radiation level was 3,811 μW/m2 (range 15.2-112,318 μW/m2) for the measurement of the whole apartment, including balconies. Particularly high levels were measured on three balconies and 3 of 4 bedrooms. The total mean RF radiation level decreased by 98% when the measured down-links from the base stations for 2, 3 and 4 G were disregarded. The results are discussed in relation to the detrimental health effects of non-thermal RF radiation. Due to the current high RF radiation, the apartment is not suitable for long-term living, particularly for children who may be more sensitive than adults. For a definitive conclusion regarding the effect of RF radiation from nearby base stations, one option would be to turn them off and repeat the measurements. However, the simplest and safest solution would be to turn them off and dismantle them.

Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5920374/

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Characteristics of perceived electromagnetic hypersensitivity in the general population

Gruber MJ, Palmquist E, Nordin S. Characteristics of perceived electromagnetic hypersensitivity in the general population. Scand J Psychol. 2018 May 9. doi: 10.1111/sjop.12449.

Abstract

Health problems evoked in the presence of electrical equipment is a concern, calling for better understanding for characteristics of electromagnetic hypersensitivity (EHS) in the general population. The present study investigated demographics, lifestyle factors, frequency and duration, coping strategies, proportion meeting clinical criteria for intolerance attributed to electromagnetic fields (EMF) and comorbidity. Using data from a large-scale population-based questionnaire study, we investigated persons with self-reported (n = 91) EHS in comparison to referents (n = 3,250). Middle age, female sex and poor perceived health was found to be associated with EHS. More than 50% in the EHS group reported having EMF-related symptoms more often than once a week, and the mean number of years experiencing EHS was 10.5. More than half of the EHS group reported that their symptoms started after a high-dose or long-term EMF exposure, that they actively tried to avoid EMF sources and that they mostly could affect the EMF environment. A minority of the EHS group had sought medical attention, been diagnosed by a physician or received treatment. Exhaustion syndrome, anxiety disorder, back/joint/muscle disorder, depression, functional somatic syndrome and migraine were comorbid with EHS. The results provide ground for future study of these characteristic features being risk factors for development of EHS and or consequences of EHS.

https://www.ncbi.nlm.nih.gov/pubmed/29741795

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Is MRI imaging in pediatric age totally safe? A critical reprisal.

Salerno S, Granata C, Trapenese M, Cannata V, Curione D, Rossi Espagnet MC, Magistrelli A, Tomà P. Is MRI imaging in pediatric age totally safe? A critical reprisal. Radiol Med. 2018 May 3. doi: 10.1007/s11547-018-0896-1.

Abstract

Current radiological literature is strongly focussed on radiation imaging risks. Indeed, given there is a small but actual augment in cancer risk from exposure to ionizing radiation in children, it is important to understand what the risk of alternative techniques could be. We retrospectively review literature data concerning possible MR imaging risks, focussing on the biological effects of MR, sedation and gadolinium compound risks when dealing with infant patients. The main concerns can be summarized in: (1) Biological effects of non-ionizing electromagnetic fields (EMF) employed-whose mechanisms of interaction with human tissues are polarization, induced current, and thermal heating, respectively. (2) Risks associated with noises produced during MRI examinations. (3) Hazards from ferromagnetic external and/or implanted devices-whose risk of being unintentionally brought inside MR room is higher in children than in adults. (4) Risks associated with sedation or general anaesthesia, essential problem in performing MR in very young patients, due to the exam long-lasting. (5) Risks related to gadolinium-based contrast agents, especially considering the newly reported brain deposition.

https://www.ncbi.nlm.nih.gov/pubmed/29725913

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RF EMF Risk Perception Revisited: Is the Focus on Concern Sufficient for Risk Perception Studies?

Wiedemann PM, Freudenstein F, Böhmert C, Wiart J, Croft RJ. RF EMF Risk Perception Revisited: Is the Focus on Concern Sufficient for Risk Perception Studies? Int J Environ Res Public Health. 2017 Jun 8;14(6). pii: E620. doi: 10.3390/ijerph14060620.

Abstract

An implicit assumption of risk perception studies is that concerns expressed in questionnaires reflect concerns in everyday life. The aim of the present study is to check this assumption, i.e., the extrapolability of risk perceptions expressed in a survey, to risk perceptions in everyday life. To that end, risk perceptions were measured by a multidimensional approach. In addition to the traditional focus on measuring the magnitude of risk perceptions, the thematic relevance (how often people think about a risk issue) and the discursive relevance (how often people think about or discuss a risk issue) of risk perceptions were also collected. Taking into account this extended view of risk perception, an online survey was conducted in six European countries with 2454 respondents, referring to radio frequency electromagnetic field (RF EMF) risk potentials from base stations, and access points, such as WiFi routers and cell phones. The findings reveal that the present study's multidimensional approach to measuring risk perception provides a more differentiated understanding of RF EMF risk perception. High levels of concerns expressed in questionnaires do not automatically imply that these concerns are thematically relevant in everyday life. We use thematic relevance to distinguish between enduringly concerned (high concern according to both questionnaire and thematic relevance) and not enduringly concerned participants (high concern according to questionnaire but no thematic relevance). Furthermore, we provide data for the empirical value of this distinction: Compared to other participants, enduringly concerned subjects consider radio frequency electromagnetic field exposure to a greater extent as a moral and affective issue. They also see themselves as highly exposed to radio frequency electromagnetic fields. However, despite these differences, subjects with high levels of thematic relevance are nevertheless sensitive to exposure reduction as a means for improving the acceptance of base stations in their neighborhood. This underlines the value of exposure reduction for the acceptance of radio frequency electromagnetic field communication technologies.

https://www.ncbi.nlm.nih.gov/pubmed/28594366

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Effective Analysis of Human Exposure Conditions with Body-worn Dosimeters in the 2.4 GHz Band

de Miguel-Bilbao S, Blas J, Ramos V. Effective Analysis of Human Exposure Conditions with Body-worn Dosimeters in the 2.4 GHz Band. J Vis Exp. 2018 May 2;(135). doi: 10.3791/56525.

Abstract

A well-defined experimental procedure is put forward to evaluate maximum exposure conditions in a worst-case scenario whilst avoiding the uncertainties caused by the use of personal exposimeters (PEMs) as measuring devices: the body shadow effect (BSE), the limited sensitivity range, and the non-identification of the radiation source. An upper bound for exposure levels to EMF in several indoor enclosures has been measured and simulated. The frequency used for the study is 2.4 GHz, as it is the most commonly used band in indoor communications. Although recorded values are well below the International Commission for Non-Ionizing Radiation Protection (ICNIRP) reference levels, there is a particular need to provide reliable exposure levels within particularly sensitive environments. In terms of electromagnetic field (EMF) exposure, limits established in national and international standards for health protection have been set for unperturbed exposure conditions; that is, for real and objective exposure data that have not been altered in any way.

https://www.ncbi.nlm.nih.gov/pubmed/29781983

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Hippocampal alterations triggered by acute exposure of mice to GSM 1800 MHz mobile phone radiation

Fragopoulou AF, Polyzos A, Papadopoulou MD, Sansone A, Manta AK, Balafas E, Kostomitsopoulos N, Skouroliakou A, Chatgilialoglu C, Georgakilas A, Stravopodis DJ, Ferreri C, Thanos D, Margaritis LH. Hippocampal lipidome and transcriptome profile alterations triggered by acute exposure of mice to GSM 1800 MHz mobile phone radiation: An exploratory study. Brain Behav. 2018 May 22.

Abstract

BACKGROUND: The widespread use of wireless devices during the last decades is raising concerns about adverse health effects of the radiofrequency electromagnetic radiation (RF-EMR) emitted from these devices. Recent research is focusing on unraveling the underlying mechanisms of RF-EMR and potential cellular targets. The "omics" high-throughput approaches are powerful tools to investigate the global effects of RF-EMR on cellular physiology.

METHODS: In this work, C57BL/6 adult male mice were whole-body exposed (nExp = 8) for 2 hr to GSM 1800 MHz mobile phone radiation at an average electric field intensity range of 4.3-17.5 V/m or sham-exposed (nSE = 8), and the RF-EMR effects on the hippocampal lipidome and transcriptome profiles were assessed 6 hr later.

RESULTS: The data analysis of the phospholipid fatty acid residues revealed that the levels of four fatty acids [16:0, 16:1 (6c + 7c), 18:1 9c, eicosapentaenoic acid omega-3 (EPA, 20:5 ω3)] and the two fatty acid sums of saturated and monounsaturated fatty acids (SFA and MUFA) were significantly altered ($p < 0.05$) in the exposed group. The observed changes indicate a membrane remodeling response of the tissue phospholipids after nonionizing radiation exposure, reducing SFA and EPA, while increasing MUFA residues. The microarray data analysis demonstrated that the expression of 178 genes changed significantly ($p < 0.05$) between the two groups, revealing an impact on genes involved in critical biological processes, such as cell cycle, DNA replication and repair, cell death, cell signaling, nervous system development and function, immune system response, lipid metabolism, and carcinogenesis.

CONCLUSIONS: This study provides preliminary evidence that mobile phone radiation induces hippocampal

lipidome and transcriptome changes that may explain the brain proteome changes and memory deficits previously shown by our group.

https://www.ncbi.nlm.nih.gov/pubmed/29786969

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2450 MHz EMR exposure causes cognition deficit with mitochondrial dysfunction & activation of intrinsic pathway of apoptosis in rats

Gupta SK, Mesharam MK, Krishnamurthy S. Electromagnetic radiation 2450 MHz exposure causes cognition deficit with mitochondrial dysfunction and activation of intrinsic pathway of apoptosis in rats. Journal of Biosciences. 43(2):263-276. June 2018.

Abstract

Electromagnetic radiation (EMR) can induce or modulate several neurobehavioral disorders. Duration and frequency of exposure of EMR is critical to develop cognitive disorders. Even though EMR-2450 is widely used, its effects on cognition in relation to mitochondrial function and apoptosis would provide better understanding of its pathophysiological effects. Therefore, a comparative study of different frequencies of EMR exposure would give valuable information on effects of discrete frequencies of EMR on cognition. Male rats were exposed to EMR (900, 1800 and 2450 MHz) every day for 1 h for 28 consecutive days. The cognitive behavior in terms of novel arm entries in Y-maze paradigm was evaluated every week after 1 h to last EMR exposure. Animals exposed to EMR-2450 MHz exhibited significant cognitive deficits. EMR-2450 MHz caused loss of mitochondrial function and integrity, an increase in amyloid beta expression. There was release of cytochrome-c and activation of apoptotic factors such as caspase-9 and -3 in the hippocampus. Further, there was decrease in levels of acetylcholine, and increase in activity of acetyl cholinesterase, indicating impairment of cholinergic system. Therefore, exposure of EMR-2450 in rats caused cognitive deficit with related pathophysiological changes in mitochondrial and cholinergic function, and amyloidogenesis.

Excerpts

The horn antenna was connected to the generator, which emitted continuous radiofrequency (RF) signals of 900, 1800 and 2450 MHz.

The rats were kept inside the cage and positioned at distance of 8, 11 and 15 cm from the antenna for exposure to 900, 1800 and 2450 MHz respectively to maintain the required power density, which is described in the following section.

The animals after being exposed to 900, 1800 and 2450 MHz EMR, the average power density was found to be 0.1227 W/m2. While the overall value of whole body average SAR was found to be approximately, 0.0227, 0.030 and 0.0616 W/kg for 900, 1800 and 2450 MHz respectively.

In summary, EMR at 2450 MHz induced cognitive behavioral deficit with concomitant loss in mitochondrial function. Alteration in the activity of mitochondrial complex enzyme systems caused oxidative stress and decrease in MMP, which ultimately lead to loss of mitochondrial integrity. Further, mitochondrial stress as observed from increases in cytochrome-c activated the expression of caspase-9 and caspase-3, indicating mitochondrial-linked apoptosis. Furthermore, exposure with EMR-2450 increased expression of hippocampal Aβ and decreased cholinergic neurotransmission in the hippocampus, which are considered to be important factors for development of cognitive dysfunction.

https://link.springer.com/article/10.1007/s12038-018-9744-7

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Measurement of 100 MHz EMF radiation in vivo effects on zebrafish embryonic development

Piccinetti CC, De Leo A, Cosoli G, Scalise L, Randazzo B, Cerri B. Olivotto I. Measurement of the 100 MHz EMF radiation in vivo effects on zebrafish D. rerio embryonic development: A multidisciplinary study. Ecotoxicology and Environmental Safety. 154:268-279. June 2018. https://doi.org/10.1016/j.ecoenv.2018.02.053

Highlights

• Setting up of an EMF exposure protocol for the unequivocal interpretation of results.
• Assessment of biological effects arising from RF-EMF exposure during zebrafish embryonic development.
• Zebrafish as a useful experimental model in electromagnetic pollution studies.

Abstract

The augmented exposure of both environment and human being to electromagnetic waves and the concomitant lack of an unequivocal knowledge about biological consequences of these radiations, raised public interest on electromagnetic pollution. In this context, the present study aims to evaluate the biological effects on zebrafish (ZF) embryos of 100 MHz radiofrequency electromagnetic field (RF-EMF) exposure through a multidisciplinary protocol.

Because of the shared synteny between human and ZF genomes that validated its use in biomedical research, toxicology and developmental biology studies, ZF was here selected as experimental model and a measurement protocol and biological analyses have been set up to clearly discriminate between RF-EMF biological and thermal effects.

The results showed that a 100 MHz EMF was able to affect ZF embryonic development, from 24 to 72 h post fertilization (hpf) in all the analyzed pathways. Particularly, at the 48 hpf stage, a reduced growth, an increased transcription of oxidative stress genes, the onset of apoptotic/autophagic processes and a modification in cholesterol metabolism were detected. ZF embryos faced stress induced by EMF radiation by triggering detoxification mechanisms and at 72 hpf they partially recovered from stress reaching the hatching time in a comparable way respect to the control group.

Data here obtained showed unequivocally the in vivo effects of RF-EMF on an animal model, excluding thermal outcomes and thus represents the starting point for more comprehensive studies on dose response effects of electromagnetic fields radiations consequences.

https://www.sciencedirect.com/science/article/pii/S0147651318301489

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Oxidative stress & an animal neurotransmitter synthesizing enzyme in wild growing myrtle leaves after GSM radiation exposure

Aikaterina L, Stefi AL, Vassilacopoulou D, Margaritis LH, Christodoulakis NS. Oxidative stress and an animal neurotransmitter synthesizing enzyme in the leaves of wild growing myrtle after exposure to GSM radiation. Flora. 243:67-76. June 2018. https://doi.org/10.1016/j.flora.2018.04.006

Highlights

• Mature myrtle plants were exposed to GSM radiation for 30 min, at 48 h intervals, for 50 days.
• Secondary metabolite accumulation was observed in the exposed leaves.
• Photosynthetic pigment content decreased in the exposed leaves.

• The oxidative stress (ROS) increased in the exposed leaves.
• Significant rise of the DDC level was recorded only in the exposed leaves.

Abstract

Mobile phones turned to be the most common form of public communication. Therefore, life on our planet continues wrapped in a “cloud” of non-ionizing radiations. Myrtus communis L. is an evergreen shrub, common in Mediterranean formations, exposed and adapted to two seasonally separated and qualitatively different environmental stresses. Thus, we considered it important to investigate the response of this tolerant species to emitted GSM non-ionizing radiations and compare it to already available data from thoroughly investigated plant species. Although the leaves of the exposed plants present unaffected tissue arrangement, their mesophyll cells accumulate large amounts of secondary metabolites, their photosynthetic pigments are dramatically reduced, the ROS counted are significantly increased and the presence of DDC, which cannot be detected in the leaves of the control plants, is recorded in high levels. The exposed leaves seem to experience a severe oxidative stress which probably induces DDC expression and the biosynthesis of the neurotransmitter dopamine, the activation of the shikimate pathway and, eventually, the accumulation of secondary metabolites.

https://www.sciencedirect.com/science/article/pii/S0367253018301208

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Selenium supplementation ameliorates electromagnetic field-induced oxidative stress in HEK293 cells

Özsobacı NP, Ergün DD, Durmuş S, Tunçdemir M, Uzun H, Gelişgen R, Özçelik D.Selenium supplementation ameliorates electromagnetic field-induced oxidative stress in the HEK293 cells. Journal of Trace Elements in Medicine and Biology. Available online 13 April 2018

There is a widespread use of 2.4 GHz electromagnetic radiation emitting devices especially in communication and education. Recent studies show the adverse effects of electromagnetic fields (EMF) such as oxidative stress, cellular damage and apoptosis on tissues. Selenium (Se) has an antioxidant properties by inhibiting oxidative damage being within the structure of antioxidant enzymes like glutathione peroxidase (GSH-Px) and it has also regulatory function for cell cycle and apoptosis. The aim of this study was to investigate the effect of Se on 2.4 GHz frequency EMF exposed human embryonic kidney cells (HEK293) by means of alterations in apoptotic and oxidative stress parameters.

Our study was planned as control, EMF, 100 nM Se+EMF, 200 nM Se+EMF groups. EMF groups were exposed to 2.4 GHz EMF for 1 hour, element groups were incubated with two different doses of Se added cell culture medium for 48 hour before EMF exposure.

MDA levels were significantly higher whereas SOD and GSH-Px activities were significantly lower in EMF compared to control. 100 and 200 nM Se + EMF application decreased MDA levels, increased SOD and GSH-Px activities than EMF. Apoptosis and caspase-3 were statistically significantly higher but bcl-2 was lower in EMF than control. Apoptosis and caspase-3 were lower in 100 and 200 nM Se + EMF, although bcl-2 were higher than EMF.

In conclusion, Se has protective effects against 2.4 GHz EMF-induced oxidative stress by reducing lipid peroxidation, regulating SOD and GSH-Px activity. Also, Se has inhibitory effect on 2.4 GHz EMF induced apoptosis by increasing the expression of anti-apoptotic protein bcl-2 and suppressing apoptosis regulatory protein caspase-3.

https://www.sciencedirect.com/science/article/pii/S0946672X17309768/pdfft?md5=8b8434bd54416111b883a00e4a6edfba&pid=1-s2.0-S0946672X17309768-main.pdf

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Extremely Low Frequency Fields

Residential magnetic fields exposure and childhood leukemia: a population-based case-control study in California

Thomas DC. Re: Kheifets et al. (2017): Residential magnetic fields exposure and childhood leukemia: a population-based case-control study in California. Cancer Causes Control 2018. doi:10.1007/s10552-018-1037-9

No abstract

Excerpts
In contrast, our LA County study reported OR 2.19 (95% CI 1.12–4.31; *p* for trend = .007) in our highest exposure category (MF > 0.125 μT) ...,

Finally, our wiring-based model found an association between residential MF and childhood leukemia when measurements alone did not [2], supporting the hypothesis that the temporal stability of distribution and transmission lines makes their wiring characteristics a better predictor of long-term residential MF exposures.

Discussion of possible mechanisms that could account for our reported effects as lower levels is beyond the scope of this comparison with previous literature, but a brief summary is provided in the Supplementary Comments. These findings suggest that innovations in ELF-MF exposure assessment may lead to more informative studies of the childhood leukemia association than the HVTL-only approach.

https://link.springer.com/article/10.1007%2Fs10552-018-1037-9

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ELF EMF impair the Cognitive and Motor Abilities of Honey Bees

Shepherd S, Lima MAP, Oliveira EE, Sharkh SM, Jackson CW, Newland PL. Extremely Low Frequency Electromagnetic Fields impair the Cognitive and Motor Abilities of Honey Bees. Sci Rep. 2018 May 21;8(1):7932. doi: 10.1038/s41598-018-26185-y.

Abstract

Extremely low frequency electromagnetic field (ELF EMF) pollution from overhead powerlines is known to cause biological effects across many phyla, but these effects are poorly understood. Honey bees are important pollinators across the globe and due to their foraging flights are exposed to relatively high levels of ELF EMF in proximity to powerlines. Here we ask how acute exposure to 50 Hz ELF EMFs at levels ranging from 20-100 μT, found at ground level below powerline conductors, to 1000-7000 μT, found within 1 m of the conductors, affects honey bee olfactory learning, flight, foraging activity and feeding. ELF EMF exposure was found to reduce learning, alter flight dynamics, reduce the success of foraging flights towards food sources, and feeding. The results suggest that 50 Hz ELF EMFs emitted from powerlines may represent a prominent environmental stressor for honey bees, with the potential to impact on their cognitive and motor abilities, which could in turn reduce their ability to pollinate crops.

https://www.ncbi.nlm.nih.gov/pubmed/29785039

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ELF EMF exposure and restraint stress induce changes on the brain lipid profile of Wistar rats

Martínez-Sámano J, Flores-Poblano A, Verdugo-Díaz L, Juárez-Oropeza MA, Torres-Durán PV. Extremely low

frequency electromagnetic field exposure and restraint stress induce changes on the brain lipid profile of Wistar rats. BMC Neurosci. 2018 May 21; 19(1):31. doi: 10.1186/s12868-018-0432-1.

Abstract

BACKGROUND: Exposure to electromagnetic fields can affect human health, damaging tissues and cell homeostasis. Stress modulates neuronal responses and composition of brain lipids. The aim of this study was to evaluate the effects of chronic extremely low frequency electromagnetic field (ELF-EMF) exposure, restraint stress (RS) or both (RS + ELF-EMF) on lipid profile and lipid peroxidation in Wistar rat brain.

METHODS: Twenty-four young male Wistar rats were allocated into four groups: control, RS, ELF-EMF exposure, and RS + ELF-EMF for 21 days. After treatment, rats were euthanized, the blood was obtained for quantitate plasma corticosterone concentration and their brains were dissected in cortex, cerebellum and subcortical structures for cholesterol, triacylglycerols, total free fatty acids, and thiobarbituric acid reactive substances (TBARS) analysis. In addition, fatty acid methyl esters (FAMEs) were identified by gas chromatography.

RESULTS: Increased values of plasma corticosterone were found in RS and ELF-EMF exposed groups ($p < 0.05$), this effect was higher in RS + ELF-EMF group ($p < 0.05$, vs. control group). Chronic ELF-EMF exposure increased total lipids in cerebellum, and total cholesterol in cortex, but decreased polar lipids in cortex. In subcortical structures, increased concentrations of non-esterified fatty acids were observed in RS + ELF-EMF group. FAMEs analysis revealed a decrease of polyunsaturated fatty acids of cerebellum and increases of subcortical structures in the ELF-EMF exposed rats. TBARS concentration in lipids was increased in all treated groups compared to control group, particularly in cortex and cerebellum regions.

CONCLUSIONS: These findings suggest that chronic exposure to ELF-EMF is similar to physiological stress, and induce changes on brain lipid profile.

https://www.ncbi.nlm.nih.gov/pubmed/29783956

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Effect of weak static & ELF alternating magnetic fields on memory & brain amyloid-β in two animal models of Alzheimer's disease

Bobkova NV, Novikov VV. Medvinskaya NI, Aleksandrova IY, Nesterova IV, Fesenko EE. Effect of weak combined static and extremely low-frequency alternating magnetic fields on spatial memory and brain amyloid-β in two animal models of Alzheimer's disease. Electromagnetic Biol Med. May 2018.

Abstract

Subchronic effect of a weak combined magnetic field (MF), produced by superimposing a constant component, 42 μT and an alternating MF of 0.08 μT, which was the sum of two frequencies of 4.38 and 4.88 Hz, was studied in olfactory bulbectomized (OBE) and transgenic Tg (APPswe, PSEN1) mice, which were used as animal models of sporadic and heritable Alzheimer's disease (AD) accordingly. Spatial memory was tested in a Morris water maze on the following day after completion of training trials with the hidden platform removed. The amyloid-β (Aβ) level was determined in extracts of the cortex and hippocampus of mice using a specific DOT analysis while the number and dimensions of amyloid plaques were detected after their staining with thioflavin S in transgenic animals. Exposure to the MFs (4 h/day for 10 days) induced the decrease of Aβ level in brain of OBE mice and reduced the number of Aβ plaques in the cortex and hippocampus of Tg animals. However, memory improvement was revealed in Tg mice only, but not in the OBE animals. Here, we suggest that in order to prevent the Aβ accumulation, MFs could be used at early stage of neuronal degeneration in case of AD and other diseases with amyloid protein deposition in other tissues.

https://www.tandfonline.com/doi/full/10.1080/15368378.2018.1471700

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Radiofrequency Radiation

Numerical evaluation of human exposure to WiMax patch antenna in tablet or laptop

Siervo B, Morelli MS, Landini L, Hartwig V. Numerical evaluation of human exposure to WiMax patch antenna in tablet or laptop. Bioelectromagnetics. 2018 Apr 30. doi: 10.1002/bem.22128.

Abstract

The use of wireless communication devices, such as tablets or laptops, is increasing among children. Only a few studies assess specific energy absorption rate (SAR) due to exposure from wireless-enabled tablets and laptops, in particular with Worldwide Interoperability for Microwave Access (WiMax) technology. This paper reports the estimation of the interaction between an E-shaped patch antenna (3.5 GHz) and human models, by means of finite-difference time-domain (FDTD) method. Specifically, four different human models (young adult male, young adult female, pre-teenager female, male child) in different exposure conditions (antenna at different distances from the human model, in different positions, and orientations) were considered and whole-body, 10 and 1 g local SAR and magnetic field value (Bmax) were evaluated. From our results, in some worst-case scenarios involving male and female children's exposure, the maximum radiofrequency energy absorption (hot spots) is located in more sensitive organs such as eye, genitals, and breast**.**

Excerpts

Worldwide Interoperability for Microwave Access (WiMax) is a communication system based on IEEE 802.16 [2004], belonging to fourth generation (4G) technology with well-known Long-term Evolution (LTE).

In conclusion, the results of our study show the importance of simulating exposure taking into account the antenna-body mutual position for the exact localization of maximum SAR values (“hot spots”). Although the average SAR values do not exceed the recommended limits for all simulated exposure conditions except one, the maximum SAR values in some scenarios are located in more sensitive organs, which are the eyes, genitals, and breast. This is particularly important for children. Their entire organism is in a process of development and it is not possible to predict long-lasting problems that might occur as a result of exposure to EM fields at an early age. Nevertheless, recently Barnes and Greenenbaum [2016] presented possible theoretical mechanisms and experimental data concerning long-term exposures to RF magnetic fields, speculating that they can be responsible for changing in radical concentrations. Moreover, the values for the SAR reported here are expected to be in a range that could change the concentration of reactive oxygen species, and long-term exposures may be significant for some health effects [De Iuliis et al., 2009; Kang et al., 2014; Wang and Zhang, 2017].

Hence, until a more exhaustive monitoring of the potential risk of exposure from wireless-enabled devices is available, exposures of the young should be As Low As Reasonably Achievable (ALARA). To prevent any potential hazard and damage from the use of wireless devices, some simple rules, such as keeping the device as far away as possible from the eyes, genitals, and breast, should be established.

https://www.ncbi.nlm.nih.gov/pubmed/29709072

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Representativeness and repeatability of microenvironmental personal and head exposures to RF EMF

Thielens A, Van den Bossche M, Brzozek C, Bhatt CR, Abramson MJ, Benke G, Martens L, Joseph W. Representativeness and repeatability of microenvironmental personal and head exposures to radio-frequency electromagnetic fields. Environ Res. 2018 Apr;162:81-96. doi: 10.1016/j.envres.2017.12.017.

Highlights

• First time assessment of head exposure to RF-EMF in uncontrolled environments, in 15 microenvironments in Melbourne, Australia.

• We show that our measurement protocol is repeatable over time.

• We show that the paths selected in our protocol are representative for the larger areas in which they are defined.

• Exposure to RF-EMF is higher in more dense urban areas than in less populated suburban areas in the outskirts of the city.

Abstract

The aims of this study were to: i) investigate the repeatability and representativeness of personal radio frequency-electromagnetic fields (RF-EMFs) exposure measurements, across different microenvironments, ii) perform simultaneous evaluations of personal RF-EMF exposures for the whole body and the head, iii) validate the data obtained with a head-worn personal distributed exposimeter (PDE) against those obtained with an on-body worn personal exposimeter (PEM). Data on personal and head RF-EMF exposures were collected by performing measurements across 15 microenvironments in Melbourne, Australia. A body-worn PEM and a head-worn PDE were used for measuring body and head exposures, respectively. The summary statistics obtained for total RF-EMF exposure showed a high representativeness ($r2 > 0.66$ for two paths in the same area) and a high repeatability over time ($r2 > 0.87$ for repetitions of the same path). The median head exposure in the 900MHz downlink band ranged between 0.06V/m and 0.31V/m. The results obtained during simultaneous measurements using the two devices showed high correlations ($0.42 < r2 < 0.94$). The highest mean total RF-EMF exposure was measured in Melbourne's central business district (0.89V/m), whereas the lowest mean total exposure was measured in a suburban residential area (0.05V/m). This study shows that personal RF-EMF microenvironmental measurements in multiple microenvironments have high representativeness and repeatability over time. The personal RF-EMF exposure levels (i.e. body and head exposures) demonstrated moderate to high correlations.

https://www.ncbi.nlm.nih.gov/pubmed/29289859

Also see: Cell Phone Towers are Largest Contributor to Environmental Radiofrequency Radiation

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Spatial and temporal variability of personal exposure to RF EMF in children in Europe

Birks LE, Struchen B, Eeftens M, Huss A, Gajšek P, Kheifets L, Gallastegi M, van Wel L, Dalmau-Bueno A, Estarlich M, Fernandez M, Meder IK, Ferrero A, Jiménez-Zabala A, Torrent M, Vrijkotte TGM, Cardis E, Olsen J, Valič B, Vermeulen R, Vrijheid M, Röösli M, Guxens M. OP VI – 5 Spatial and temporal variability of personal exposure to radio frequency electromagnetic fields in children in europe. Occupational and Environmental Medicine 75(Suppl 1):A13.1-A13. March 2018. DOI: 10.1136/oemed-2018-ISEEabstracts.31

Conference: ISEE Young 2018, Early Career Researchers Conference on Environmental Epidemiology – Together for a Healthy Environment, 19–20 March 2018, Freising, Germany

Abstract

Background/aim Exposure to radiofrequency electromagnetic fields (RF-EMF) has rapidly increased and little is known about exposure levels in children. This study aims to describe personal RF-EMF environmental exposure levels from handheld devices and fixed site transmitters in European children and its day-to-day and year-to-year repeatability.

Methods Environmental RF-EMF exposure (μW/m²) was measured in 529 children (ages 8–18) in Denmark, the Netherlands, Slovenia, Switzerland, and Spain using personal portable exposure metres over 3 days in 2014–2016, and repeated in 28 children one year later. Metres captured exposure every 4 s. Activity diaries collected children's location and use of mobile devices. Six general frequency bands were defined: total, digital enhanced cordless telecommunications (DECT), television and radio antennas (broadcast), mobile phones (uplink), mobile phone base stations (downlink), and WiFi. We used mixed effects models with region random effects to estimate associations between mobile device use and exposure. Day-to-day and year-to-year repeatability was calculated through Spearman correlations.

Results Median total exposure was 75.5 μW/m². Downlink was the largest contributor to total exposure (27.2 μW/m²) followed by broadcast (9.9 μW/m²). Exposure from uplink was lower (4.7 μW/m²). WiFi and DECT contributed very little to exposure levels. Exposure was higher during day (94.2 μW/m²) than night (23.0 μW/m²), and slightly higher during weekends than weekdays, although varying across regions. Exposure was generally highest while children were travelling (171.3 μW/m²) and outside (157.0 μW/m²). Children living in urban environments had higher exposure. Older children, girls, and users of mobile phones had higher uplink exposure but not total exposure. Repeatability was high for total, downlink, and broadcast in the year-to-year repeatability (rho between 0.54 and 0.66).

Conclusion Largest contributors to total RF-EMF exposure were downlink and broadcast, which was consistent one year later. Location of home (region and urbanicity) was associated with higher exposure. More frequent mobile phone use was associated with higher uplink exposure. It is important to continue evaluating RF-EMF exposure in children as mobile devices, use habits, and technologies continue to evolve.

http://oem.bmj.com/content/75/Suppl_1/A13.1

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Wireless Phone Use and Risk of Adult Glioma: Evidence from Meta-analysis

Wang P, Hou C, Li Y, Zhou D. Wireless Phone Use and Risk of Adult Glioma: Evidence from Meta-analysis. World Neurosurgery. Available online 28 April 2018.

Objective Wireless phone use has been increasing rapidly and is associated with the risk of glioma. Many studies have been conducted on this association, but did not reach an agreement. The aim of this meta-analysis was to determine the possible association between wireless phone use and the risk of adult glioma.

Methods Eligible studies were identified by searching Pubmed and Embase till July 2017. The random- or fixed-effects model was used to combine the results depending on the heterogeneity of the analysis. Publication bias was evaluated using Begg's funnel plot and Egger's regression asymmetry test. Subgroup analysis was performed to evaluate the possible influence of these variables.

Results A total of 10 studies about the association of wireless phone use and the risk of glioma were included in this meta-analysis. The combined odd's ratio (OR) of adult glioma associated with ever use of wireless phone was 1.03 (95% CI=0.92–1.16) with high heterogeneity (I2=54.2%, P=0.013). In the subgroup analyses, no significant association was found among tumor location in the temporal lobe and adult glioma risk, with ORs of 1.26 (95% CI=0.87–1.84), 0.93 (95%CI=0.69–1.24), 1.61 (95%CI=0.78–3.33), respectively. Significant association was found in long-term users (≥10 years) with OR 1.33 (95%CI =1.05–1.67) and risk of glioma.

Conclusions Our analysis suggested that ever use of wireless phone was not significantly associated with the risk of adult glioma, but could increase the risk in long-term users.

https://www.sciencedirect.com/science/article/pii/S1878875018308428

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Recall of mobile phone usage and laterality in young people: The multinational Mobi-Expo study

Goedhart G, van Wel L, Langer CE, de Llobet Viladoms P, Wiart J, Hours M, Kromhout H, Benke G, Bouka E, Bruchim R, Choi KH, Eng A, Ha M, Huss A, Kiyohara K, Kojimahara N, Krewski D, Lacour B, 't Mannetje A, Maule M, Migliore E, Mohipp C, Momoli F, Petridou ET, Radon K, Remen T, Sadetzki S, Sim M, Weinmann T, Cardis E, Vrijheid M, Vermeulen R. Recall of mobile phone usage and laterality in young people: The multinational Mobi-Expo study. Environ Res. 2018 Apr 25;165:150-157. doi: 10.1016/j.envres.2018.04.018.

Abstract

OBJECTIVE: To study recall of mobile phone usage, including laterality and hands-free use, in young people.

METHODS: Actual mobile phone use was recorded among volunteers aged between 10 and 24 years from 12 countries by the software application XMobiSense and was compared with self-reported mobile phone use at 6 and 18 months after using the application. The application recorded number and duration of voice calls, number of text messages, amount of data transfer, laterality (% of call time the phone was near the right or left side of the head, or neither), and hands-free usage. After data cleaning, 466 participants were available for the main analyses (recorded vs. self-reported phone use after 6 months).

RESULTS: Participants were on average 18.6 years old (IQR 15.2-21.8 years). The Spearman correlation coefficients between recorded and self-reported (after 6 months) number and duration of voice calls were 0.68 and 0.65, respectively. Number of calls was on average underestimated by the participants (adjusted geometric mean ratio (GMR) self-report/recorded = 0.52, 95% CI = 0.47-0.58), while duration of calls was overestimated (GMR=1.32, 95%, CI = 1.15-1.52). The ratios significantly differed by country, age, maternal educational level, and level of reported phone use, but not by time of the interview (6 vs. 18 months). Individuals who reported low mobile phone use underestimated their use, while individuals who reported the highest level of phone use were more likely to overestimate their use. Individuals who reported using the phone mainly on the right side of the head used it more on the right (71.1%) than the left (28.9%) side. Self-

reported left side users, however, used the phone only slightly more on the left (53.3%) than the right (46.7%) side. Recorded percentage hands-free use (headset, speaker mode, Bluetooth) increased with increasing self-reported frequency of hands-free device usage. Frequent (≥50% of call time) reported headset or speaker mode use corresponded with 17.1% and 17.2% of total call time, respectively, that was recorded as hands-free use.

DISCUSSION: These results indicate that young people can recall phone use moderately well, with recall depending on the amount of phone use and participants' characteristics. The obtained information can be used to calibrate self-reported mobile use to improve estimation of radiofrequency exposure from mobile phones.

https://www.ncbi.nlm.nih.gov/pubmed/29704776

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Mobile phone EMF induced DNA damage in human ear canal hair follicle cells

Akdag M, Dasdag S, Canturk F, Akdag MZ. Exposure to non-ionizing electromagnetic fields emitted from mobile phones induced DNA damage in human ear canal hair follicle cells. Electromagn Biol Med. 2018 Apr 18:1-10. doi: 10.1080/15368378.2018.1463246.

Abstract

The aim of this study was to investigate effect of radiofrequency radiation (RFR) emitted from mobile phones on DNA damage in follicle cells of hair in the ear canal. The study was carried out on 56 men (age range: 30-60 years old) in four treatment groups with n = 14 in each group. The groups were defined as follows: people who did not use a mobile phone (Control), people use mobile phones for 0-30 min/day (second group), people use mobile phones for 30-60 min/day (third group) and people use mobile phones for more than 60 min/day (fourth group). Ear canal hair follicle cells taken from the subjects were analyzed by the Comet Assay to determine DNA damages. The Comet Assay parameters measured were head length, tail length, comet length, percentage of head DNA, tail DNA percentage, tail moment, and Olive tail moment. Results of the study showed that DNA damage indicators were higher in the RFR exposure groups than in the control subjects. In addition, DNA damage increased with the daily duration of exposure. In conclusion, RFR emitted from mobile phones has a potential to produce DNA damage in follicle cells of hair in the ear canal. Therefore, mobile phone users have to pay more attention when using wireless phones.

https://www.ncbi.nlm.nih.gov/pubmed/29667447

Excerpts

Participants using smart phones with similar SAR values, were used. The head peak SAR values of the smart phones used by the participants, ranged between 0.45–0.97 W/kg.

Comet Assay was performed by researchers who were unaware of which group the hair samples were from.

In conclusion, the findings of the present study indicated that exposure to radiation from mobile phones can lead to DNA single-strand breaks, therefore, to DNA damage. The results of this study indicated a positive correlation between duration of exposure and DNA damage. We consider that the result of this study might be

important in terms of the balance involved in DNA damage and repair mechanisms.

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Temperature induced in human organs due to near-field and far-field electromagnetic exposure effects

Wessapan T, Rattanadech P. Temperature induced in human organs due to near-field and far-field electromagnetic exposure effects. International Journal of Heat and Mass Transfer. 119:65-76. April 2018.

Highlights

• The field radiation pattern and the operating frequency significantly influence the temperature distribution in each organ.
• The testis temperature increases are lower than the thresholds for the induction of infertility for both 900 and 1800 MHz.
• For distances less than 2 m, the SAR values are higher than the general public exposure limit of ICNIRP.

Abstract

The main biological effect from exposure to electromagnetic (EM) radiation is a temperature rise in the human body and its sensitive organs, which results from absorbing electromagnetic field (EMF) power. EM near-field and far-field sources, which have different operating frequencies and exposure distances, result in different EMF distribution patterns and EMF power absorptions by the human body. Actually, the severity of the physiological effect can occur with small temperature increases in the sensitive organs. However, the EM absorption characteristics and the temperature increase distribution resulting from different field radiation patterns from EM sources are not well established. To adequately explain the biological effects that are associated with the EMF energy absorption, a systematic study of different EMF distribution patterns and how they interact with body tissue is needed. This study considers the computationally determined specific absorption rate (SAR) and the heat transfer in a heterogeneous human torso model with internal organs exposed to near-field and far-field EM radiations at different frequencies. The electric field, SAR, and the temperature distributions in various organs during exposure to EMFs are obtained through the numerical simulation of EM wave propagation and an unsteady bioheat transfer model. The findings indicate that the field radiation pattern and the operating frequency of an EM source significantly influence the electric field, the SAR, and the temperature distribution in each organ. Moreover, the tissue's dielectric properties also affect the temperature distribution patterns within the body tissue. These findings enable researchers to more accurately determine the exposure limits for the power output of wireless transmitters, and the distance that they should remain from the humans.

https://www.sciencedirect.com/science/article/pii/S0017931017342709

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Does acute RF EMF exposure affect visual event-related potentials in healthy adults?

Dalecki A, Loughran SP, Verrender A, Burdon CA, Taylor NAS, Croft RJ. Does acute radio-frequency electromagnetic field exposure affect visual event-related potentials in healthy adults? Clinical Neurophysiology. 129(5):901-908. May 2018.

Abstract

Objective To use improved methods to address the question of whether acute exposure to radio-frequency (RF) electromagnetic fields (RF-EMF) affects early (80–200 ms) sensory and later (180–600 ms) cognitive processes as indexed by event-related potentials (ERPs).

Methods Thirty-six healthy subjects completed a visual discrimination task during concurrent exposure to a Global System for Mobile Communications (GSM)-like, 920 MHz signal with peak-spatial specific absorption rate for 10 g of tissue of 0 W/kg of body mass (Sham), 1 W/kg (Low RF) and 2 W/kg (High RF). A fully randomised, counterbalanced, double-blind design was used.

Results P1 amplitude was reduced ($p = .02$) and anterior N1 latency was increased ($p = .04$) during Exposure compared to Sham. There were no effects on any other ERP latencies or amplitudes.

Conclusions RF-EMF exposure may affect early perceptual (P1) and preparatory motor (anterior N1) processes. However, only two ERP indices, out of 56 comparisons, were observed to differ between RF-EMF exposure and Sham, suggesting that these observations may be due to chance.

Excerpts

It should be noted that the RF-EMF exposure in the present study was a simulated GSM signal, delivered via planar antenna (Murbach et al., 2012). This planar antenna delivers a relatively homogenous SAR distribution to brain structures in the exposed hemisphere (Murbach et al., 2012).... We note that, in contrast to the homogenous SAR distribution produced by the planar antenna used in the present study, exposures from individual mobile phones are far more localised, such that SARs in brain regions more distant from the mobile phone are markedly smaller than those more proximal to the phone (Boutry et al., 2008; Loughran et al., 2008). Therefore, given the lack of effects on central nervous system function under conditions where the maximal SAR is delivered to the entire hemisphere, it is unlikely that a markedly smaller, localised SAR exposure, such as that which might be present during mobile phone use, would affect the processes assessed in the present study.

This study was funded by the National Health and Medical Research Council of Australia [Grant 1042464] and the **Electric Power Research Institute** [Grant 00-10003301].

Conflict of interest statement: None.

https://www.sciencedirect.com/science/article/pii/S1388245718301044

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Commentary: Geographic Variations in Incidence of Glioblastoma & Prognostic Factors Predictive of Overall Survival in US Adults from 2004–2013

Mortazavi SMJ. Commentary: Geographic Variations in the Incidence of Glioblastoma and Prognostic Factors Predictive of Overall Survival in US Adults from 2004–2013. Front Aging Neurosci. 2018; 10: 105. Published online 2018 Apr 12. doi: 10.3389/fnagi.2018.00105.

No abstract

Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5906709/

See the article "Geographic Variations in the Incidence of Glioblastoma and Prognostic Factors Predictive of Overall Survival in US Adults from 2004–2013" in volume 9, 352. Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5681990/

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Tumor-treating fields as a fourth treating modality for glioblastoma: a meta-analysis

Magouliotis DE, Asprodini EK, Svokos KA, Tasiopoulou VS, Svokos AA, Toms SA. Tumor-treating fields as a fourth treating modality for glioblastoma: a meta-analysis. Acta Neurochir (Wien). 2018 Apr 25. doi: 10.1007/s00701-018-3536-6. [Epub ahead of print]

Abstract

BACKGROUND: We aim to review the available literature on patients suffering from glioblastoma treated with tumor-treating fields (TTFields) plus radio chemotherapy or conventional radio chemotherapy alone, to compare the efficacy and safety of the two methods.

METHODS: A systematic literature search was performed in PubMed, Cochrane library, and Scopus databases, in accordance with the PRISMA guidelines. Six studies met the inclusion criteria incorporating 1806 patients for the qualitative analysis and 1769 for the quantitative analysis.

RESULTS: This study reveals increased median overall survival (weighted mean difference (WMD) 3.29 [95% confidence interval (CI) 2.37, 4.21]; $p < 0.00001$), survival at 1 year (odds ratio (OR) 1.81 [95% CI 1.41, 2.32]; $p < 0.00001$) and 2 years (OR 2.33 [95% CI 1.73, 3.14]; $p < 0.00001$), and median progression-free survival (WMD 2.35 [95% CI 1.76, 2.93]; $p < 0.00001$) along with progression-free survival at 6 months (WMD 6.86 [95% CI 5.91, 7.81]; $p < 0.00001$) for the patients treated with TTFields. Survival at 3 years was comparable between the two groups. TTFields were associated with fewer adverse events compared to chemotherapy along with similar incidence of skin irritation.

CONCLUSIONS: TTFields are a safe and efficient novel treatment modality. More randomized controlled studies, with longer follow-up, are necessary to further assess the clinical outcomes of TTFields.

https://www.ncbi.nlm.nih.gov/pubmed/29696502

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Electronics in fluorescent bulbs & LEDs cause malignant melanoma in indoor office workers & tanning bed users

Milham S, Stetzer D. The electronics in fluorescent bulbs and light emitting diodes (LED), rather than ultraviolet radiation, cause increased malignant melanoma incidence in indoor office workers and tanning bed users. Medical Hypotheses. 116:33-39. Jul 2018.

Abstract

The epidemiology of cutaneous malignant melanoma (CMM) has a number of facets that do not fit with sunlight and ultraviolet light as the primary etiologic agents. Indoor workers have higher incidence and mortality rates of CMM than outdoor workers; CMM occurs in body locations never exposed to sunlight; CMM incidence is increasing in spite of use of UV blocking agents and small changes in solar radiation.

Installation of two new fluorescent lights in the milking parlor holding area of a Minnesota dairy farm in 2015 caused an immediate drop in milk production. This lead to measurement of body amperage in humans exposed to modern non-incandescent lighting. People exposed to old and new fluorescent lights, light emitting diodes (LED) and compact fluorescent lights (CFL) had body amperage levels above those considered carcinogenic. We hypothesize that modern electric lighting is a significant health hazard, a carcinogen, and is causing increasing CMM incidence in indoor office workers and tanning bed users. These lights generate dirty electricity (high frequency voltage transients), radio frequency (RF) radiation, and increase body amperage, all of which have been shown to be carcinogenic. This could explain the failure of ultraviolet blockers to stem the malignant melanoma pandemic. Tanning beds and non-incandescent lighting could be made safe by incorporating a grounded Faraday cage which allows passage of ultraviolet and visible light frequencies and blocks other frequencies. Modern electric lighting should be fabricated to be electrically clean.

https://www.medical-hypotheses.com/article/S0306-9877(18)30116-6/abstract

Evaluation of hypothesis

To test this hypothesis, tanning beds with and without grounded Faraday cages which allow passage of UV light and block other electromagnetic frequencies should be tested with a body amperage meter and with animal malignant melanoma models. Incandescent (no internal or external electronics) and fluorescent tanning bulbs of the same UV frequency (wavelength) and intensity should also be tested similarly. Modern non-incandescent lighting of all types should be tested and compared to incandescent lights and lights fabricated to be electrically clean. Case/control and cohort studies of CMM cases focused on lighting exposures should be undertaken.

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A proposed explanation for thunderstorm asthma and leukemia risk near high-voltage power lines: a supported hypothesis

Redmayne M. A proposed explanation for thunderstorm asthma and leukemia risk near high-voltage power lines: a supported hypothesis
Electromagnetic Biology and Medicine. Published online 30 Apr 2018.

Abstract

Thunderstorm asthma and increased childhood leukemia risk near high-voltage power lines (HVPL) are occurrences whose mechanism of effect is not fully understood.

This paper proposes and discusses a key similarity: both thunderstorms and HVPL generate a high enough electrical field in the environment to ionize nearby air and air-borne particles.

I argue that the repeatedly demonstrated acute asthma response to pollen-laden air during thunderstorms is largely due to ionization of air-borne allergens, which adhere more readily and in greater quantity in the lungs than non-ionized particles. If these bind to mucous or phagocytic cells, it would enhance immune response. A rapid temperature drop and high ozone also seem to be drivers of thunderstorm asthma.

This causal nexus provides strong support for the parallel situation of prolonged exposure to ionized particles near HVPL and an increased rate of childhood leukemia. Here, it is proposed that upwind carcinogens are ionized when passing HVPL and then residential and business areas. Published evidence for most steps are presented, but have not previously been published as a coherent whole, nor has it been suggested that the inhaled ionized micro-particle explanation for acute asthma may also explain development of childhood leukemia over time.

The demonstrated series of events leading to increased deposition and retention of ionized particles in airways provides support for explaining both adverse health outcomes: acute thunderstorm asthma and increased risk of childhood leukemia near HVPL. Further support for this explanation of both outcomes is provided by effects of on-going proximity to highways.

https://doi.org/10.1080/15368378.2018.1466309

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Alteration of adaptive behaviors of progeny after maternal mobile phone exposure

Petitdant N, Lecomte A, Robidel F, Gamez, C, Blazy K, Villégier A-S. Alteration of adaptive behaviors of progeny after maternal mobile phone exposure. Environmental Science and Pollution Research. 25(11):10894-10903. Apr 2018.

Exposure of pregnant women to radiofrequency (RF) devices raises questions on their possible health consequences for their progeny. We examined the hazard threshold of gestational RF on the progeny's glial homeostasis, sensory-motor gating, emotionality, and novelty seeking and tested whether maternal immune activation would increase RF toxicity. Pregnant dams were daily restrained with loop antennas adjoining the abdomen (fetus body specific absorption rates (SAR): 0, 0.7, or 2.6 W/kg) and received three lipopolysaccharide (LPS) intra-peritoneal injections (0 or 80 mu g/kg). Scores in the prepulse startle inhibition, fear conditioning, open field, and elevated plus maze were assessed at adolescence and adulthood. Glial fibrillary acidic protein (GFAP) and interleukines-1 beta (ILs) were quantified. LPS induced a SAR-dependent reduction of the prepulse startle inhibition in adults. Activity in the open field was reduced at 2.6 W/kg at adolescence. GFAP and ILs, emotional memory, and anxiety-related behaviors were not modified. These data support the hypothesis that maternal immune activation increased the developmental RF exposure-induced long-term neurobiological impairments. These data support the fact that fetuses who receive combined environmental exposures with RF need special attention for protection.

https://www.ncbi.nlm.nih.gov/pubmed/29397508

Excerpts

GD 1 dams were randomly assigned to one RF-EMF emission power group (0 (sham), 1 or 4 W) or to the cage control group (no daily restraint). Half of each RF-EMF group was randomly assigned to receive vehicle

(saline) or LPS intraperitoneal injections (80 µg/ml/kg, *E. coli*, serotype 055:B5, phenol extraction Sigma-Aldrich, MO) at GD 15, 17 and 19 ($n = 6–9$/group). At birth, the number of pups per litter was recorded. At post-natal day (PND) 3, litters were adjusted to four males by reduction or adoption.

According to the finite difference time domain calculations, numerical dosimetry indicated 20 GD-averaged fetus whole body SAR of 0.7 +/− 1.5 W/kg for 1 W and 2,6 +/− 6 W/kg for 4 W emitting power.

To conclude, our study is the first to highlight gestational inflammation-induced vulnerability towards RF-EMF exposure on the ability to filtrate sensory information. Cerebral impairments were SAR-dependent supporting the causal relationship between EMF-RF exposure and deficits. RF-EMF levels tested in this study may surround the possible toxic threshold for gestational RF-EMF. These data with those of other studies support the fact that special attention should be devoted to the protection of embryos and fetuses that can be co-exposed to environmental factors and EMFs at diverse frequencies and intensities.

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Effects of 1.8 GHz radiofrequency field on microstructure and bone metabolism of femur in mice

Guo L, Zhang JP, Zhang KY, Wang HB, Wang H, An GZ, Zhou Y, Meng GL, Ding DR. Effects of 1.8 GHz radiofrequency field on microstructure and bone metabolism of femur in mice. Bioelectromagnetics. Published online Apr 30, 2018.

Abstract

To investigate the effects of 1.8 GHz radiofrequency (RF) field on bone microstructure and metabolism of femur in mice, C57BL/6 mice (male, age 4 weeks) were whole-body exposed or sham exposed to 1.8 GHz RF field. Specific absorption rates of whole body and bone were approximately 2.70 and 1.14 W/kg (6 h/day for 28 days). After exposure, microstructure and morphology of femur were observed by microcomputed tomography (micro-CT), Hematoxylin and Eosin (HE) and Masson staining. Subsequently, bone parameters were calculated directly from the reconstructed images, including structure model index, bone mineral density, trabecular bone volume/total volume, connectivity density, trabecular number, trabecular thickness, and trabecular separation. Biomarkers that reflect bone metabolism, such as serum total alkaline phosphatase (ALP), bone-specific alkaline phosphatase (BALP), and tartrate-resistant acid phosphatase 5b (TRACP-5b), were determined by biochemical assay methods. Micro-CT and histology results showed that there was no significant change in bone microstructure and the above parameters in RF group, compared with sham group. The activity of serum ALP and BALP increased 29.47% and 16.82%, respectively, in RF group, compared with sham group ($P < 0.05$). In addition, there were no significant differences in the activity of serum TRACP-5b between RF group and sham group. In brief, under present experimental conditions, we did not find support for an effect of 1.8 GHz RF field on bone microstructure; however, it might promote metabolic function of osteoblasts in mice.

https://doi.org/10.1002/bem.22125

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835 MHz RF-EMF decreases expression of calcium channels, inhibits apoptosis, but induces

autophagy in mouse hippocampus

Kim JH, Sohn UD, Kim HG, Kim HR. Exposure to 835 MHz RF-EMF decreases the expression of calcium channels, inhibits apoptosis, but induces autophagy in the mouse hippocampus. Korean J Physiol Pharmacol. 2018 May;22(3):277-289. doi: 10.4196/kjpp.2018.22.3.277.

Abstract

The exponential increase in the use of mobile communication has triggered public concerns about the potential adverse effects of radiofrequency electromagnetic fields (RF-EMF) emitted by mobile phones on the central nervous system (CNS). In this study, we explored the relationship between calcium channels and apoptosis or autophagy in the hippocampus of C57BL/6 mice after RF-EMF exposure with a specific absorption rate (SAR) of 4.0 W/kg for 4 weeks. Firstly, the expression level of voltage-gated calcium channels (VGCCs), a key regulator of the entry of calcium ions into the cell, was confirmed by immunoblots. We investigated and confirmed that pan-calcium channel expression in hippocampal neurons were significantly decreased after exposure to RF-EMF. With the observed accumulation of autolysosomes in hippocampal neurons via TEM, the expressions of autophagy-related genes and proteins (e.g., LC3B-II) had significantly increased. However, down-regulation of the apoptotic pathway may contribute to the decrease in calcium channel expression, and thus lower levels of calcium in hippocampal neurons. These results suggested that exposure of RF-EMF could alter intracellular calcium homeostasis by decreasing calcium channel expression in the hippocampus; presumably by activating the autophagy pathway, while inhibiting apoptotic regulation as an adaptation process for 835 MHz RF-EMF exposure.

Open access paper: http://pdf.medrang.co.kr/paper/pdf/Kjpp/Kjpp022-03-06.pdf

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Extremely Low Frequency Fields

Electric cars and EMI with cardiac implantable electronic devices: A cross-sectional evaluation

Lennerz C, O'Connor M, Horlbeck L, Michel J, Weigand S, Grebmer C, Blazek P, Brkic A, Semmler V, Haller B, Reents T, Hessling G, Deisenhofer I, Whittaker P, Lienkamp M, Kolb C. Letter: Electric cars and electromagnetic interference with cardiac implantable electronic devices: A cross-sectional evaluation. *Annals of Internal Medicine*. Apr 24, 2018.

No abstract

See Hybrid & Electric Cars: Electromagnetic Radiation Risks for excerpts and link to paper.

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Antitumor effect of static and ELF MF against nephroblastoma and neuroblastoma

Yuan LQ, Wang C, Zhu K, Li HM, Gu WZ, Zhou DM, Lai JQ, Zhou D, Lv Y, Tofani S, Chen X. The antitumor effect of static and extremely low frequency magnetic fields against nephroblastoma and neuroblastoma. Bioelectromagnetics. 2018 May 2. doi: 10.1002/bem.22124.

Abstract

Certain magnetic fields (MF) have potential therapeutic antitumor effect whereas the underlying mechanism remains undefined. In this study, a well-characterized MF was applied to two common childhood malignancies, nephroblastoma and neuroblastoma. This MF has a time-averaged total intensity of 5.1 militesla (mT), and was generated as a superimposition of a static and an extremely low frequency (ELF) MF in 50 Hertz (Hz). In nephroblastoma and neuroblastoma cell lines including G401, CHLA255, and N2a, after MF exposure of 2 h per day, the cell viability decreased significantly after 2 days. After 3 days, inhibition rates of 17-22% were achieved in these cell lines. Furthermore, the inhibition rate was positively associated with exposure time. On the other hand, when using static MF only while maintaining the same time-averaged intensity of 5.1 mT, the inhibition rate was decreased. Thus, both time and combination of ELF field were positively associated with the inhibitory effect of this MF. Exposure to the field decreased cell proliferation and induced apoptosis. Combinational use of MF together with chemotherapeutics cisplatin (DDP) was performed in both in vitro and in vivo experiments. In cell lines, combinational treatment further increased the inhibition rate compared with single use of either DDP or MF. In G401 nephroblastoma tumor model in nude mice, combination of MF and DDP resulted in significant decrease of tumor mass, and the side effect was limited in mild liver injury. MF exposure by itself did not hamper liver or kidney functions. In summary, the antitumor effect of an established MF against neuroblastoma and nephroblastoma is reported, and this field has the potential to be used in combination with DDP to achieve increased efficacy and reduce side effects in these two childhood malignancies.

https://www.ncbi.nlm.nih.gov/pubmed/29719057

Radio Frequency Radiation

5G wireless telecommunications expansion: Public health and environmental implications

Russell CL. 5G wireless telecommunications expansion: Public health and environmental implications. Environmental Research. Available online 11 April 2018. in press. https://doi.org/10.1016/j.envres.2018.01.016

Abstract

The popularity, widespread use and 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. On the horizon, a new generation of even shorter high frequency 5G wavelengths is being proposed to power the Internet of Things (IoT). The IoT promises us convenient and easy lifestyles with 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.

Radiofrequency radiation (RF) is increasingly being recognized as a new form of environmental pollution. Like other common toxic exposures, the effects of radiofrequency electromagnetic radiation (RF EMR) will be problematic if not impossible to sort out epidemiologically as there no longer remains an unexposed control group. This is especially important considering these effects are likely magnified by synergistic toxic exposures and other common health risk behaviors. Effects can also be non-linear. Because this is the first generation to have cradle-to-grave lifespan exposure to this level of man-made microwave (RF EMR) radiofrequencies, it will be years or decades before the true health consequences are known. Precaution in the roll out of this new technology is strongly indicated.

This article will review relevant electromagnetic frequencies, exposure standards and current scientific literature on the health implications of 2G, 3G, 4G exposure, including some of the available literature on 5G frequencies. The question of what constitutes a public health issue will be raised, as well as the need for a precautionary approach in advancing new wireless technologies.

Conclusion

Although 5G technology may have many unimagined uses and benefits, it is also increasingly clear that significant negative consequences to human health and ecosystems could occur if it is widely adopted. Current radiofrequency radiation wavelengths we are exposed to appear to act as a toxin to biological systems. A moratorium on the deployment of 5G is warranted, along with development of independent health and environmental advisory boards that include independent scientists who research biological effects and exposure levels of radiofrequency radiation. Sound regulatory policy regarding current and future telecommunications initiative will require more careful assessment of risks to human health, environmental health, public safety, privacy, security and social consequences. Public health regulations need to be updated to match appropriate independent science with the adoption of biologically based exposure standards prior to further deployment of 4G or 5G technology.

Considering the current science, lack of relevant exposure standards based on known biological effects and data gaps in research, we need to reduce our exposure to RF EMR where ever technically feasible. Laws or policies which restrict the full integrity of science and the scientific community with regards to health and environmental effects of wireless technologies or other toxic exposures should be changed to enable unbiased, objective and precautionary science to drive necessary public policies and regulation. Climate change, fracking, toxic emissions and microwave radiation from wireless devices all have something in common with smoking. There is much denial and confusion about health and environmental risks, along with industry insistence for absolute proof before regulatory action occurs (Frentzel-Beyme, 1994; Michaels 2008). There are many lessons we have not learned with the introduction of novel substances, which later became precarious environmental pollutants by not heeding warning signs from scientists (Gee, 2009). The threats of these common pollutants continue to weigh heavily on the health and wellbeing of our nation. We now accept them as the price of progress. If we do not take precautions but wait for unquestioned proof of harm will it be too late at that point for some or all of us?

https://www.sciencedirect.com/science/article/pii/S0013935118300161

More information about 5G:

Physicians for Safe Technology

Scientists and Doctors Demand Moratorium on 5G

5G Wireless Technology: Is 5G Harmful to Our Health?
5G Wireless Technology: Millimeter Wave Health Effects

5G Wireless Technology: Cutting Through the Hype

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Human Exposure to RF Fields in 5G Downlink

Nasim I, Kim S. Human Exposure to RF Fields in 5G Downlink. Submitted on 10 Nov 2017 to IEEE International Communications Conference. arXiv:1711.03683v1.

Abstract

While cellular communications in millimeter wave (mmW) bands have been attracting significant research interest, their potential harmful impacts on human health are not as significantly studied. Prior research on human exposure to radio frequency (RF) fields in a cellular communications system has been focused on uplink only due to the closer physical contact of a transmitter to a human body. However, this paper claims the necessity of thorough investigation on human exposure to downlink RF fields, as cellular systems deployed in mmW bands will entail (i) deployment of more transmitters due to smaller cell size and (ii) higher concentration of RF energy using a highly directional antenna. In this paper, we present human RF exposure levels in downlink of a Fifth Generation Wireless Systems (5G). Our results show that 5G downlink RF fields generate significantly higher power density (PD) and specific absorption rate (SAR) than a current cellular system. This paper also shows that SAR should also be taken into account for determining human RF exposure in the mmW downlink.

Open access paper: https://arxiv.org/abs/1711.03683

Note: Although this is not a peer-reviewed paper, this may be the first study to explore potential RF exposures under 5G.

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Intensity-time dependence dosing criterion in the EMF exposure guidelines in Russia

Rubtsova N, Paltsev Y, Perov S, Bogacheva E. Intensity-time dependence dosing criterion in the EMF exposure guidelines in Russia. Electromagn Biol Med. 2018;37(1):43-49. doi: 10.1080/15368378.2017.1414056. Epub 2018 Mar 1.

Abstract

Major approaches of the Russian Federation in setting of exposure guidelines to electromagnetic fields (EMF) in occupational and public environments are discussed in this paper. EMF exposure guidelines in Russia are based on the results of hygienic, clinical, physiological, epidemiological and experimental studies and are frequency-dependent. The concept of a threshold principle of occupational and environmental factors due to hazardous exposure effects has been used to set permissible exposure levels of different EMF frequency ranges. The data of experimental studies showed hazardous threshold levels of EMF effects. The main criteria

of EMF hazardous exposure evaluated in the experimental study concerned both estimation of threshold levels of chronic (long-term) and acute exposure. Also, this paper contains some recent experimental study data on correlation of long-term radiofrequency and power-frequency EMF exposure effects with regard to time duration, the so-called time-dependence approach. It enables identification of the value of permissible EMF exposure levels depending on exposure duration. This approach is used in occupational exposure guideline setting and requires the introduction of "power exposition" (PE) and "maximal permissible level" (MPL). In general, EMF exposure guidelines are established with regard to possible duration of exposure per day.

https://www.ncbi.nlm.nih.gov/pubmed/29493302

Excerpts

Threshold hazardous effect, as mentioned above, is the EMF level that causes significant functional changes of body compensatory systems at the boundary of physiologically normal and abnormal state.

Today, the sphere of interests lies in radiofrequency exposure guideline standardization. Currently, the “dosing-time-dependence approach” is used for EMF frequency range from 30 kHz to 300 GHz. This approach specifies values of EMF-exposure permissible levels depending on exposure duration per work day which helps to provide more adequate evaluation of personnel exposure measurements such as “power exposition” (PE) and “maximal permissible level” (MPL), where MPL is the maximum exposure EMF level for very short time per work day (<10 minutes) (Table 1) (Ministry of Health of the Russian Federation, 2016). PE is calculated by multiplying the values of electric field or magnetic field by the square value of exposure duration per 8-hr work day, or by multiplying power density value and the value of exposure duration per work day.

An example of EMF Russian hygienic norms for cellular phones is 0.1 mW/cm2 (Rospotrebnadzor of the Russian Federation, 2003). The study directed to
EMF rating of cellular phones included examination of cardiovascular and nervous systems of cellular phone users before and after a short-term call of 30 min. The study was also meant to find out intensity-time correlation of EMF biological effects with NMT and GSM systems that were studied at 450, 900 and 1800 MHz carrier frequencies with modulations. Also, comput ersimulation of EMF absorption in biological objects (rats) was performed.

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Mobile phone use during pregnancy with birth weight: Kumamoto of Japan Environment and Children's Study

Lu X, Oda M, Ohba T, Mitsubuchi H, Masuda S, Katoh T. Association of excessive mobile phone use during pregnancy with birth weight: an adjunct study in Kumamoto of Japan Environment and Children's Study. Environ Health Prev Med. 2017 Jun 8;22(1):52. doi: 10.1186/s12199-017-0656-1.

Abstract

BACKGROUND: Low birth weight has been shown to be closely associated with neonatal mortality and morbidity, inhibited growth, poor cognitive development, and chronic diseases later in life. Some studies have also shown that excessive mobile phone use in the postnatal period may lead to behavioral complications in

the children during their growing years; however, the relationship between mobile phone use during pregnancy and neonatal birth weight is not clear. The aim of the present study was to determine the associations of excessive mobile phone use with neonatal birth weight and infant hea lth status.

METHODS: A sample of 461 mother and child pairs participated in a survey on maternal characteristics, infant characteristics, and maternal mobile phone usage information during pregnancy.

RESULTS: Our results showed that pregnant women tend to excessively use mobile phones in Japan. The mean infant birth weight was lower in the excessive use group than in the ordinary use group, and the frequency of infant emergency transport was significantly higher in the excessive use group than in the ordinary use group.

CONCLUSIONS: Excessive mobile phone use during pregnancy may be a risk factor for lower birth weight and a high rate of infant emergency transport.

Open access paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5664573/

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RF exposure assessment of baby surveillance devices in the frequency range 400 MHz-2.45 GHz

Vermeeren G, Joseph W, Martens L. Radiofrequency exposure assessment of baby surveillance devices in the frequency range 400 MHz-2.45 GHz. Bioelectromagnetics. 2018 Apr;39(3):244-248. doi: 10.1002/bem.22113.

No abstract

Excerpts

We investigated the exposure, in terms of both the peak spatial-averaged specific absorption rate (SAR) in 10 g of tissue and the time-averaged root-mean-squared (RMS) electric (E) field, induced by baby monitors operating in a frequency range between 400 MHz and 2.45 GHz. We selected nine commercially available baby monitors ...

Considering all investigated devices, the peak spatial SAR in 10 g ranged from 0.09 to 0.37 W/kg, which is 22.3–5.4 times below the ICNIRP basic restriction.

In summary, we measured the induced time-averaged root-mean-square electric field strength and the peak spatial-averaged specific absorption rate from the baby unit of nine commercially available devices and compared both with the ICNIRP guidelines. The communication technologies implemented in the baby monitors were: PMR446, continuous transmission at 864 MHz, DECT, and communication in the ISM band at 2450 MHz. The electric field was measured at a distance of 50 cm from the baby unit of the baby monitor. We measured the SAR in a flat phantom filled with head tissue simulating liquid and the baby unit touching the flat phantom. The maximum time-averaged root-mean-square electric field value closest to the ICNIRP reference level over all investigated devices was 1.51 V/m (for modern-electronics DBS 3), which is 19.4 times below the ICNIRP reference level at 466 MHz. The peak spatial-averaged SAR in 10 g of tissue was 0.37 W/kg in head simulating tissue (for Alecto-DBX-82), which is 5.4 times below the basic restriction of 2 W/kg as specified by ICNIRP.

https://www.ncbi.nlm.nih.gov/pubmed/29492985

Note: The ICNIRP guidelines were designed to protect users only from short-term thermal effects.

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Heart rate variability affected by RF EMF in adolescent students

Misek J, Belyaev I, Jakusova V, Tonhajzerova I, Barabas J, Jakus J. Heart rate variability affected by radiofrequency electromagnetic field in adolescent students. Bioelectromagnetics. 2018 Feb 22. doi: 10.1002/bem.22115.

Abstract

This study examines the possible effect of radiofrequency (RF) electromagnetic fields (EMF) on the autonomic nervous system (ANS). The effect of RF EMF on ANS activity was studied by measuring heart rate variability (HRV) during ortho-clinostatic test (i.e., transition from lying to standing and back) in 46 healthy grammar school students. A 1788 MHz pulsed wave with intensity of 54 ± 1.6 V/m was applied intermittently for 18 min in each trial. Maximum specific absorption rate (SAR10) value was determined to 0.405 W/kg. We also measured the respiration rate and estimated a subjective perception of EMF exposure. RF exposure decreased heart rate of subjects in a lying position, while no such change was seen in standing students. After exposure while lying, a rise in high frequency band of HRV and root Mean Square of the Successive Differences was observed, which indicated an increase in parasympathetic nerve activity. Tympanic temperature and skin temperature were measured showing no heating under RF exposure. No RF effect on respiration rate was observed. None of the tested subjects were able to distinguish real exposure from sham exposure when queried at the end of the trial. In conclusion, short-term RF EMF exposure of students in a lying position during the ortho-clinostatic test affected ANS with significant increase in parasympathetic nerve activity compared to sham exposed group.

https://www.ncbi.nlm.nih.gov/pubmed/29469164

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Estimates of Environmental Exposure to RF EMF and Risk of Lymphoma Subtypes

G. Satta, N. Mascia, T. Serra, A. Salis, L. Saba, S. Sanna, M. G. Zucca, E. Angelucci, A. Gabbas, F. Culurgioni, P. Pili, E. Mura, M. Cappai, M. G. Ennas, and P. Cocco (2018) Estimates of Environmental Exposure to Radiofrequency Electromagnetic Fields and Risk of Lymphoma Subtypes. Radiation Research In-Press. https://doi.org/10.1667/RR14952.1

We investigated the association between environmental exposure to radiofrequency electromagnetic fields (RF-EMF) and risk of lymphoma subtypes in a case-control study comprised of 322 patients and 444 individuals serving as controls in Sardinia, Italy in 1998–2004. Questionnaire information included the self-reported distance of the three longest held residential addresses from fixed radio-television transmitters and mobile phone base stations. We georeferenced the residential addresses of all study subjects and obtained the spatial coordinates of mobile phone base stations. For each address within a 500-meter radius from a mobile phone base station, we estimated the RF-EMF intensity using predictions from spatial models, and we performed RF-EMF measurements at the door in the subset of the longest held addresses within a 250-meter radius. We calculated risk of lymphoma and its major subtypes associated with the RF-EMF exposure metrics

with unconditional logistic regression, adjusting by age, gender and years of education. In the analysis of self-reported data, risk associated with residence in proximity (within 50 meters) to fixed radio-television transmitters was likewise elevated for lymphoma overall [odds ratio = 2.7, 95% confidence interval = 1.5–4.6], and for the major lymphoma subtypes. With reference to mobile phone base stations, we did not observe an association with either the self-reported, or the geocoded distance from mobile phone base stations. RF-EMF measurements did not vary by case-control status. By comparing the self-reports to the geocoded data, we discovered that the cases tended to underestimate the distance from mobile phone base stations differentially from the controls (P = 0.073). The interpretation of our findings is compromised by the limited study size, particularly in the analysis of the individual lymphoma subtypes, and the unavailability of the spatial coordinates of radio-television transmitters. Nonetheless, our results do not support the hypothesis of a link between environmental exposure to RF-EMF from mobile phone base stations and risk of lymphoma subtypes.

https://www.ncbi.nlm.nih.gov/pubmed/29547352

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Analysis of ear side of mobile phone use in the general population of Japan

Sato Y, Kojimahara N, Taki M, Yamaguchi N. Analysis of ear side of mobile phone use in the general population of Japan.Bioelectromagnetics. 2018 Jan;39(1):53-59. doi: 10.1002/bem.22098.

Abstract

This study aimed to clarify the distribution of the ear side of mobile phone use in the general population of Japan and clarify what factors are associated with the ear side of mobile phone use. Children at elementary and junior high schools (n = 2,518) and adults aged ≥20 years (n = 1,529) completed an Internet-based survey. Data were subjected to a logistic regression analysis. In children, due to the tendency to use the dominant hand, we analyzed the factors associated with the use of right ear in right-handed people. Statistically significant differences were observed only in talk time per call (odds ratio (OR) = 2.17; 95% confidence interval (CI): 1.22-3.99). In adults, due to the tendency to use the left ear, we analyzed factors associated with the use of left ear in right-handed people. Significant differences were observed in those aged 30-39 years (OR = 2.55; 95% CI: 1.79-3.68), those aged 40-49 years (OR = 3.08; 95% CI: 2.15-4.43), those aged >50 years (OR = 1.85; 95% CI: 1.20-2.85), and in those with a percentage of total talk time when using mobile phones at work of 51-100% (OR = 1.75; 95% CI: 1.21-2.55). We believe that future epidemiological studies on mobile phone use can be improved by considering the trends in mobile phone use identified in this study

https://www.ncbi.nlm.nih.gov/pubmed/29171064

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Mathematical Structure for EMF that May Reflect Pilot Waves of Bohm's Implicate Order

Geesink, H.J.H. and Meijer, D.K.F. Mathematical Structure for Electromagnetic Frequencies that May Reflect Pilot Waves of Bohm's Implicate Order. Journal of Modern Physics, 9, 851-897. 2018.

Abstract

The mathematical basis for the earlier reported spectrum of discrete electromagnetic field (EMF) frequencies that were shown to affect health and disease is substantiated and generalized in the present paper. The particular EMF pattern was revealed by a meta-analysis of, now, more than 500 biomedical publications that reported life-sustaining as well as life-decaying EMF frequencies. These discrete eigenfrequency values can be related to supposed bio-resonance of solitons or polaron quasi particles in life systems. Bio-solitons are conceived as self-reinforcing solitary waves that are constituting local fields, being involved in intracellular geometric ordering and patterning, as well as in intra- and inter-cellular signalling. Literature search, revealed very similar frequency patterns for wave resonances of nucleotides in aqueous so-lution, for a candidate RNA-catalyst, as well as for sound-induced vibrations evoked in thin vibrating membranes. This collective evidence points at a gen-eralized biophysical algorithm underlying complexity in nature, evidently manifest in both animate and non-animate modalities. The detected EMF eigenfrequencies could be arithmetically scaled according to an adapted Pythagorean tuning. The mathematical analysis shows that the derived arithmetical scale exhibits a sequence of unique products of integer powers of 2, 3 and a factor 2. This generalized semi-harmonic frequency spectrum may reflect a discrete pilot-wave structure that can be interpreted as a, so called, hidden variable in Bohm's causal interpretation of quantum field theory.

https://doi.org/10.4236/jmp.2018.95055

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RF EMR and Memory Performance: Sources of Uncertainty in Epidemiological Cohort Studies

Brzozek C, Benke KK, Zeleke BM, Abramson MJ, Benke G.Radiofrequency Electromagnetic Radiation and Memory Performance: Sources of Uncertainty in Epidemiological Cohort Studies. Int J Environ Res Public Health. 2018 Mar 26;15(4). pii: E592. doi: 10.3390/ijerph15040592.

Abstract

Uncertainty in experimental studies of exposure to radiation from mobile phones has in the past only been framed within the context of statistical variability. It is now becoming more apparent to researchers that epistemic or reducible uncertainties can also affect the total error in results. These uncertainties are derived from a wide range of sources including human error, such as data transcription, model structure, measurement and linguistic errors in communication. The issue of epistemic uncertainty is reviewed and interpreted in the context of the MoRPhEUS, ExPOSURE and HERMES cohort studies which investigate the effect of radiofrequency electromagnetic radiation from mobile phones on memory performance. Research into this field has found inconsistent results due to limitations from a range of epistemic sources. Potential analytic approaches are suggested based on quantification of epistemic error using Monte Carlo simulation. It is recommended that future studies investigating the relationship between radiofrequency electromagnetic radiation and memory performance pay more attention to treatment of epistemic uncertainties as well as further research into improving exposure assessment. Use of directed acyclic graphs is also encouraged to display the assumed covariate relationship.

Open access paper: http://www.mdpi.com/1660-4601/15/4/592/htm

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Mobile phone specific EMF induce transient DNA damage and nucleotide excision repair in serum-

deprived human glioblastoma cells

Halh Al-Serori, Franziska Ferk, Michael Kundi, Andrea Bileck, Christopher Gerner, Miroslav Mišík, Armen Nersesyan, Monika Waldherr, Manuel Murbach, Tamara T. Lah, Christel Herold-Mende, Andrew R. Collins, Siegfried Knasmülle. Mobile phone specific electromagnetic fields induce transient DNA damage and nucleotide excision repair in serum-deprived human glioblastoma cells. PLOS One. April 12, 2018. https://doi.org/10.1371/journal.pone.0193677

Abstract

Some epidemiological studies indicate that the use of mobile phones causes cancer in humans (in particular glioblastomas). It is known that DNA damage plays a key role in malignant transformation; therefore, we investigated the impact of the UMTS signal which is widely used in mobile telecommunications, on DNA stability in ten different human cell lines (six brain derived cell lines, lymphocytes, fibroblasts, liver and buccal tissue derived cells) under conditions relevant for users (SAR 0.25 to 1.00 W/kg). We found no evidence for induction of damage in single cell gel electrophoresis assays when the cells were cultivated with serum. However, clear positive effects were seen in a p53 proficient glioblastoma line (U87) when the cells were grown under serum free conditions, while no effects were found in p53 deficient glioblastoma cells (U251). Further experiments showed that the damage disappears rapidly in U87 and that exposure induced nucleotide excision repair (NER) and does not cause double strand breaks (DSBs). The observation of NER induction is supported by results of a proteome analysis indicating that several proteins involved in NER are up-regulated after exposure to UMTS; additionally, we found limited evidence for the activation of the γ-interferon pathway. The present findings show that the signal causes transient genetic instability in glioma derived cells and activates cellular defense systems.

Open access paper: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0193677#sec027

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Effect of electromagnetic waves from mobile phones on spermatogenesis in the era of 4G-LTE

Oh JJ, Byun S, Lee SE, Choe G, Hong SK. Effect of electromagnetic waves from mobile phones on spermatogenesis in the era of 4G-LTE. BioMed Research International. Vol 2018 (2018), Article ID 1801798.

Abstract

Objective. To investigate the effect of long duration exposure to electromagnetic field from mobile phones on spermatogenesis in rats using 4G-LTE.

Methods. Twenty Sprague-Dawley male rats were placed into 4 groups according to the intensity and exposure duration: Group 1 (sham procedure), Group 2 (3 cm distance + 6 h exposure daily), Group 3 (10 cm distance + 18 h exposure daily), and Group 4 (3 cm distance + 18 h exposure daily). After 1 month, we compared sperm parameters and histopathological findings of the testis.

Results.The mean spermatid count (×106/ml) was 398.6 in Group 1, 365.40 in Group 2, 354.60 in Group 3, and 298.60in Group 4 (p = 0.041). In the second review, the mean count of spermatogonia in Group 4 (43.00) was significantly lower than in Group 1 (57.00) and Group 2 (53.40) (p < 0.001 and p = 0.010, resp.). The sum

of the germ cell counts was decreased in Group 4 compared to Groups 1, 2, and 3 (p = 0.032). The mean Leydig cell count was significantly decreased in Group 4 (p < 0.001).

Conclusions.The longer exposure duration of electromagnetic field decreased the spermatogenesis. Our findings warrant further investigations on the potential effects of EMF from mobile phones on male fertility.

https://www.hindawi.com/journals/bmri/2018/1801798/

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1800 MHz mobile phone radiation induced oxidative and nitrosative stress leads to p53 dependent Bax mediated testicular apoptosis in mice

Shahin S, Singh SP, Chaturvedi CM. 1800 MHz mobile phone irradiation induced oxidative and nitrosative stress leads to p53 dependent Bax mediated testicular apoptosis in mice, Mus musculus. J Cell Physiol. 2018 Apr 10. doi: 10.1002/jcp.26558.

Abstract

Present study was carried out to investigate the effect of long-term mobile phone radiation exposure in different operative modes (Dialing, Receiving, and Stand-by) on immature male mice. Three-week old male mice were exposed to mobile phone (1800 MHz) radiation for 3 hr/day for 120 days in different operative modes. To check the changes/alteration in testicular histoarchitecture and serum testosterone level, HE staining and ELISA was performed respectively. Further, we have checked the redox status (ROS, NO, MDA level, and antioxidant enzymes: SOD, CAT, and GPx) by biochemical estimation, alteration in the expression of pro-apoptotic proteins (p53 and Bax), active executioner caspase-3, full length/uncleaved PARP-1 (DNA repair enzyme), anti-apoptotic proteins (Bcl-2 and Bcl-xL) in testes by immunofluorescence and cytosolic cytochrome-c by Western blot. Decreased seminiferous tubule diameter, sperm count, and viability along with increased germ cells apoptosis and decreased serum testosterone level, was observed in the testes of all the mobile phone exposed mice compared with control. We also observed that, mobile phone radiation exposure in all the three different operative modes alters the testicular redox status via increasing ROS, NO, and MDA level, and decreasing antioxidant enzymes levels leading to enhanced apoptosis of testicular cells by increasing the expression of pro-apoptotic and apoptotic proteins along with decreasing the expression of anti-apoptotic protein. On the basis of results, it is concluded that long-term mobile phone radiation exposure induced oxidative stress leads to apoptosis of testicular cells and thus impairs testicular function.

https://www.ncbi.nlm.nih.gov/pubmed/29637556

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Oxidative stress and an animal neurotransmitter synthesizing enzyme in the leaves of wild growing myrtle after exposure to GSM radiation

Stefi AL, Copoulou DV, Margaritis LH, Christodoulakis NS. Oxidative stress and an animal neurotransmitter synthesizing enzyme in the leaves of wild growing myrtle after exposure to GSM radiation. Flora. Available online 16 April 2018. https://doi.org/10.1016/j.flora.2018.04.006

Highlights

• Mature myrtle plants were exposed to GSM radiation for 30 min, at 48 h intervals, for 50 days.
• Secondary metabolite accumulation was observed in the exposed leaves.
• Photosynthetic pigment content decreased in the exposed leaves.
• The oxidative stress (ROS) increased in the exposed leaves.
• Significant rise of the DDC level was recorded only in the exposed leaves.

Abstract

Mobile phones turned to be the most common form of public communication. Therefore, life on our planet continues wrapped in a “cloud” of non-ionizing radiations. Myrtus communis L. is an evergreen shrub, common in Mediterranean formations, exposed and adapted to two seasonally separated and qualitatively different environmental stresses. Thus, we considered it important to investigate the response of this tolerant species to emitted GSM non-ionizing radiations and compare it to already available data from thoroughly investigated plant species. Although the leaves of the exposed plants present unaffected tissue arrangement, their mesophyll cells accumulate large amounts of secondary metabolites, their photosynthetic pigments are dramatically reduced, the ROS counted are significantly increased and the presence of DDC, which cannot be detected in the leaves of the control plants, is recorded in high levels. The exposed leaves seem to experience a severe oxidative stress which probably induces DDC expression and the biosynthesis of the neurotransmitter dopamine, the activation of the shikimate pathway and, eventually, the accumulation of secondary metabolites.

https://www.sciencedirect.com/science/article/pii/S0367253018301208

Extremely Low Frequency Fields

Evaluating ELF magnetic fields in the rear seats of electric vehicles

Lin J, Lu M, Wu T, Yang L, Wu T. Evaluating extremely low frequency magnetic fields in the rear seats of the electric vehicles. Radiat Prot Dosimetry. 2018 Mar 23. doi: 10.1093/rpd/ncy048.

Abstract

In the electric vehicles (EVs), children can sit on a safety seat installed in the rear seats. Owing to their smaller physical dimensions, their heads, generally, are closer to the underfloor electrical systems where the magnetic field (MF) exposure is the greatest. In this study, the magnetic flux density (B) was measured in the rear seats of 10 different EVs, for different driving sessions. We used the measurement results from different heights corresponding to the locations of the heads of an adult and an infant to calculate the induced electric field (E-field) strength using anatomical human models. The results revealed that measured B fields in the rear seats were far below the reference levels by the International Commission on Non-Ionizing Radiation Protection. Although small children may be exposed to higher MF strength, induced E-field strengths were much lower than that of adults due to their particular physical dimensions.

https://www.ncbi.nlm.nih.gov/pubmed/29584925

Excerpts

Small children and infants sitting in a safety seat at the rear part of the vehicle is a common occurrence.

Children have smaller physical dimensions and, thus, their heads are generally much closer to the car floor, where the MF strength has been reported to be higher due to tire magnetization and the operation of the underfloor electrical systems (6, 7). The matter of children being potentially subject to greater magnetic field exposure may be relevant as leukemia is the most common type of childhood cancer (8). In particular, Ahlbom et al. (9) and Greenland et al. (10) indicated that the exposure to 50 and 60 Hz MF exceeding 0.3–0.4 μT may result in an increased risk for childhood leukemia although a satisfactory causal relationship has not yet been reliably demonstrated. Also, it was reported that a combination of weak, steady and alternating MF could modify the radical concentration, which had the potential to lead to biologically significant changes (11).

... the *B* field values measured at location #4 (floor in from of rear seat) were the highest, followed by values from location #3 (rear seat cushion), #2 (child's head position) and #1 (adult's head position) ($p < 0.012$, $\alpha = 0.05/3 = 0.017$). There was a significant difference between the driving scenarios ($F(3, 117) = 3.72$, $p = 0.013$). The acceleration and deceleration scenarios generated higher *B* fields compared with the stationary and the 40 km/h driving scenarios ($p < 0.01$, $\alpha = 0.05/3 = 0.017$) while no difference was identified between acceleration and deceleration ($p = 0.16$).

... The results demonstrate that the induced *E*-field strength was lower for the infant model compared with that of the adult in terms of both the head and body as a whole.

The infant was reported to have higher electrical conductivity [(29)] but there was no database dedicated to the infant. Furthermore, below 1 MHz, the database was hard to be measured and the uncertainty was large [(30)]. Therefore, we would not include the issue in the study.

Although several SCs on higher frequencies have been observed (can spread to 1.24 kHz), the spectral analysis revealed that the SCs concentrated on bands below 1000 Hz. The EVs under test used aluminum alloy wheel rims, which have low magnetic permeability. However, the steel wire in the reinforcing belts of radial tires pick up magnetic fields from the terrestrial MF. When the tires spin, the magnetized steel wire in the reinforcing belts generates ELF MF usually below 20 Hz, that can exceed 2.0 μT at seat level in the passenger compartment[(6)]. The measurement did not identify the ELF MF by different sources because the purpose of the study was to investigate the realistic exposure scenario for the occupants. To note, degaussing the tires or using the fiberglass belted tires can eliminate this effect and provide the MF results solely introduced by the operation of the electrified system.

ICNIRP proposed guidelines to evaluate the compliance of the non-sinusoidal signal exposure[(3)]. The measurements rendered the maximal *B* field at the level of one-tenth to several μT, far below the reference level of the guidelines (e.g. 200 μT for 20–400 Hz). The similar non-sinusoidal MF signal magnitudes can only account for 6–10% of the reference levels according to the previous reports[(32)]. However, as noted in the Introduction, '… 50 and 60 Hz MF exceeding 0.3–0.4 μT may result in an increased risk for childhood leukemia'. Therefore, it is necessary to measure the MF in the EVs to limit the exposure and for the purpose of epidemiological studies.

In this study, we measured ELF MF in the rear seats of ten types of EVs. The measurements were performed for four different driving scenarios. The measurement results were analyzed to determine the worst-case scenario and those values were used for simulations. We made numerical simulations to compare the induced E-field strength due to the physical difference between children and adults using detailed anatomical models. The results support the contention that the MF in the EVs that we tested was far below the reference levels of the ICNIRP guidelines. Furthermore, our findings show that children would not be more highly exposed compared to adults when taking into consideration of their physical differences. However, the measurement results indicated that further studies should be performed to elucidate the concerns on the incidence of the childhood leukemia for infant and child occupants.

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Occupational ELF-MF exposure and hematolymphopoietic cancers - Swiss National Cohort analysis and updated meta-analysis

Huss A, Spoerri A, Egger M, Kromhout H, Vermeulen R; Swiss National Cohort. Occupational extremely low frequency magnetic fields (ELF-MF) exposure and hematolymphopoietic cancers - Swiss National Cohort analysis and updated meta-analysis. Environ Res. 2018 Mar 24;164:467-474. doi: 10.1016/j.envres.2018.03.022.

Highlights

• ELF-MF exposure may affect specific hematolymphopoietic malignancies rather than “all leukaemia”.
• We evaluated effects of occupational ELF-MF exposure on different types of hematolymphopoietic malignancies.
• We observed increased risks of AML if workers were exposed to higher levels and for a longer period of time.
• Risks were in line with meta-analysed findings of previous studies.

Abstract

PURPOSE: Previous studies have examined risks of leukaemia and selected lymphoid malignancies in workers exposed to extremely low frequency magnetic fields (ELF-MF). Most studies evaluated hematolymphopoietic malignancies as a combined category, but some analyses suggested that effects may be contained to some specific leukaemia or lymphoma subtypes, with inconsistent results.

METHODS: We examined exposure to ELF-MF and mortality 1990-2008 from different types of hematolymphopoietic cancers in the Swiss National Cohort, using a job exposure matrix for occupations recorded at censuses 1990 and 2000. We analysed 3.1 million workers exposed at different levels to ELF-MF: ever-high, only-medium, only-low exposure using Cox proportional hazard models. We evaluated risk of death from acute myeloid leukaemia (AML), chronic myeloid leukaemia, lymphoid leukaemia, diffuse large B-cell lymphomas, follicular lymphoma, Waldenström's macroglobulinemia, multiple myeloma and Hodgkin lymphoma.

RESULTS: Mortality from hematolymphopoietic cancers was not associated with exposure to ELF-MF with the exception of an increase in ever-high exposed men of myeloid leukaemias (HR 1.31, 95% CI 1.02-1.67), and AML (HR 1.26, 95%CI 0.93-1.70). If workers had been high exposed during their vocational training and at both censuses, these HR increased to 2.24 (95%CI 0.91-5.53) and 2.75 (95%CI 1.11-6.83), respectively.

CONCLUSIONS:Our analysis provided no convincing evidence for an increased risk of death from a range of hematolymphopoietic cancers in workers exposed to high or medium levels of ELF magnetic fields. However, we observed an increased risk of acute myeloid leukaemia in workers exposed to high levels for a longer duration. Observed risks are in line with meta-analysed previous reports on ELF-MF exposure and AML risk, with a summary relative risk of 1.21 (95%CI 1.08-1.37).

https://www.ncbi.nlm.nih.gov/pubmed/29587222

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Residential mobility and childhood leukemia

Amoon AT, Oksuzyan S, Crespi CM, Arah OA, Cockburn M, Vergara X, Kheifets L. Residential mobility and childhood leukemia. Environ Res. 2018 Mar 22;164:459-466. doi: 10.1016/j.envres.2018.03.016.

Highlights

• Children who moved were older, had younger mothers, and lower SES.
• Non-movers showed stronger associations with EMF exposures and childhood leukemia.
• Adjustment for variables predicting mobility, save dwelling, did not alter results.
• Mobility does not appear to explain observed links between EMF and leukemia.

Abstract

AIMS: Studies of environmental exposures and childhood leukemia studies do not usually account for residential mobility. Yet, in addition to being a potential risk factor, mobility can induce selection bias, confounding, or measurement error in such studies. Using data collected for California Powerline Study (CAPS), we attempt to disentangle the effect of mobility.

METHODS: We analyzed data from a population-based case-control study of childhood leukemia using cases who were born in California and diagnosed between 1988 and 2008 and birth certificate controls. We used stratified logistic regression, case-only analysis, and propensity-score adjustments to assess predictors of residential mobility between birth and diagnosis, and account for potential confounding due to residential mobility.

RESULTS: Children who moved tended to be older, lived in housing other than single-family homes, had younger mothers and fewer siblings, and were of lower socioeconomic status. Odds ratios for leukemia among non-movers living <50 meters (m) from a 200+ kilovolt line (OR: 1.62; 95% CI: 0.72-3.65) and for calculated fields ≥ 0.4 microTesla (OR: 1.71; 95% CI: 0.65-4.52) were slightly higher than previously reported overall results. Adjustments for propensity scores based on all variables predictive of mobility, including dwelling type, increased odds ratios for leukemia to 2.61 (95% CI: 1.76-3.86) for living < 50 m from a 200 + kilovolt line and to 1.98 (1.11-3.52) for calculated fields. Individual or propensity-score adjustments for all variables, except dwelling type, did not materially change the estimates of power line exposures on childhood leukemia.

CONCLUSION: The residential mobility of childhood leukemia cases varied by several sociodemographic characteristics, but not by the distance to the nearest power line or calculated magnetic fields. Mobility appears to be an unlikely explanation for the associations observed between power lines exposure and childhood leukemia.

Funding: This work was supported by the Electric Power Research Institute. Crespi was also partially supported by the National Cancer Institute at the National Institutes of Health (grant P30 CA16042). Vergara is an employee of the Electric Power Research Institute.

https://www.ncbi.nlm.nih.gov/pubmed/29574256

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Reactive oxygen species mediates 50-Hz magnetic field-induced EGF receptor clustering via acid sphingomyelinase activation

Sun L, Chen L, Bai L, Xia Y, Yang X, Jiang W, Sun W. Reactive oxygen species mediates 50-Hz magnetic field-induced EGF receptor clustering via acid sphingomyelinase activation. Int J Radiat Biol. 2018 Apr 16:1-19. doi: 10.1080/09553002.2018.1466208.

Abstract

PURPOSE: Exposure to extremely low frequency electromagnetic fields (ELF-MFs) could elicit biological effects including carcinogenesis. However, the detailed mechanisms by which these ELF-MFs interact with biological system are currently unclear. Previously, we found that a 50-Hz magnetic field (MF) exposure could induce epidermal growth factor receptor (EGFR) clustering and phosphorylation on cell membranes. In the present experiment, the possible roles of reactive oxygen species (ROS) in MF-induced EGFR clustering were investigated.

MATERIALS AND METHODS: Human amnion epithelial (FL) cells were exposed to a 50-Hz MF with or without N-acetyl-L-cysteine (NAC) or pyrrolidine dithiocarbamate (PDTC). EGFR clustering on cellular membrane surface was analyzed using confocal microscopy after indirect immunofluorescence staining. The intracellular ROS level and acid sphingomyelinase (ASMase) activity were detected using a reactive oxygen species assay kit and an Amplex® Red Sphingomyelinase Assay Kit, respectively.

RESULTS: Results showed that exposure of FL cells to a 50-Hz MF at 0.4 mT for 15 min significantly enhanced the ROS level, induced EGFR clustering and increased ASMase activity. However, pretreatment with NAC or PDTC, the scavenger of ROS, not only counteracted the effects of a 50-Hz MF on ROS level and AMS activity, but also inhibited the EGFR clustering induced by MF exposure.

CONCLUSION: Based on present and previous data, it suggests that ROS mediates the MF-induced EGFR clustering via ASMase activation.

https://www.ncbi.nlm.nih.gov/pubmed/29659325

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Final results regarding brain & heart tumors in rats exposed from prenatal life until natural death to mobile phone RF (1.8 GHz GSM base station environmental emission)

Falcioni et al (2018). Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission. Environmental Research. 2018 Mar 7. pii: S0013-9351(18)30036-7. doi: 10.1016/j.envres.2018.01.037.

Abstract

Background: In 2011, IARC classified radiofrequency radiation (RFR) as possible human carcinogen (Group 2B). According to IARC, animals studies, as well as epidemiological ones, showed limited evidence of carcinogenicity. In 2016, the NTP published the first results of its long-term bioassays on near field RFR, reporting increased incidence of malignant glial tumors of the brain and heart Schwannoma in rats exposed to GSM – and CDMA –modulated cell phone RFR. The tumors observed in the NTP study are of the type similar

to the ones observed in some epidemiological studies of cell phone users.

Objectives: The Ramazzini Institute (RI) performed a life-span carcinogenic study on Sprague-Dawley rats to evaluate the carcinogenic effects of RFR in the situation of far field, reproducing the environmental exposure to RFR generated by 1.8 GHz GSM antenna of the radio base stations of mobile phone. This is the largest long-term study ever performed in rats on the health effects of RFR, including 2448 animals. In this article, we reported the final results regarding brain and heart tumors.

Methods: Male and female Sprague-Dawley rats were exposed from prenatal life until natural death to a 1.8 GHz GSM far field of 0, 5, 25, 50 V/m with a whole-body exposure for 19 h/day.

Results: A statistically significant increase in the incidence of heart Schwannomas was observed in treated male rats at the highest dose (50 V/m). Furthermore, an increase in the incidence of heart Schwann cells hyperplasia was observed in treated male and female rats at the highest dose (50 V/m), although this was not statistically significant. An increase in the incidence of malignant glial tumors was observed in treated female rats at the highest dose (50 V/m), although not statistically significant.

Conclusions: The RI findings on far field exposure to RFR are consistent with and reinforce the results of the NTP study on near field exposure, as both reported an increase in the incidence of tumors of the brain and heart in RFR-exposed Sprague-Dawley rats. These tumors are of the same histotype of those observed in some epidemiological studies on cell phone users. These experimental studies provide sufficient evidence to call for the reevaluation of IARC conclusions regarding the carcinogenic potential of RFR in humans.

Among male rats, the incidence of heart schwannoma and hyperplasia was 0.7% (3 of 412) in the control group, 1.2% (5/401) in the 5 volts/meter (V/m) group, 1.0% (2/209) in the 25 V/m group, and 3.9% (8/207) in the 50 V/m group. The 50 V/m group had significantly greater incidence than the control group ($p < .02$).

Among male rats, the incidence of glioma and glial cell hyperplasia in the control group was 0.0% (0 of 412), 0.7% (3/401) in the 5 volts/meter (V/m) group, 1.4% (3/209) in the 25 V/m group, and 0.0% (0/207) in the 50 V/m group.

https://www.ncbi.nlm.nih.gov/pubmed/29530389

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Brain tumors: rise in Glioblastoma incidence in England 1995–2015 suggests adverse environmental or lifestyle factor

Alasdair Philips, Denis L. Henshaw, Graham Lamburn, and Michael O'Carroll. Brain tumours: rise in Glioblastoma Multiforme incidence in England 1995–2015 suggests an adverse environmental or lifestyle factor. Journal of Environmental and Public Health, in press.

Highlights

• A clear description of the changing pattern in incidence of brain tumour types
• The study used extensive data from an official and recognised quality source
• The study included histological and morphological information
• The study identified a significant and concerning incidence time trend
• Some evidence is provided to help guide future research into causal mechanisms

Abstract

Objective To investigate detailed trends in malignant brain tumour incidence over a recent time period.

Methods UK Office of National Statistics (ONS) data covering 81,135 ICD10 C71 brain tumours diagnosed in England (1995–2015) were used to calculate incidence rates (ASR) per 100k person–years, age–standardised to the European Standard Population (ESP–2013).

Results We report a sustained and highly statistically significant ASR rise in glioblastoma multiforme (GBM) across all ages. The ASR for GBM more than doubled from 2.4 to 5.0, with annual case numbers rising from 983 to 2531. Overall, this rise is mostly hidden in the overall data by a reduced incidence of lower grade tumours.

Conclusions The rise is of importance for clinical resources and brain tumour aetiology. The rise cannot be fully accounted for by promotion of lower–grade tumours, random chance or improvement in diagnostic techniques as it affects specific areas of the brain and only one type of brain tumour. Despite the large variation in case numbers by age, the percentage rise is similar across the age groups which suggests widespread environmental or lifestyle factors may be responsible.

http://downloads.hindawi.com/journals/jeph/aip/7910754.pdf

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Wi-Fi is an important threat to human health

Pall M.L. Wi-Fi is an important threat to human health. Environmental Research. 164:405-416. 2018.

Abstract

Repeated Wi-Fi studies show that Wi-Fi causes oxidative stress, sperm/testicular damage, neuropsychiatric effects including EEG changes, apoptosis, cellular DNA damage, endocrine changes, and calcium overload. Each of these effects are also caused by exposures to other microwave frequency EMFs, with each such effect being documented in from 10 to 16 reviews. Therefore, each of these seven EMF effects are established effects of Wi-Fi and of other microwave frequency EMFs. Each of these seven is also produced by downstream effects of the main action of such EMFs, voltage-gated calcium channel (VGCC) activation. While VGCC activation via EMF interaction with the VGCC voltage sensor seems to be the predominant mechanism of action of EMFs, other mechanisms appear to have minor roles. Minor roles include activation of other voltage-gated ion channels, calcium cyclotron resonance and the geomagnetic magnetoreception mechanism.

Five properties of non-thermal EMF effects are discussed. These are that pulsed EMFs are, in most cases, more active than are non-pulsed EMFs; artificial EMFs are polarized and such polarized EMFs are much more active than non-polarized EMFs; dose-response curves are non-linear and non-monotone; EMF effects are often cumulative; and EMFs may impact young people more than adults.

These general findings and data presented earlier on Wi-Fi effects were used to assess the Foster and Moulder (F&M) review of Wi-Fi. The F&M study claimed that there were seven important studies of Wi-Fi that each showed no effect. However, none of these were Wi-Fi studies, with each differing from genuine Wi-Fi in three distinct ways. F&M could, at most conclude that there was no statistically significant evidence of an effect. The tiny numbers studied in each of these seven F&M-linked studies show that each of them lack power to make any substantive conclusions.

In conclusion, there are seven repeatedly found Wi-Fi effects which have also been shown to be caused by other similar EMF exposures. Each of the seven should be considered, therefore, as established effects of Wi-Fi.

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

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Favorable and Unfavorable EMF Frequency Patterns in Cancer: Perspectives for Improved Therapy and Prevention

Meijer DKF, Geesink HJH. Favourable and Unfavourable EMF Frequency Patterns in Cancer: Perspectives for Improved Therapy and Prevention. Journal Cancer Therapy. 9(3):188-230. 2018.

Carcinogenesis fits in a frequency pattern of electromagnetic field (EMF) waves, in which a gradual loss of cellular organization occurs. Such generation of cancer features can be inhibited by adequate exposure to coherent electromagnetic frequencies. However, cancer can also be initiated and promoted at other distinct frequencies of electromagnetic waves. Both observations were revealed by analyzing 100 different EMF frequency data reported in a meta-analyses of 123 different, earlier published, biomedical studies. The studied EM frequencies showed a fractal pattern of 12 beneficial (anti-cancer) frequencies, and 12 detrimental (cancer promoting) frequencies, that form the central pattern of a much wider self-similar EMF spectrum of cancer inhibiting or promoting activities. Inhibiting of the cancer process, and even curing of the disease, can thus be considered through exposure to the coherent type of EM fields. Stabilization of the disease can be understood by constructive resonance of macromolecules in the cancer cell with the externally appied coherent EMF field frequencies, called solitons/polarons. The latter, for instance, have been shown earlier to induce repair in DNA/RNA conformation and/or epigenetic changes. The field of EMF treatment of cancer disorders is rapidly expanding and our studies may invite further experimental and clinical studies in which systematically various potential EMF treatment protocols could be applied, with combined and modulated frequencies, to obtain even more efficient EMF anti-cancer therapies.

Open access paper: http://www.scirp.org/journal/PaperInformation.aspx?paperID=82944

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Fatal collision? Are wireless headsets a risk in treating patients?

Cindy Sage & Lennart Hardell (2018): Fatal collision? Are wireless headsets a risk in treating patients?, Electromagnetic Biology and Medicine. Published online Feb 5, 2018. DOI: 10.1080/15368378.2017.1422261

Abstract

Wireless-enabled headsets that connect to the internet can provide remote transcribing of patient examination notes. Audio and video can be captured and transmitted by wireless signals sent from the computer screen in the frame of the glasses. But using wireless glass-type devices can expose the user to a specific absorption rates (SAR) of 1.11–1.46 W/kg of radiofrequency radiation. That RF intensity is as high as or higher than RF emissions of some cell phones. Prolonged use of cell phones used ipsilaterally at the head has been associated with statistically significant increased risk of glioma and acoustic neuroma. Using wireless glasses for extended periods to teach, to perform surgery, or conduct patient exams will expose the medical professional to similar RF exposures which may impair brain performance, cognition and judgment, concentration and attention and increase the risk for brain tumors. The quality of medical care may be compromised by extended use of wireless-embedded devices in health care settings. Both medical professionals and their patients should know the risks of such devices and have a choice about allowing their use during patient exams. Transmission of sensitive patient data over wireless networks may increase the risk of hacking and security breaches leading to losses of private patient medical and financial data that are strictly protected under HIPPA health information privacy laws

http://www.tandfonline.com/doi/full/10.1080/15368378.2017.1422261

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Meeting the imperative to accelerate environmental bioelectromagnetics research

McKee L. Meeting the imperative to accelerate environmental bioelectromagnetics research. Environ Res. 2018 Feb 23;164:100-108. doi: 10.1016/j.envres.2018.01.036

Highlights

Concerns mount about adverse health effects of low-level radiofrequency (RF) radiation.
Bioelectronics and environmental RF effects research both need an omics platform.
Standard bioelectromagnetic data models would advance dosimetry and omics work.
Steps toward developing standards and a shared research platform are proposed.

Abstract

In this article, the author draws on his experience in the world of geospatial information technology standards to suggest a path toward acceleration of bioelectromagnetics science. Many studies show biological effects of extremely low frequency (ELF) and radiofrequency (RF) radiation despite that fact that the radiation is too weak to cause temperature changes in biological features. Considered together in worst case scenarios, such effects, many of which appear to have long latencies, could have potentially disastrous consequences for the health and safety of humans and wildlife. Other studies show no such effects, and in both cases, often there are significant research quality deficits that make it difficult to draw firm conclusions from the data. The progress of bioelectromagnetics science is retarded by a lack of standard data models and experimental protocols that could improve the overall quality of research and make it easier for researchers to benefit from omics-related bioinformatics resources. "Certainty of safety" of wireless devices used in digital communications and remote sensing (radar) is impossible without dosimetry standards that reflect the effects of non-thermal exposures. Electrical signaling in biological systems, a poorly funded research domain, is as biologically important as chemical signaling, a richly funded research domain, and these two types of signaling are inextricably connected. Entreprenuerial scientists pursuing bioelectronic innovations have begun to attract new funding. With appropriate institutional coordination, this new funding could equally benefit those investigating environmental effects of ELF and RF radiation. The author proposes a concerted effort among both bioelectronics technology stakeholders and environmental bioelectromagnetics science researchers to collaborate in developing institutional arrangements and standard data models that would give the science a stronger bioinformatics platform and give researchers better access to omics data. What is proposed here is essentially a bioelectromagnetics omics initiative.

https://www.ncbi.nlm.nih.gov/pubmed/29482182

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The human skin as a sub-THz receiver - Does 5G pose a danger to it or not?

Betzalel N, Ben Ishai P, Feldman Y. The human skin as a sub-THz receiver - Does 5G pose a danger to it or not? Environ Res. 2018 May;163:208-216. doi: 10.1016/j.envres.2018.01.032.

Highlights

• The sweat duct is regarded as a helical antenna in the sub-THz band, reflectance depends on perspiration.
• We outline the background for non-thermal effects based on the structure of sweat ducts.
• We have introduced a realistic skin EM model and found the expected SAR for the 5G standard.

Abstract

In the interaction of microwave radiation and human beings, the skin is traditionally considered as just an absorbing sponge stratum filled with water. In previous works, we showed that this view is flawed when we demonstrated that the coiled portion of the sweat duct in upper skin layer is regarded as a helical antenna in

the sub-THz band. Experimentally we showed that the reflectance of the human skin in the sub-THz region depends on the intensity of perspiration, i.e. sweat duct's conductivity, and correlates with levels of human stress (physical, mental and emotional). Later on, we detected circular dichroism in the reflectance from the skin, a signature of the axial mode of a helical antenna. The full ramifications of what these findings represent in the human condition are still unclear. We also revealed correlation of electrocardiography (ECG) parameters to the sub-THz reflection coefficient of human skin. In a recent work, we developed a unique simulation tool of human skin, taking into account the skin multi-layer structure together with the helical segment of the sweat duct embedded in it. The presence of the sweat duct led to a high specific absorption rate (SAR) of the skin in extremely high frequency band. In this paper, we summarize the physical evidence for this phenomenon and consider its implication for the future exploitation of the electromagnetic spectrum by wireless communication. Starting from July 2016 the US Federal Communications Commission (FCC) has adopted new rules for wireless broadband operations above 24 GHz (5 G). This trend of exploitation is predicted to expand to higher frequencies in the sub-THz region. One must consider the implications of human immersion in the electromagnetic noise, caused by devices working at the very same frequencies as those, to which the sweat duct (as a helical antenna) is most attuned. We are raising a warning flag against the unrestricted use of sub-THz technologies for communication, before the possible consequences for public health are explored.

https://www.ncbi.nlm.nih.gov/pubmed/29459303

Excerpt

The need for high data transmission rates, coupled with advances in semiconductor technology, is pushing the communications industry towards the sub-THz frequency spectrum. While the promises of a glorious future, resplendent with semi-infinite data streaming, may be attractive, there is a price to pay for such luxury. We shall find our cities, workspace and homes awash with 5 G base stations and we shall live though an unprecedented EM smog. The benefits to our society of becoming so wired cannot ignore possible health concerns, as yet unexplored. There is enough evidence to suggest that the combination of the helical sweat duct and wavelengths approaching the dimensions of skin layers could lead to non-thermal biological effects. Such fears should be investigated and these concerns should also effect the definition of standards for the application of 5G communications.

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Effect of cell phone RFR on body temperature in rodents: Pilot studies of NTP’s reverberation chamber exposure system

Wyde ME, Horn TL, Capstick MH, Ladbury JM, Koepke G, Wilson PF, Kissling GE, Stout MD, Kuster N, Melnick RL, Gauger J, Bucher JR, McCormick DL. Effect of cell phone radiofrequency radiation on body temperature in rodents: Pilot studies of the National Toxicology Program's reverberation chamber exposure system. Bioelectromagnetics. 2018 Apr;39(3):190-199. doi: 10.1002/bem.22116.

Abstract

Radiofrequency radiation (RFR) causes heating, which can lead to detrimental biological effects. To characterize the effects of RFR exposure on body temperature in relation to animal size and pregnancy, a series of short-term toxicity studies was conducted in a unique RFR exposure system. Young and old B6C3F1 mice and young, old, and pregnant Harlan Sprague-Dawley rats were exposed to Global System for Mobile Communication (GSM) or Code Division Multiple Access (CDMA) RFR (rats = 900 MHz, mice = 1,900 MHz) at specific absorption rates (SARs) up to 12 W/kg for approximately 9 h a day for 5 days. In general, fewer and less severe increases in body temperature were observed in young than in older rats. SAR-dependent increases in subcutaneous body temperatures were observed at exposures ≥6 W/kg in both modulations. Exposures of ≥10 W/kg GSM or CDMA RFR induced excessive increases in body temperature, leading to mortality. There was also a significant increase in the number of resorptions in pregnant rats at 12 W/kg GSM RFR. In mice, only sporadic increases in body temperature were observed regardless of sex or age when

exposed to GSM or CDMA RFR up to 12 W/kg. These results identified SARs at which measurable RFR-mediated thermal effects occur, and were used in the selection of exposures for subsequent toxicology and carcinogenicity studies.

https://www.ncbi.nlm.nih.gov/pubmed/29537695

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Rats exposed to 2.45 GHz of non-ionizing radiation exhibit behavioral changes with increased brain expression of apoptotic caspase 3

Rini Varghese, Anuradha Majumdar, Girish Kumar, Amit Shukla. Rats exposed to 2.45 GHz of non-ionizing radiation exhibit behavioral changes with increased brain expression of apoptotic caspase 3. Pathophysiology. 25(1):19-30. March 2018. https://doi.org/10.1016/j.pathophys.2017.11.001

Highlights

• The exposure to non-ionizing radiation of 2.45 GHz caused detrimental changes in rat brain leading to learning and memory decline and expression of anxiety behavior.
• The exposure to radiation induced oxidative stress and fall in brain antioxidants.
• The exposure triggered the gene expression of caspase 3.

Abstract

In recent years there has been a tremendous increase in use of Wi-Fi devices along with mobile phones, globally. Wi-Fi devices make use of 2.4 GHz frequency. The present study evaluated the impact of 2.45 GHz radiation exposure for 4 h/day for 45 days on behavioral and oxidative stress parameters in female Sprague Dawley rats. Behavioral tests of anxiety, learning and memory were started from day 38. Oxidative stress parameters were estimated in brain homogenates after sacrificing the rats on day 45. In morris water maze, elevated plus maze and light dark box test, the 2.45 GHz radiation exposed rats elicited memory decline and anxiety behavior. Exposure decreased activities of super oxide dismutase, catalase and reduced glutathione levels whereas increased levels of brain lipid peroxidation was encountered in the radiation exposed rats, showing compromised anti-oxidant defense. Expression of caspase 3 gene in brain samples were quantified which unraveled notable increase in the apoptotic marker caspase 3 in 2.45 GHz radiation exposed group as compared to sham exposed group. No significant changes were observed in histopathological examinations and brain levels of TNF-α. Analysis of dendritic arborization of neurons showcased reduction in number of dendritic branching and intersections which corresponds to alteration in dendritic structure of neurons, affecting neuronal signaling. The study clearly indicates that exposure of rats to microwave radiation of 2.45 GHz leads to detrimental changes in brain leading to lowering of learning and memory and expression of anxiety behavior in rats along with fall in brain antioxidant enzyme systems.

Excerpts

The animals of group 2 were exposed to the 2.45 GHz radiation for 4 h/day for 45 days between 10 am to 6 pm, at a power density of 7.88 W/m^2.

... the radiated power absorbed by the body of rat was calculated to be 0.04728 W.

Conclusion

The study was an attempt to draw attention towards the adverse effects of non-ionizing electromagnetic radiations (NI-EMR) in the frequency that is used widely in the field of telecommunication. Many studies have captured the impact of the 900 MHz and 1800 MHz frequencies, however the frequency of radiation in Wi-Fi range has not been much explored. Along with the use of cell phones there is a growing concern with the use

of Wi-Fi devices which continuously emit radiations in the frequency of 2.4 GHz. Hence we thought it prudent to investigate the impact of radiation of the frequency of 2.45 GHz. It can be concluded that the exposure to non-ionizing radiation of 2.45 GHz caused detrimental changes in rat brain leading to learning and memory decline and expression of anxiety behavior along with fall in brain antioxidants. The exposure triggered the gene expression of caspase 3 which plays a major role in the apoptotic pathway. The chronic impact of non-ionizing radiation needs to be thoroughly evaluated in humans so that combative steps can be taken.

https://www.sciencedirect.com/science/article/pii/S0928468017300524

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Intensity-time dependence dosing criterion in the EMF exposure guidelines in Russia

Rubtsova N, Paltsev Y, Perov S, Bogacheva E. Intensity-time dependence dosing criterion in the EMF exposure guidelines in Russia. Electromagn Biol Med. 2018 Mar 1:1-7. doi: 10.1080/15368378.2017.1414056.

Abstract

Major approaches of the Russian Federation in setting of exposure guidelines to electromagnetic fields (EMF) in occupational and public environments are discussed in this paper. EMF exposure guidelines in Russia are based on the results of hygienic, clinical, physiological, epidemiological and experimental studies and are frequency-dependent. The concept of a threshold principle of occupational and environmental factors due to hazardous exposure effects has been used to set permissible exposure levels of different EMF frequency ranges. The data of experimental studies showed hazardous threshold levels of EMF effects. The main criteria of EMF hazardous exposure evaluated in the experimental study concerned both estimation of threshold levels of chronic (long-term) and acute exposure. Also, this paper contains some recent experimental study data on correlation of long-term radiofrequency and power-frequency EMF exposure effects with regard to time duration, the so-called time-dependence approach. It enables identification of the value of permissible EMF exposure levels depending on exposure duration. This approach is used in occupational exposure guideline setting and requires the introduction of "power exposition" (PE) and "maximal permissible level" (MPL). In general, EMF exposure guidelines are established with regard to possible duration of exposure per day.

https://www.ncbi.nlm.nih.gov/pubmed/29493302

Excerpt

The most important unknown effect is that of concomitant exposure to EMF from different sources.

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Radiofrequency radiation from nearby base stations gives high levels in an apartment in Stockholm, Sweden: A case report

Lennart Hardell, Michael Carlberg, Lena K. Hedendahl. Radiofrequency radiation from nearby base stations gives high levels in an apartment in Stockholm, Sweden: A case report. Oncology Letters. Published online on: March 16, 2018 https://doi.org/10.3892/ol.2018.8285

Abstract

Exposure to radiofrequency (RF) radiation was classified in 2011 as a possible human carcinogen, Group 2B, by the International Agency for Research on Cancer of the World Health Organisation. Evidence of the risk of cancer risk has since strengthened. Exposure is changing due to the rapid development of technology resulting in increased ambient radiation. RF radiation of sufficient intensity heats tissues, but the energy is insufficient to cause ionization, hence it is called non-ionizing radiation. These non-thermal exposure levels have resulted in

biological effects in humans, animals and cells, including an increased cancer risk. In the present study, the levels of RF radiation were measured in an apartment close to two groups of mobile phone base stations on the roof. A total of 74,531 measurements were made corresponding to ~83 h of recording. The total mean RF radiation level was 3,811 µW/m2 (range 15.2-112,318 µW/m2) for the measurement of the whole apartment, including balconies. Particularly high levels were measured on three balconies and 3 of 4 bedrooms. The total mean RF radiation level decreased by 98% when the measured down-links from the base stations for 2, 3 and 4 G were disregarded. The results are discussed in relation to the detrimental health effects of non-thermal RF radiation. Due to the current high RF radiation, the apartment is not suitable for long-term living, particularly for children who may be more sensitive than adults. For a definitive conclusion regarding the effect of RF radiation from nearby base stations, one option would be to turn them off and repeat the measurements. However, the simplest and safest solution would be to turn them off and dismantle them.

Open Access Paper: https://www.spandidos-publications.com/10.3892/ol.2018.8285/abstract

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The effects of microwave radiation on rabbit's retina

Mohammad R. Talebnejad MR,Sadeghi-Sarvestani A, Hossein Nowroozzadeh M, Mortazavi SMJ, Khalili MR.The effects of microwave radiation on rabbit's retina. Journal of Current Ophthalmology. 30(1):74-79. Mar 2018.

Purpose Mobile cell phones are used extensively these days, and their microwave (MW) radiation has been shown to affect the eye. The purpose of the present study was to evaluate the effects of MW radiation on rabbit retina.

Methods This experimental study (concluded in 2015) was conducted on 40 adult white New Zealand rabbits. A Global System for Mobile Communications (GSM) cell phone simulator was used for MW irradiation. The rabbits were randomized into five groups (8 in each) and treated as follows: Group 1: no irradiation (sham); Group 2: irradiation at 10 cm for 1 day; Group 3: irradiation at 30 cm for 1 day; Group 4: irradiation at 10 cm for 3 days; and Group 5: irradiation at 30 cm for 3 days. Scotopic and photopic electroretinography (ERG) responses were obtained at baseline and 7 days after the last exposure. Then all the rabbits were euthanized, and their eyes were enucleated and sent for pathology examination. Kruskal–Wallis and Chi-Square tests were used to evaluate intergroup differences in ERG parameters and histological findings, respectively.

Results ERG responses obtained 7 days after irradiation did not show any statistically significant difference between the groups ($P > 0.1$, for all tested parameters). There were statistically non-significant trends toward greater changes in the MW irradiated eyes. In pathological examination, retina was normal with no sign of degeneration or infiltration. Ciliary body congestion was observed in greater fraction of those who received higher MW doses. ($P = 0.005$).

Conclusions Histopathologically, cell phone simulated MW irradiation had no significant detrimental effect on the retina. However, ciliary body congestion was observed in greater fraction of those who received higher MW doses. Although there was no significant difference between post-treatment mean ERG values, there were statistically non-significant trends toward greater changes in the MW irradiated eyes.

https://ac.els-cdn.com/S2452232517300562/1-s2.0-S2452232517300562-main.pdf?_tid=4249e90b-438f-43f4-b681-a67c72fb8ce7&acdnat=1521759969_87729ccbd7b1a4e21078c03d443000be

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Electromagnetic radiation and behavioural response of ticks: an experimental test

Vargová B, Majláth I, Kurimský J, Cimbala R, Kosterec M, Tryjanowski P, Jankowiak Ł, Raši T, Majláthová V.

Electromagnetic radiation and behavioural response of ticks: an experimental test. Exp Appl Acarol. 2018 Mar 31. doi: 10.1007/s10493-018-0253-z.

Abstract

Factors associated with the increased usage of electronic devices, wireless technologies and mobile phones nowadays are present in increasing amounts in our environment. All living organisms are constantly affected by electromagnetic radiation which causes serious environmental pollution. The distribution and density of ticks in natural habitats is influenced by a complex of abiotic and biotic factors. Exposure to radio-frequency electromagnetic field (RF-EMF) constitutes a potential cause altering the presence and distribution of ticks in the environment. Our main objective was to determine the affinity of Dermacentor reticulatus ticks towards RF-EMF exposure. Originally designed and constructed radiation-shielded tube (RST) test was used to test the affinity of ticks under controlled laboratory conditions. All test were performed in an electromagnetic compatibility laboratory in an anechoic chamber. Ticks were irradiated using a Double-Ridged Waveguide Horn Antenna to RF-EMF at 900 and 5000 MHz, 0 MHz was used as control. The RF-EMF exposure to 900 MHz induced a higher concentration of ticks on irradiated arm of RST as opposed to the RF-EMF at 5000 MHz, which caused an escape of ticks to the shielded arm. This study represents the first experimental evidence of RF-EMF preference in D. reticulatus. The projection of obtained results to the natural environment could help assess the risk of tick borne diseases and could be a tool of preventive medicine.

https://www.ncbi.nlm.nih.gov/pubmed/29605834

Excerpts

The results of testing D. reticulatus ticks in RST multi tubes revealed that ticks are attracted significantly more to a frequency of 900 MHz RF-EMF frequency in comparison to control or 5000 MHz RF-EMF frequency. Lázaro et al. (2016) found similar phenomenon in wild bees and bee flies which were attracted by the source of artificial EMF exposure in natural habitat (Lázaro et al. 2016). However, the exposure to 900 MHz FR-EMF radiation on D. reticulatusc showed specific behavioural response of ticks, the reaction was presented by unusual specific sudden movements during the RF-EMF exposition, which was described as a body jerking or leg jerking (Vargová et al. 2017).

According to our laboratory findings, we hypothesize that RF-EMF radiation could influence the distribution of ticks in the natural habitats. The RF-EMF radiation of various frequencies can be, besides humidity, temperature or host presence, one of the factors causing non-homogenous or rather mosaic distribution of ticks in the natural habitats.

We confirmed the extraordinary preference and active movement of D. reticulatus ticks towards the electromagnetic field from the radio wave spectrum of 900 MHz frequency. This RF-EMF tick preference may point to a new phenomenon with possibly important ecological and epidemiological consequences. Increasing electromagnetic waves by using personal electronic devices in natural habitats where ticks occur could increase the risk tick infestation and diseases transmission. Further studies should be undertaken to support this hypothesis, which analyse the impact of RF-EMF directly in the natural habitats of ticks.

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Effect of Ginkgo biloba on hippocampus of rats exposed to long-term cellphone radiation

Gevrek, F. Histopathological, immunohistochemical, and stereological analysis of the effect of Ginkgo biloba (Egb761) on the hippocampus of rats exposed to long-term cellphone radiation. Histology and Histopathology. 33(5):463-473. May 2018. DOI: 10.14670/HH-11-943

Abstract

Cellular phones are major sources of electromagnetic radiation (EMR) that can penetrate the human body and pose serious health hazards. The increasingly widespread use of mobile communication systems has raised concerns about the effects of cellphone radiofrequency (RF) on the hippocampus because of its close proximity to radiation during cellphone use. The effects of cellphone EMR exposure on the hippocampus of rats and the possible counteractive effects of Ginkgo biloba (Egb761) were aimed to investigate. Rats were divided into three groups: Control, EMR, and EMR+Egb761. The EMR and EMR+Egb761 groups were exposed to cellphone EMR for one month. Egb761 was also administered to the EMR+Egb761 group. Specifically, we evaluated the effect of RF exposure on rat hippocampi at harmful EMR levels (0.96 W/kg specific absorption rate [SAR]) for one month and also investigated the possible impact of Egb761 using stereological, TUNEL-staining, and immunohistochemical methods. An increase in apoptotic proteins (Bax, Acas-3) and a decrease in anti-apoptotic protein (Bcl-2) immuno-reactivity along with a decrease in the total granule and pyramidal cell count were noted in the EMR group. A decrease in Bax and Acas-3 and an increase in Bcl-2 immunoreactivity were observed in rats treated with Egb761 in addition to a decrease in TUNEL-stained apoptotic cells and a higher total viable cell number. In conclusion, chronic cellphone EMR exposure may affect hippocampal cell viability, and Egb761 may be used to mitigate some of the deleterious effects.

https://www.ncbi.nlm.nih.gov/pubmed/29120031

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Genotoxicity and genomic instability in rat primary astrocytes exposed to 872 MHz RF and chemicals

Herrala M, Mustafa E, Naarala J, Juutilainen J. Assessment of genotoxicity and genomic in stability in rat primary astrocytes exposed to 872 MHz radiofrequency radiation and chemicals. International journal of radiation biology. Epub 2018 Mar 23. DOI:10.1080/09553002.2018.1450534

Abstract

PURPOSE: We examined genotoxicity, co-genotoxicity and induced genomic instability (IGI) in primary astrocytes exposed to radiofrequency (RF) radiation.

MATERIALS AND METHODS: Rat primary astrocytes were exposed to 872MHz GSM-modulated or continuous wave (CW) RF radiation at specific absorption rates of 0.6 or 6.0 W/kg for 24h. Menadione (MQ) and methyl methanesulfonate (MMS; only in genotoxicity experiments) were used as co-exposures. Alkaline Comet assay and flow cytometric micronucleus scoring were used to detect genetic damage.

RESULTS: No IGI was observed from RF radiation alone or combined treatment with MQ. RF radiation alone was not genotoxic. RF radiation combined with chemical exposure showed some statistically significant differences: increased DNA damage at 6.0 W/kg but decreased DNA damage at 0.6 W/kg in cells exposed to GSM-modulated RF radiation and MQ, and increased micronucleus frequency in cells exposed to CW RF radiation at 0.6 W/kg and MMS.

CONCLUSIONS: Exposure to GSM modulated RF radiation at levels up to 6.0 W/kg did not induce or enhance genomic instability in rat primary astrocytes. Lack of genotoxicity from RF radiation alone was convincingly shown in multiple experiments. Co-genotoxicity of RF radiation and genotoxic chemicals was not consistently supported by the results.

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Exposure of Insects to RF EMF from 2 to 120 GHz

Thielens A, Bell D, Mortimore DB, Greco MK, Martens L, Joseph W. Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz. Scientific Reports. 8:3924. Mar 2, 2018. DOI: 10.1038/s41598-018-

22271-3

Abstract

Insects are continually exposed to Radio-Frequency (RF) electromagnetic fields at different frequencies. The range of frequencies used for wireless telecommunication systems will increase in the near future from below 6 GHz (2 G, 3 G, 4 G, and WiFi) to frequencies up to 120 GHz (5 G). This paper is the first to report the absorbed RF electromagnetic power in four different types of insects as a function of frequency from 2 GHz to 120 GHz. A set of insect models was obtained using novel Micro-CT (computer tomography) imaging. These models were used for the first time in finite-difference time-domain electromagnetic simulations. All insects showed a dependence of the absorbed power on the frequency. All insects showed a general increase in absorbed RF power at and above 6 GHz, in comparison to the absorbed RF power below 6 GHz. Our simulations showed that a shift of 10% of the incident power density to frequencies above 6 GHz would lead to an increase in absorbed power between 3-370%

Excerpt

Figure 4 illustrates the frequency dependence of the absorption of RF-EMFs in the Western Honeybee in terms of the ratio of the electric field strength inside the insect to the maximum electric field in the simulation domain. At the currently used frequencies for telecommunication (<6 GHz), the wavelength is relatively large compared to the insects and the waves do not penetrate into the insects, which results in lower Pabs values. At 12–24 GHz, the fields penetrate more and more into the insect as the wavelength becomes comparable to the insects' size and the conductivity increases as well. At the highest studied frequencies, the fields penetrate less deep into the insect, but their amplitude is higher, resulting in a similar or slightly lower P_{abs}.

Figure 5 shows the P_{abs} linearly averaged over all twelve plane waves as a function of frequency for all studied insects. The absorbed power increases with increasing frequency from 2–6 GHz for all insects under exposure at a constant incident power density or incident electric field strength of 1 V/m...

The three smaller insects show their maximum at a frequency higher than 6 GHz: 60 GHz, 24 GHz, and 12 GHz for the Australian Stingless Bee, the Beetle, and the Honey Bee, respectively....

We investigated the absorbed radio-frequency electromagnetic power in four different real insects as a function of frequency from 2–120 GHz. Micro-CT imaging was used to obtain realistic models of real insects. These models were assigned dielectric parameters obtained from literature and used in finite-difference time-domain simulations. All insects show a dependence of the absorbed power on the frequency with a peak frequency that depends on their size and dielectric properties. The insects show a maximum in absorbed radio frequency power at wavelengths that are comparable to their body size. They show a general increase in absorbed radio-frequency power above 6 GHz (until the frequencies where the wavelengths are comparable to their body size), which indicates that if the used power densities do not decrease, but shift (partly) to higher frequencies, the absorption in the studied insects will increase as well. A shift of 10% of the incident power density to frequencies above 6 GHz would lead to an increase in absorbed power between 3–370%. This could lead to changes in insect behaviour, physiology, and morphology over time due to an increase in body temperatures, from dielectric heating. The studied insects that are smaller than 1 cm show a peak in absorption at frequencies (above 6 GHz), which are currently not often used for telecommunication, but are planned to be used in the next generation of wireless telecommunication systems. At frequencies above the peak frequency (smaller wavelengths) the absorbed power decreases slightly.

Open access paper: https://www.nature.com/articles/s41598-018-22271-3

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Results of lifespan exposure to ELF EMF administered alone to Sprague Dawley rats

L. Bua, E. Tibaldi, L. Falcioni, M. Lauriola, L. De Angelis, F. Gnudi, M. Manservigi, F. Manservisi, I. Manzoli, I. Menghetti, R. Montella, S. Panzacchi, D. Sgargi, V. Strollo, A. Vornoli, D. Mandrioli, Results of lifespan exposure to continuous and intermittent extremely low frequency electromagnetic fields (ELFEMF) administered alone to Sprague Dawley rats Environmental Research. 164:271-279. July 2018.

Highlights

• Carcinogenic effects of ELFEMF whole-body chronic exposure were evaluated on rats.
• Exposure to ELFEMF alone does not represent risk factor for neoplastic development.
• ELFEMF might act as a cancer enhancer if co-administered to other known carcinogens.

Abstract

Background Up to now, experimental studies on rodents have failed to provide definitive confirmation of the carcinogenicity of extremely low frequency electromagnetic fields (ELFEMF). Two recent studies performed in our laboratory on Sprague-Dawley rats reported a statistically significant increase in malignant tumors of different sites (mammary gland, C-cells carcinoma, hemolymphoreticular neoplasia, and malignant heart Schwannoma) when ELFEMF exposure was associated with exposure to formaldehyde (50 mg/l) or acute low dose of γ-radiation (0.1 Gy) (Soffritti et al., 2016a) (Soffritti et al., 2016b). The same doses of known carcinogenic agents (50 mg/l formaldehyde, or acute 0.1 Gy γ-radiation), when administered alone, previously failed to induce any statistically significant increase in the incidence of total and specific malignant tumors in rats of the sa me colony.

Objectives A lifespan whole-body exposure study was conducted to evaluate the possible carcinogenic effects of ELFEMF exposure administered alone to Sprague-Dawley rats, as part of the integrated project of the Ramazzini Institute (RI) for studying the effects on health of ELFEMF alone or in combination with other known carcinogens.

Methods Male and female Sprague-Dawley rats were exposed 19 h/day to continuous sinusoidal-50 Hz magnetic fields (S-50 Hz MF) at flux densities of 0 (control group), 2, 20, 100 or 1000μT, and to intermittent (30 min on/30 min off) S-50 Hz MF at 1000 μT, from prenatal life until natural death.

Results Survival and body weight trends in all groups of rats exposed to ELFEMF were comparable to those found in sex-matched controls. The incidence and number of malignant and benign tumors was similar in all groups. Magnetic field exposure did not significantly increase the incidence of neoplasias in any organ, including those sites that have been identified as possible targets in epidemiological studies (leukemia, breast cancer, and brain cancer).

Conclusions Life-span exposures to continuous and intermittent sinusoidal-50 Hz ELFEMFs, when administered alone, did not represent a significant risk factor for neoplastic development in our experimental rat model. In light of our previous results on the carcinogenic effects of ELFEMF in combination with formaldehyde and γ-radiation, further experiments are necessary to elucidate the possible role of ELFEMF as cancer enhancer in presence of other chemical and physical carcinogens.

https://www.sciencedirect.com/science/article/pii/S001393511830104X

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ELF MF and Redox-Responsive Pathways Linked to Cancer Drug Resistance: Insights from Co-Exposure-Based In Vitro Studies

Falone S, Santini S, Cordone V, Di Emidio G, Tatone C, Caachio M, Amicarelli F. Extremely Low-Frequency Magnetic Fields and Redox-Responsive Pathways Linked to Cancer Drug Resistance: Insights from Co-Exposure-Based In Vitro Studies. 23 Feb 2018. https://doi.org/10.3389/fpubh.2018.00033

Electrical devices currently used in clinical practice and common household equipments generate extremely low-frequency magnetic fields (ELF-MF) that were classified by the International Agency for Research on Cancer as “possible carcinogenic.” Assuming that ELF-MF plays a role in the carcinogenic process without inducing direct genomic alterations, ELF-MF may be involved in the promotion or progression of cancers. In particular, ELF-MF-induced responses are suspected to activate redox-responsive intracellular signaling or detoxification scavenging systems. In fact, improved protection against oxidative stress and redox-active xenobiotics is thought to provide critical proliferative and survival advantage in tumors. On this basis, an ever-growing research activity worldwide is attempting to establish whether tumor cells may develop multidrug resistance through the activation of essential cytoprotective networks in the presence of ELF fields, and how this might trigger relevant changes in tumor phenotype. This review builds a framework around how the activity of redox-responsive mediators may be controlled by co-exposure to ELF-MF and reactive oxygen species-generating agents in tumor and cancer cells, in order to clarify whether and how such potential molecular targets could help to minimize or neutralize the functional interaction between ELF-MF and malignancies.

Open Access Paper: https://www.frontiersin.org/articles/10.3389/fpubh.2018.00033/full

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Genotoxic and carcinogenic effects of non-ionizing electromagnetic fields

Kocaman A, Altun G, Kaplan AA, Deniz ÖG, Yurt KK, Kaplan S. Genotoxic and carcinogenic effects of non-ionizing electromagnetic fields.
Environ Res. 2018 Feb 7;163:71-79. doi: 10.1016/j.envres.2018.01.034.

Abstract

New technologies in electronics and communications are continually emerging. An increasing use of these electronic devices such as mobile phone, computer, wireless fidelity connectors or cellular towers is raising questions concerning whether they have an adverse effect on the body. Exposure to electromagnetic fields (EMF) is frequently suggested to have adverse health effects on humans and other organisms. This idea has been reported in many studies. In contrast, the therapeutic effects of EMF on different organs have also been reported. Research findings are inconsistent. This has given rise to very profound discrepancies. The duration and frequency of mobile phone calls and the association observed with various health effects has raised serious concerns due to the frequency with which these devices are used and the way they are held close to the head. The present review assesses the results of in vitro, in vivo, experimental, and epidemiological studies. The purpose of the study is to assess data concerning the carcinogenic and genotoxic effects of non-ionizing EMF. The major genotoxic and carcinogenic effects of EMF, divided into subsections as low frequency effects and radiofrequency effects, were reviewed. The inconsistent results between similar studies and the same research groups have made it very difficult to make any comprehensive interpretation. However, evaluation of current studies suggests that EMF may represent a serious source of concern and may be hazardous to living organisms.

https://www.ncbi.nlm.nih.gov/pubmed/29427953

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Towards 5G communication systems: Are there health implications?

Di Ciaula A. Towards 5G communication systems: Are there health implications? Int J Hyg Environ Health. 2018 Feb 2. pii: S1438-4639(17) 30814-3. doi: 10.1016/j.ijheh.2018.01.011.

Highlights

• RF-EMF exposure is rising and health effects of are still under investigation.
• Both oncologic and non-cancerous chronic effects have been suggested.
• 5G networks could have health effects and will use MMW, still scarcely explored.
• Adequate knowledge of RF-EMF biological effects is also needed in clinical practice.
• Underrating the problem could lead to a further rise in noncommunicable diseases.

Abstract

The spread of radiofrequency electromagnetic fields (RF-EMF) is rising and health effects are still under investigation. RF-EMF promote oxidative stress, a condition involved in cancer onset, in several acute and chronic diseases and in vascular homeostasis. Although some evidences are still controversial, the WHO IARC classified RF-EMF as "possible carcinogenic to humans", and more recent studies suggested reproductive, metabolic and neurologic effects of RF-EMF, which are also able to alter bacterial antibiotic resistance. In this evolving scenario, although the biological effects of 5G communication systems are very scarcely investigated, an international action plan for the development of 5G networks has started, with a forthcoming increment in devices and density of small cells, and with the future use of millimeter waves (MMW). Preliminary observations showed that MMW increase skin temperature, alter gene expression, promote cellular proliferation and synthesis of proteins linked with oxidative stress, inflammatory and metabolic processes, could generate ocular damages, affect neuro-muscular dynamics. Further studies are needed to better and independently explore the health effects of RF-EMF in general and of MMW in particular. However, available findings seem sufficient to demonstrate the existence of biomedical effects, to invoke the precautionary principle, to define exposed subjects as potentially vulnerable and to revise existing limits. An adequate knowledge of pathophysiological mechanisms linking RF-EMF exposure to health risk should also be useful in the current clinical practice, in particular in consideration of evidences pointing to extrinsic factors as heavy contributors to cancer risk and to the progressive epidemiological growth of noncommunicable diseases.

https://www.ncbi.nlm.nih.gov/pubmed/29402696

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RF radiation-related cancer: assessing causation in the occupational/military setting

Peleg M, Nativ O, Richter ED. Radio frequency radiation-related cancer: assessing causation in the occupational/military setting.
Environ Res. 2018 Feb 9;163:123-133. doi: 10.1016/j.envres.2018.01.003.

Abstract

BACKGROUND AND AIM: We reexamine whether radio frequency radiation (RFR) in the occupational and military settings is a human carcinogen.

METHODS: We extended an analysis of an already-reported case series of patients with cancer previously exposed to whole-body prolonged RFR, mainly from communication equipment and radar. We focused on hematolymphatic (HL) cancers. We used analysis by percentage frequency (PF) of a cancer type, which is the proportion of a specific cancer type relative to the total number of cancer cases. We also examined and analyzed the published data on three other cohort studies from similar military settings from different countries.

RESULTS: The PF of HL cancers in the case series was very high, at 40% with only 23% expected for the series age and gender profile, confidence interval CI95%: 26-56%, $p<0.01$, 19 out of 47 patients had HL cancers. We also found high PF for multiple primaries. As for the three other cohort studies: In the Polish military sector, the PF of HL cancers was 36% in the exposed population as compared to 12% in the unexposed population, $p<0.001$. In a small group of employees exposed to RFR in Israeli defense industry, the PF of HL cancers was 60% versus 17% expected for the group age and gender profile, $p<0.05$. In Belgian radar battalions the HL PF was 8.3% versus 1.4% in the control battalions as shown in a causes of deaths

study and HL cancer mortality rate ratio was 7.2 and statistically significant. Similar findings were reported on radio amateurs and Korean war technicians. Elevated risk ratios were previously reported in most of the above studies.

CONCLUSIONS: The consistent association of RFR and highly elevated HL cancer risk in the four groups spread over three countries, operating different RFR equipment types and analyzed by different research protocols, suggests a cause-effect relationship between RFR and HL cancers in military/occupational settings. While complete measurements of RFR exposures were not available and rough exposure assessments from patients interviews and from partial exposure data were used instead, we have demonstrated increased HL cancers in occupational groups with relatively high RFR exposures. Our findings, combined with other studies, indicate that exposures incurred in the military settings evaluated here significantly increased the risk of HL cancers. Accordingly, the RFR military exposures in these occupations should be substantially reduced and further efforts should be undertaken to monitor and measure those exposures and to follow cohorts exposed to RFR for cancers and other health effects. Overall, the epidemiological studies on excess risk for HL and other cancers together with brain tumors in cellphone users and experimental studies on RFR and carcinogenicity make a coherent case for a cause-effect relationship and classifying RFR exposure as a human carcinogen (IARC group 1).

https://www.ncbi.nlm.nih.gov/pubmed/29433020

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Are Exposures to Multiple Frequencies the Key to Future Radiofrequency Research?

Sienkiewicz Z, Calderón C, Broom KA, Addison D, Gavard A, Lundberg L, Maslanyj M. Are Exposures to Multiple Frequencies the Key to Future Radiofrequency Research? Front Public Health. 2017 Dec 8;5:328. doi: 10.3389/fpubh.2017.00328.

Abstract

There is an extensive literature investigating possible effects of exposure to radiofrequency (RF) electromagnetic fields associated with mobile phone technologies. This has not identified any public health risks with any degree of certainty. Some epidemiological studies have observed associations between heavy users of mobile phones and some types of cancer, but animal studies do not support this association, although a few studies have reported increased tumor yields. However, there is a crucial difference between epidemiology studies and laboratory work in terms of signals investigated: most people are exposed to a complex mixture of frequencies and signals at varying intensities, whereas the majority of animal studies have been performed using a single frequency or intensity. Whether this might explain the differences in outcome will be discussed, and whether there is a need for additional laboratory investigations that reproduce more accurately realistic exposure conditions will be considered.

Open Access Paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5727023/

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On the effects of glasses on the SAR in human head resulting from wireless eyewear devices at phone call state

Lan JQ, Liang X, Hong T, Du GH. On the effects of glasses on the SAR in human head resulting from wireless eyewear devices at phone call state. Prog Biophys Mol Biol. 2018 Feb 8. pii: S0079-6107(17)30082-2. doi: 10.1016/j.pbiomolbio.2018.02.001.

Abstract

This paper evaluates the effects of glasses on the specific absorption rates (SAR) in the human head resulting from wireless eyewear device at phone call state. We mainly concentrate on the SAR in the eyes since their sensitivity to electromagnetic fields (EMF). We find wearing glasses obviously alters the distribution and magnitude of the SAR. The maximal SAR in the ocular tissues with glasses is even 6 times more than that without glasses. Wearing glasses also induce the new hotspot in the eyes which may cause the biggest SAR increment in the ocular tissues. Moreover, calculated results indicate that the maximal SAR is sensitive to the size of glasses and radiation frequency. Because of this, we believe wearing glasses may possibly increase the risk of health hazard to eyes of wireless eyewear device user. These calculated results could be a valuable reference for the glasses designer to reduce the SAR in the eyes.

https://www.ncbi.nlm.nih.gov/pubmed/29428220

Conclusions

Based on the calculated results, we find wearing glasses obviously alters the distribution and magnitude of SAR. The maximal SAR in the ocular tissues with glasses is even 6 times more than that without glasses. Wearing glasses also could induce the new hotspot in the eyeballs which may cause the biggest SAR increment in the ocular tissues. Moreover, calculated results indicate that the maximal SAR is sensitive to the size of glasses and radiation frequency. Therefore, we believe wearing glasses may possibly increase the risk of health hazard to human eyes. In order to decrease the SAR in the ocular tissues, people should choose the adaptive glasses according to the radiation frequency. If possible, we advise people to take off their glasses when they use the eyewear device. These calculated results could be a valuable reference for the glasses designer to reduce the SAR in the eyes. However, due to the limited research conditions, the experiment is not included. So conclusions, in this paper, are just indicative but not definitive.

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Exposure to Mobile Phone-Emitted EMF and Human Attention: No Evidence of a Causal Relationship: Mini Review

Curcio G. Exposure to Mobile Phone-Emitted Electromagnetic Fields and Human Attention: No Evidence of a Causal Relationship. Front. Public Health, 23 February 2018.

No Abstract

Concluding Remarks

On the basis of reviewed literature, we can reasonably conclude that there is no evidence of a negative influence of mobile phone emitted EMFs on different aspects of human attention. As pointed out in Discussion, published literature is very heterogeneous with respect to methodology, dosimetry, or statistical analyses, and thus a conclusive generalization to everyday life is still very difficult. For these reasons, further research is needed, particularly on real-working settings and environments.

Open Access Paper: https://www.frontiersin.org/articles/10.3389/fpubh.2018.00042/full

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A Multi-Band Body-Worn Distributed RF Exposure Meter: Design, On-Body Calibration and Study of Body Morphology

Aminzadeh R, Thielens A, Agneessens S, Van Torre P, Van den Bossche M, Dongus S, Eeftens M, Huss A, Vermeulen R, de Seze R, Mazet P, Cardis E, Rogier H, Röösli M, Martens L Wout J. A Multi-Band Body-Worn Distributed Radio-Frequency Exposure Meter: Design, On-Body Calibration and Study of Body Morphology. Sensors. 18(1). Jan 2018.

Abstract

A multi-band Body-Worn Distributed exposure Meter (BWDM) calibrated for simultaneous measurement of the incident power density in 11 telecommunication frequency bands, is proposed. The BDWM consists of 22 textile antennas integrated in a garment and is calibrated on six human subjects in an anechoic chamber to assess its measurement uncertainty in terms of 68% confidence interval of the on-body antenna aperture. It is shown that by using multiple antennas in each frequency band, the uncertainty of the BWDM is 22 dB improved with respect to single nodes on the front and back of the torso and variations are decreased to maximum 8.8 dB. Moreover, deploying single antennas for different body morphologies results in a variation up to 9.3 dB, which is reduced to 3.6 dB using multiple antennas for six subjects with various body mass index values. The designed BWDM, has an improved uncertainty of up to 9.6 dB in comparison to commercially available personal exposure meters calibrated on body. As an application, an average incident power density in the range of 26.7–90.8 μW·m−2 is measured in Ghent, Belgium. **The measurements show that commercial personal exposure meters underestimate the actual exposure by a factor of up to 20.6.**

Excerpt

Two commercially available PEMs are used in this study: EME Spy 200 (MVG, Brest, France) and ExpoM-RF (Fields at Work GmbH, Zürich, Switzerland). Eleven frequency bands are studied in this paper ...

For the BWDM, the mean measured power densities are in the range of 26.7 μW/m2 (800-DL) to 90.8 μW/m2 (900 DL). The large standard deviation is due to the city environment where several buildings with different heights are present. For the EME Spy 200, the mean power density ranges from 4.41 μW/m2 (1800-DL) to 60.1 μW/m2 (900-DL). ExpoM-RF registered mean power densities in the range of 14.53 μW/m2 (1800-DL) to 151.5 μW/m2 (900-DL). All the three devices measured the maximum mean power density for 900-DL band (2G). For the BWDM, the median Sinc is in the range of 3.21 μW/m2 (800-DL) to 29 μW/m2 for 2100-DL. Both PEMs registered the minimum p50 of Sinc for 1800-DL (EME Spy 200: 0.59 μW/m2, ExpoM-RF: 1.62 μW/m2) and the maximum median Sinc for 900-DL (EME Spy 200: 12.26 μW/m2, ExpoM-RF: 34.77 μW/m2).

Conclusions

For the first time, a multi-band body-worn distributed-exposure meter (BWDM) is proposed for simultaneous on-body measurements of the incident power density in 11 telecommunication bands. The BWDM is designed and calibrated on a male human subject, in an anechoic chamber. The optimized location of 22 nodes covering 11 frequency bands is determined on the front and on the back of the torso. The optimized BWDM is also calibrated on five more subjects in order to study the effect of human body morphology on the measurement uncertainty of the designed BWDM. The uncertainty is quantified as the 68% confidence interval of the on-body antenna aperture obtained during calibrations. It is shown that using multiple antennas improved the uncertainty up to 22 dB with respect to single nodes for all subjects in all frequency bands. We also demonstrated that, using single antennas, the variation on CI68 for the six people in this study was about 9.3 dB. This value reduced to the range of 1.2 to 3.6 dB for all the subjects, which is 5.7 dB improvement. Except for 1800-DL (3.6 dB) the maximum variation on the CI68 of subjects of this study is limited to below 2 dB. The designed BWDM has an improved CI68 of 9.6 dB compared to CI68 of commercially available PEMs calibrated on body. Using the proposed BWDM and two PEMs, fields along an outdoor route are measured in Ghent, Belgium including 800, 900, 1800 and 2100 MHz downlink bands. The BWDM measured a mean power density in the range of 26.7 to 90.8 μW/m2, which are below the issued reference levels by ICNIRP. The results show that commercial PEMs underestimate the actual incident power densities by a factor of 1.6 to 20.6. Moreover, the measured exposure to 2G and 3G signals are 3.8 to 9 times higher than the 4G signals. The study of the subject's posture and application of SAR measurement will be part of the future work.

https://www.researchgate.net/publication/322569489_A_Multi-Band_Body-Worn_Distributed_Radio-Frequency_Exposure_Meter_Design_On-Body_Calibration_and_Study_of_Body_Morphology

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Representativeness and repeatability of microenvironmental personal and head exposures to RF-EMF

Thielens A, Van den Bossche M, Brzozek C, Bhatt CR, Abramson MJ, Benke G, Martens L, Joseph W. Representativeness and repeatability of microenvironmental personal and head exposures to radio-frequency electromagnetic fields. Environ Res. 2018 Apr;162:81-96. doi: 10.1016/j.envres.2017.12.017.

Abstract

The aims of this study were to: i) investigate the repeatability and representativeness of personal radio frequency-electromagnetic fields (RF-EMFs) exposure measurements, across different microenvironments, ii) perform simultaneous evaluations of personal RF-EMF exposures for the whole body and the head, iii) validate the data obtained with a head-worn personal distributed exposimeter (PDE) against those obtained with an on-body worn personal exposimeter (PEM). Data on personal and head RF-EMF exposures were collected by performing measurements across 15 microenvironments in Melbourne, Australia. A body-worn PEM and a head-worn PDE were used for measuring body and head exposures, respectively. The summary statistics obtained for total RF-EMF exposure showed a high representativeness ($r2 > 0.66$ for two paths in the same area) and a high repeatability over time ($r2 > 0.87$ for repetitions of the same path). The median head exposure in the 900MHz downlink band ranged between 0.06V/m and 0.31V/m. The results obtained during simultaneous measurements using the two devices showed high correlations ($0.42 < r2 < 0.94$). The highest mean total RF-EMF exposure was measured in Melbourne's central business district (0.89V/m), whereas the lowest mean total exposure was measured in a suburban residential area (0.05V/m). This study shows that personal RF-EMF microenvironmental measurements in multiple microenvironments have high representativeness and repeatability over time. The personal RF-EMF exposure levels (i.e. body and head exposures) demonstrated moderate to high correlations.

https://www.ncbi.nlm.nih.gov/pubmed/29289859

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Effects of time delays on biological feedback systems and electromagnetic field exposures

Barnes F, Kandala S. Effects of time delays on biological feedback systems and electromagnetic field exposures. Bioelectromagnetics. 2018 Feb 19. doi: 10.1002/bem.22114.

No Abstract

https://www.ncbi.nlm.nih.gov/pubmed/29457641

Excerpts

Biological systems contain a large number of signaling pathway and amplifying systems. Often these signaling systems operate in parallel and include both feedback and feed forward signals. An extensive review of how feedback loops shape cellular signals in space and time is presented by Brandman and Meyer [2008]. There are over 3,000 signaling proteins and over 15 s messengers that lead to hundreds of cell-specific signaling systems. These multiple feedback loops lead to a wide variety of responses including oscillations, bi-stability, and system stabilization. The multiple feedback loops often make it hard to separate cause and effect.

Changes in concentrations of ROS molecules have been shown to have a wide range of both positive and negative effects on biological systems [Halliwell and Gutteridge, 2015]. Early works on the exposures of biological systems to microwaves show that even when the biological system was held at constant temperatures, there were changes in membrane resistance that differed from the first exposures to the second, and there was a time delay in the response [Arber and Lin, 1985a,b]. More recent works show that magnetic

fields have been shown to modify ROS concentrations [Georgiou, 2010; Castello et al., 2014; Usselman et al., 2014, 2016].

We can expect signals such as modulated sine waves or pulses at different repetition rates containing more than one frequency to modify more than one biological process.

Overall, we know that there are many feedback and repair processes in biological systems. These feedback processes occur with time delays following a stimulus, and thus we can expect that the timing of a periodic stimulus can either lead to an amplified or attenuated response. Additionally, we can expect the responses of biological systems to be frequency-dependent. With knowledge of time constants for various biological and medical responses, we may be able to signal the systems to increase or decrease such things as cell growth rates or immune responses.

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RF EMR exposure effects on amygdala morphology, place preference behavior and brain caspase-3 activity in rats

Narayanan, SN, Mohapatra, N, John, P, Suresh Kumar, NKR,. Nayak, SB, Gopalakrishna Bhat, P. Radiofrequency electromagnetic radiation exposure effects on amygdala morphology, place preference behavior and brain caspase-3 activity in rats. Environmental Toxicology and Pharmacology. 58:220-229. 2018.

Abstract

The purpose of the study was to evaluate the changes in amygdala morphology and emotional behaviors, upon exposure to chronic RF-EMR in adolescent rats. Four weeks old male albino Wistar rats were exposed to 900 MHz (power density:146.60 μW/cm2) from a mobile phone in silent-mode for 28 days. Amygdala morphology was studied using cresyl violet, TUNEL and Golgi-Cox staining. Place preference behavior was studied using light/dark chamber test and following this brain caspase-3 activity was determined. Number of healthy neurons was decreased in the basolateral amygdala and cortical amygdala but not in the central amygdala after RF-EMR exposure. It also induced apoptosis in the amygdala. RF-EMR exposure altered dendritic arborization pattern in basolateral amygdala but not in the central amygdala. Altered place preference and hyperactivity-like behavior was evident after RF-EMR exposure, but brain caspase-3 activity did not change. RF-EMR exposure perturbed normal cellular architecture of amygdala and this was associated with altered place preference.

https://doi.org/10.1016/j.etap.2018.01.009

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Cell phone exposure induces apoptosis, mitochondrial oxidative stress & TRPV1 channel activation in hippocampus of rats

Ertilav K, Uslusoy F, Ataizi S, Nazıroğlu M. Long term exposure to cell phone frequencies (900 and 1800 MHz) induces apoptosis, mitochondrial oxidative stress and TRPV1 channel activation in the hippocampus and dorsal root ganglion of rats. Metab Brain Dis. 2018 Jan 13. doi: 10.1007/s11011-017-0180-4.

Abstract

Mobile phone providers use electromagnetic radiation (EMR) with frequencies ranging from 900 to 1800 MHz. The increasing use of mobile phones has been accompanied by several potentially pathological consequences, such as neurological diseases related to hippocampal (HIPPON) and dorsal root ganglion neuron (DRGN). The TRPV1 channel is activated different stimuli, including CapN, high temperature and oxidative stress. We investigated the contribution TRPV1 to mitochondrial oxidative stress and apoptosis in

HIPPON and DRGN following long term exposure to 900 and 1800 MHz in a rat model. Twenty-four adult rats were equally divided into the following groups: (1) control, (2) 900 MHz, and (3) 1800 MHz exposure. Each experimental group was exposed to EMR for 60 min/ 5 days of the week during the one year. The 900 and 1800 MHz EMR exposure induced increases in TRPV1 currents, intracellular free calcium influx (Ca2+), reactive oxygen species (ROS) production, mitochondrial membrane depolarization (JC-1), apoptosis, and caspase 3 and 9 activities in the HIPPON and DRGN. These deleterious processes were further increased in the 1800 MHz experimental group compared to the 900 MHz exposure group. In conclusion, mitochondrial oxidative stress, programmed cell death and Ca2+ entry pathway through TRPV1 activation in the HIPPON and DRGN of rats were increased in the rat model following exposure to 900 and 1800 MHz cell frequencies. Our results suggest that exposure to 900 and 1800 MHz EMR may induce a dose-associated, TRPV1-mediated stress response.

https://www.ncbi.nlm.nih.gov/pubmed/29332300

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RF EMR exposure effects on amygdala morphology, place preference behavior and brain caspase-3 activity in rats

Narayanan SN, Mohapatra N, John P, Kumar NKRS, Nayak SB, Bhat PG. Radiofrequency electromagnetic radiation exposure effects on amygdala morphology, place preference behavior and brain caspase-3 activity in rats. Environmental Toxicology and Pharmacology, Available online 31 January 2018.

Highlights

• Chronic 900 MHz exposure perturbed cellular architecture of rat amygdala.
• Number of healthy neurons decreased in basolateral, cortical nuclei but not in central nuclei.
• Dendritic arborization of basolateral neurons was found to be reduced.
• This was associated with altered place preference behavior.
• Brain caspase-3 was not found to be altered after chronic radiation exposure.

Abstract

The purpose of the study was to evaluate the changes in amygdala morphology and emotional behaviors, upon exposure to chronic RFEMR in adolescent rats. Four weeks old male albino Wistar rats were exposed to 900 MHz (power density:146.60 μW/cm2) from a mobile phone in silent-mode for 28 days. Amygdala morphology was studied using cresyl violet, TUNEL and Golgi-Cox staining. Place preference behavior was studied using light/dark chamber test and following this brain caspase-3 activity was determined. Number of healthy neurons was decreased in the basolateral amygdala and cortical amygdala but not in the central amygdala after RF-EMR exposure. It also induced apoptosis in the amygdala. RF-EMR exposure altered dendritic arborization pattern in basolateral amygdala but not in the central amygdala. Altered place preference and hyperactivity-like behavior was evident after RF-EMR exposure, but brain caspase-3 activity did not change. EMR exposure perturbed architecture of amygdala and this was associated with altered place preference.

https://www.sciencedirect.com/science/article/pii/S1382668918300164

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Evaluation of oxidative injury in sciatic nerves of male rats exposed to continuous 900-MHz EMF throughout adolescence

Kerimoğlu G, Güney C, Ersöz Ş, Odacı E. A histopathological and biochemical evaluation of oxidative injury in the sciatic nerves of male rats exposed to a continuous 900-megahertz electromagnetic field throughout all

periods of adolescence. J Chem Neuroanat. 2018 Jan 10. pii: S0891-0618(17)30212-0. doi: 10.1016/j.jchemneu.2018.01.001.

Abstract

The effects on human health of the electromagnetic field (EMF) emitted by mobile phones, used by approximately 7 billion people worldwide, have become an important subject for scientific research. Studies have suggested that the EMF emitted by mobile phones can cause oxidative stress in different tissues and age groups. Young people in adolescence, a time period when risky behaviors and dependences increase, use mobile phones more than adults. The EMF emitted by mobile phones, which are generally carried in the pocket or in bags when not in use, will very probably affect the sciatic nerve. No previous study has investigated the effect of mobile phone use in adolescence on peripheral nerve. This study was planned accordingly. Twenty-four male Sprague Dawley rats aged 21 days were divided equally into control (CGr), Sham (SGr) and EMF (EMFGr) groups. No procedure was performed on CGr rats. EMFGr were exposed to the effect of a 900-megahertz (MHz) EMF for 1 h at the same time every day between postnatal days 21-59 (the entire adolescent period) inside a cage in the EMF apparatus. SGr rats were placed inside the cage for 1 h every day without being exposed to EMF. All rats were sacrificed at the end of the study period, and 1 cm sections of sciatic nerve were extracted. Malondialdehyde (MDA), glutathione, catalase (CAT) superoxide dismutase (SOD) values were investigated biochemically in half of the right sciatic nerve tissues. The other halves of the nerve tissues were subjected to routine histopathological tissue procedures, sectioned and stained with hematoxylin and eosin (H&E) and Masson's trichrome. Histopathological evaluation of slides stained with Masson's trichrome and H&E revealed a normal appearance in Schwann cells and axons in all groups. However, there was marked thickening in the epineurium of sciatic nerves from EMFGr rats. MDA, SOD and CAT levels were higher in EMFGr than in CGr and SGr at biochemical analyses. Apoptotıc index (AI) analysis revealed a significant increase in the number of TUNEL (+) cells when EMFGr was compared with CGr and SGr. In conclusion, our study results suggest that continuous exposure to a 900-MHz EMF for 1 h throughout adolescence can cause oxidative injury and thickening in the epineurium in the sciatic nerve in male rats.

https://www.ncbi.nlm.nih.gov/pubmed/29331319

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1950 MHz RF EMR Inhibits Testosterone Secretion of Mouse Leydig Cells

Lin YY, Wu T, Liu JY, Gao P, Li KC, Guo QY, Yuan M, Lang HY, Zeng LH, Guo GZ. 1950 MHz Radio Frequency Electromagnetic Radiation Inhibits Testosterone Secretion of Mouse Leydig Cells. Int J Environ Res Public Health. 2017 Dec 23;15(1). pii: E17. doi: 10.3390/ijerph15010017.

Abstract

More studies that are focused on the bioeffects of radio-frequency (RF) electromagnetic radiation that is generated from the communication devices, but there were few reports with confirmed results about the bioeffects of RF radiation on reproductive cells. To explore the effects of 1950 MHz RF electromagnetic radiation (EMR) on mouse Leydig (TM3) cells. TM3 cells were irradiated or sham-irradiated continuously for 24 h by the specific absorption rate (SAR) 3 W/kg radiation. At 0, 1, 2, 3, 4, and 5 days after irradiation, cell proliferation was detected by cell counting kit-8 (CCK-8) method, cell cycle distribution, percentage of apoptosis, and cellular reactive oxygen species (ROS) were examined by flow cytometry, Testosterone level was measured using enzyme-linked immunosorbent assay (ELISA) assay, messenger ribonucleic acid (mRNA) expression level of steroidogenic acute regulatory protein (StAR) and P450scc in TM3 cells was detected by real-time polymerase chain reaction (PCR). After being irradiated for 24 h, cell proliferation obviously decreased and cell cycle distribution, secretion capacity of Testosterone, and P450scc mRNA level were reduced. While cell apoptosis, ROS, and StAR mRNA level did not change significantly. The current results indicated that 24 h of exposure at 1950 MHz 3 W/kg radiation could cause some adverse effects on TM3 cells proliferation and Testosterone secretion, further studies about the biological effects in the

reproductive system that are induced by RF radiation are also needed.

https://www.ncbi.nlm.nih.gov/pubmed/29295490

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Extremely Low Frequency Fields

Occupational exposure to ELF magnetic fields and risk of ALS: systematic review and meta-analysis

Huss A, Peters S, Vermeulen R. Occupational exposure to extremely low-frequency magnetic fields and the risk of ALS: A systematic review and meta-analysis. Bioelectromagnetics. doi:10.1002/bem.22104. Published online Jan 19, 2018.

Abstract

We performed a meta-analysis to examine associations of occupational exposure to extremely-low frequency magnetic fields (ELF-MF) with amyotrophic lateral sclerosis (ALS). Epidemiologic studies were identified in EMBASE and MEDLINE, in reference lists and a specialist database. We included studies that reported risk estimates of ALS in association with occupational ELF-MF exposure. Summary relative risks (RR) or odds ratios (OR) were obtained with random effect meta-analysis, and analyses were stratified by type of exposure assessment. This was done to evaluate whether observed heterogeneity between studies could be explained with differences in the way the exposure had been determined. We included 20 studies in our meta-analysis. Overall, studies reported a slightly increased risk of ALS in those exposed to higher levels of ELF-MF compared to lower levels with a summary RR (sRR) of 1.14 (95% Confidence Interval [CI] 1.00–1.30) and for workers in electrical occupations (sRR 1.41, CI 1.05–1.92), but with large heterogeneity between studies ($I^2 > 70\%$). Self-reported exposure or occupations determined from death certificates did not show increased risks. Highest-longest types of exposure translated into increased risks of ALS if the studies had evaluated the whole occupational history, in contrast to evaluating only few points in time (e.g., from census records); sRR were 1.89 (CI 1.31–2.73, I^2 0%) and 1.06 (CI 0.75–1.57, I^2 76%), respectively. In this meta-analysis, we observed an increased risk of ALS in workers occupationally exposed to ELF-MF. Results of studies depended on the quality of the exposure assessment.

http://onlinelibrary.wiley.com/doi/10.1002/bem.22104/abstract

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Occupational exposure to ELF magnetic fields and risk of Alzheimer disease: systematic review and meta-analysis

Jalilian H, Teshnizi SH, Röösli M, Neghab M. Occupational exposure to extremely low frequency magnetic fields and risk of Alzheimer disease: A systematic review and meta-analysis. Neurotoxicology. 2017 Dec 24. pii: S0161-813X(17)30239-5. doi: 10.1016/j.neuro.2017.12.005.

Abstract

INTRODUCTION: Occupational exposure to extremely low frequency magnetic fields (ELF-MF) occurs in many occupations such as welders, electric utility workers, train drivers and sewing machine operators. There is some evidence suggesting ELF-MF exposure to be a risk factor for Alzheimer's disease (AD). The current study aims at systematically reviewing the literature and conducting a meta-analysis to evaluate the risk of AD amongst workers exposed to ELF-MF.

METHODS: Bibliographic databases were searched including PubMed, EMBASE, Cochrane Library, and Web of Science in November 2017. Risk of bias was assessed in the all included studies. Pooled estimates were

obtained using random-effects meta-analysis. In addition, sources of heterogeneity between studies and publication bias were explored.

RESULTS: In total, 20 articles met the inclusion criteria. The pooled results suggest an increased risk of AD (RR: 1.63; 95% CI: 1.35, 1.96). Higher risk estimates were obtained from case-control studies (OR: 1.80; 95% CI: 1.40, 2.32) than from cohort studies (RR: 1.42; 95% CI: 1.08, 1.87). A moderate to high heterogeneity ($I^2 = 61.0\%$) and indication for publication bias (Egger test: $p < 0.001$) were found.

CONCLUSION: The results suggested that occupational exposure to ELF-MF might increase the risk of AD. However, this suggestion should be interpreted with caution given the moderate to high heterogeneity and indication for publication bias.

https://www.ncbi.nlm.nih.gov/pubmed/29278690

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Distinguishing Polemic From Commentary in Science: Some Guidelines Illustrated With the Case of Sage and Burgio (2017)

Grimes DR, Bishop DV. Distinguishing Polemic From Commentary in Science: Some Guidelines Illustrated With the Case of Sage and Burgio (2017). Child Dev. 2017 Dec 21. doi: 10.1111/cdev.13013.

Abstract

Exposure to nonionizing radiation used in wireless communication remains a contentious topic in the public mind-while the overwhelming scientific evidence to date suggests that microwave and radio frequencies used in modern communications are safe, public apprehension remains considerable. A recent article in Child Development has caused concern by alleging a causative connection between nonionizing radiation and a host of conditions, including autism and cancer. This commentary outlines why these claims are devoid of merit, and why they should not have been given a scientific veneer of legitimacy. The commentary also outlines some hallmarks of potentially dubious science, with the hope that authors, reviewers, and editors might be better able to avoid suspect scientific claims.

https://www.ncbi.nlm.nih.gov/pubmed/29266222

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Averaged head phantoms from magnetic resonance images of Korean children and young adults

Han M, Lee AK, Choi HD, Jung YW, Park JS. Averaged head phantoms from magnetic resonance images of Korean children and young adults. Phys Med Biol. 2017 Dec 14. doi: 10.1088/1361-6560/aaa1c7.

Abstract

Increased use of mobile phones raises concerns about the health risks of electromagnetic radiation. Phantom heads are routinely used for radiofrequency dosimetry simulations, and the purpose of this study was to construct averaged phantom heads for children and young adults. Using magnetic resonance images (MRI), sectioned cadaver images, and a hybrid approach, we initially built template phantoms representing 6-, 9-, 12-, 15-year-old children and adult. Our subsequent approach revised the template phantoms using 29 averaged

items that were identified by averaging the MRI data from 500 children and young adults. In females, the brain size and cranium thickness peaked in the early teens and then decreased. This is contrary to what was observed in males, where brain size and cranium thicknesses either plateaued or grew continuously. The overall shape of brains was spherical in children and became ellipsoidal by adulthood. In this study, we devised a method to build averaged phantom heads by constructing surface and voxel models. The surface model could be used for phantom manipulation, whereas the voxel model could be used for compliance test of specific absorption rate (SAR) for users of mobile phones or other electronic devices.

https://www.ncbi.nlm.nih.gov/pubmed/29239853

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Effects of GSM and UMTS mobile telephony signals on neuron degeneration and blood-brain barrier permeation in the rat brain

Poulletier de Gannes F, Masuda H, Billaudel B, Poque-Haro E, Hurtier A, Lévêque P, Ruffié G, Taxile M, Veyret B, Lagroye I. Effects of GSM and UMTS mobile telephony signals on neuron degeneration and blood-brain barrier permeation in the rat brain. Sci Rep. 2017 Nov 14;7(1):15496. doi: 10.1038/s41598-017-15690-1.

Abstract

Blood-brain barrier (BBB) permeation and neuron degeneration were assessed in the rat brain following exposure to mobile communication radiofrequency (RF) signals (GSM-1800 and UMTS-1950). Two protocols were used: (i) single 2 h exposure, with rats sacrificed immediately, and 1 h, 1, 7, or 50 days later, and (ii) repeated exposures (2 h/day, 5 days/week, for 4 weeks) with the effects assessed immediately and 50 days after the end of exposure. The rats' heads were exposed at brain-averaged specific absorption rates (BASAR) of 0.026, 0.26, 2.6, and 13 W/kg. No adverse impact in terms of BBB leakage or neuron degeneration was observed after single exposures or immediately after the end of repeated exposure, with the exception of a transient BBB leakage (UMTS, 0.26 W/kg). Fifty days after repeated exposure, the occurrence of degenerating neurons was unchanged on average. However, a significant increased albumin leakage was detected with both RF signals at 13 W/kg. In this work, the strongest, delayed effect was induced by GSM-1800 at 13 W/kg. Considering that 13 W/kg BASAR in the rat head is equivalent to 4 times as much in the human head, deleterious effects may occur following repeated human brain exposure above 50 W/kg.

Open Access Paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5686211/
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Extremely Low Frequency Fields

Exposure to Magnetic Field Non-Ionizing Radiation and the Risk of Miscarriage: A Prospective Cohort Study

Li DK, Chen H, Ferber JR, Odouli R, Quesenberry C. Exposure to Magnetic Field Non-Ionizing Radiation and the Risk of Miscarriage: A Prospective Cohort Study. Sci Rep. 2017 Dec 13;7(1):17541. doi: 10.1038/s41598-017-16623-8.

Abstract

Magnetic field (MF) non-ionizing radiation is widespread and everyone is exposed to some degree. This prospective cohort study of 913 pregnant women examined the association between high MF exposure and miscarriage risk. Cox (proportional hazards) regression was used to examine the association. After controlling for multiple other factors, women who were exposed to higher MF levels had 2.72 times the risk of miscarriage (hazard ratio = 2.72, 95% CI: 1.42-5.19) than those with lower MF exposure. The increased risk of miscarriage associated with high MF was consistently observed regardless of the sources of high MF. The association was

much stronger if MF was measured on a typical day of participants' pregnancies. The finding also demonstrated that accurate measurement of MF exposure is vital for examining MF health effects. This study provides fresh evidence, directly from a human population, that MF non-ionizing radiation could have adverse biological impacts on human health.

Open Access Paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5727515/

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Exposure to ELF EMF during Lessons in Secondary Schools

Silangam W, Yoosook W, Kongtip P, Kongtawelert A, Theppeang K. EXPOSURE TO EXTREMELY LOW FREQUENCY ELECTROMAGNETIC FIELDS DURING LESSONS IN SECONDARY SCHOOLS. Radiat Prot Dosimetry. 2017 Dec 5:1-5. doi: 10.1093/rpd/ncx266. [Epub ahead of print]

Abstract

Schools are a significant location where children are exposed to electromagnetic fields (EMFs), which may cause adverse health effects. This cross-sectional study aimed to examine exposure levels to extremely low frequency magnetic fields (ELF-MFs) with a range of 5 Hz-32 kHz, and ELF-electric fields (ELF-EFs) with a range of 5 Hz-2 kHz in secondary schools in Bangkok, Thailand. This study was conducted in 60 classrooms from three schools during class hours. Spot measurements were taken with a Narda EFA 300 field analyzer to evaluate exposure levels. This study showed that ELF-EMF exposure levels are lower than ICNIRP guidelines, while 21.67% of classrooms had a magnetic field strength above 0.2 μT, and the main sources of ELF-EMFs were electrical equipment and electrical wiring. Future studies should measure ELF-EMF levels in other areas and evaluate the effects of long term exposure to ELF-EMFs on children's health.

https://www.ncbi.nlm.nih.gov/pubmed/29216404

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Stochastic Dosimetry for the Assessment of Children Exposure to Uniform 50 Hz Magnetic Field with Uncertain Orientation

Chiaramello E, Fiocchi S, Ravazzani P, Parazzini M. Stochastic Dosimetry for the Assessment of Children Exposure to Uniform 50 Hz Magnetic Field with Uncertain Orientation. Biomed Res Int. 2017;2017:4672124. doi: 10.1155/2017/4672124. Epub 2017 Oct 31.

Abstract

This study focused on the evaluation of the exposure of children aging from five to fourteen years to 50 Hz homogenous magnetic field uncertain orientation using stochastic dosimetry. Surrogate models allowed assessing how the variation of the orientation of the magnetic field influenced the induced electric field in each tissue of the central nervous system (CNS) and in the peripheral nervous system (PNS) of children. Results showed that the electric field induced in CNS and PNS tissues of children were within the ICNIRP basic restrictions for general public and that no significant difference was found in the level of exposure of children of different ages when considering 10000 possible orientations of the magnetic field. A "mean stochastic model," useful to estimate the level of exposure in each tissue of a representative child in the range of age from five to fourteen years, was developed. In conclusion, this study was useful to deepen knowledge about the ELF-MF exposure, including the evaluation of variable and uncertain conditions, thus representing a step towards a more realistic characterization of the exposure to EMF.

Open Access Paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5684611/

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Maternal cumulative exposure to ELF EMF and pregnancy outcomes in the Elfe cohort

Migault L, Piel C, Carles C, Delva F, Lacourt A, Cardis E, Zaros C, de Seze R, Baldi I, Bouvier G. Maternal cumulative exposure to extremely low frequency electromagnetic fields and pregnancy outcomes in the Elfe cohort. Environ Int. 2017 Dec 20;112:165-173. doi: 10.1016/j.envint.2017.12.025.

Abstract

OBJECTIVES: To study the relations between maternal cumulative exposure to extremely low frequency electromagnetic fields (ELF EMF) and the risk of moderate prematurity and small for gestational age within the Elfe cohort.

METHODS: The Elfe study included 18,329 infants born at 33weeks of gestation or more in France in 2011 and was designed to follow the children until 20years of age. Gestational age and anthropometric data at birth were collected in medical records and small for gestational age was defined according to a French customized growth standard. During interviews, mothers were asked to report their job status during pregnancy. If employed, their occupation was coded according to the International Standard Classification of Occupations 1988 and the date on which they stopped their work was recorded. Cumulative exposure to ELF EMF during pregnancy was assessed, for both mothers who worked and those who did not during pregnancy, using a recently-updated job-exposure matrix (JEM). Cumulative exposure was considered as a categorical variable (<17.5, 17.5-23.8, 23.8-36.2, 36.2-61.6 or ≥61.6μT-days), a binary variable (<44.1 and ≥44.1μT-days) and a continuous variable. Associations were analyzed by logistic regression, adjusting for the mother's lifestyle factors, sociodemographic characteristics and some mother's medical history during and before pregnancy. Analyses were restricted to single births and to complete values for the pregnancy outcomes (n=16,733).

RESULTS: Cumulative exposure was obtained for 96.0% of the mothers. Among them, 37.5% were classified in the 23.8-36.2μT-days category, but high exposures were rare: 1.3% in the ≥61.6μT-days category and 5.5% in the ≥44.1μT-days category. No significant association was observed between maternal cumulative exposure and moderate prematurity and small for gestational age in this exposure range.

CONCLUSION: This large population-based study does not suggest that maternal exposure to ELF EMF during pregnancy is highly associated with risks of moderate prematurity or small for gestational age.

https://www.ncbi.nlm.nih.gov/pubmed/29275242

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Effects of ELF EMF on Neurogenesis and Cognitive Behavior in an Experimental Model of Hippocampal Injury

Sakhaie MH, Soleimani M, Pourheydar B, Majd Z, Atefimanesh P, Asl SS, Mehdizadeh M. Effects of Extremely Low-Frequency Electromagnetic Fields on Neurogenesis and Cognitive Behavior in an Experimental Model of Hippocampal Injury. Behav Neurol. 2017;2017:9194261. doi: 10.1155/2017/9194261. Epub 2017 Nov 12.

Abstract

Exposure to extremely low-frequency electromagnetic fields may induce constant modulation in neuronal plasticity. In recent years, tremendous efforts have been made to design a suitable strategy for enhancing adult neurogenesis, which seems to be deterred due to brain senescence and several neurodegenerative diseases. In this study, we evaluated the effects of ELF-EMF on neurogenesis and memory, following treatment with trimethyltin chloride (TMT) as a neurotoxicant. The mice in all groups (n = 56) were injected with BrdU during the experiment for seven consecutive days to label newborn cells. Spatial memory was assessed

by the Morris water maze (MWM) test. By the end of the experiment, neurogenesis and neuronal differentiation were assessed in the hippocampus, using immunohistochemistry and Western blot analysis. Based on the findings, exposure to ELF-EMF enhanced spatial learning and memory in the MWM test. ELF-EMF exposure significantly enhanced the number of BrdU+ and NeuN+ cells in the dentate gyrus of adult mice ($P < 0.001$ and $P < 0.05$, resp.). Western blot analysis revealed significant upregulation of NeuroD2 in ELF-EMF-exposed mice compared to the TMT-treated group ($P < 0.05$). These findings suggest that ELF-EMF might have clinical implications for the improvement of neurodegenerative processes and could help develop a novel therapeutic approach in regenerative medicine.

https://www.ncbi.nlm.nih.gov/pubmed/29259353

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Spatial memory recovery in Alzheimer's rat model by ELF EMF exposure

Akbarnejad Z, Esmaeilpour K, Shabani M, Asadi-Shekaari M, Saeedi Goraghani M, Ahmadi-Zeidabadi M. Spatial memory recovery in Alzheimer's rat model by electromagnetic field exposure. Int J Neurosci. 2017 Dec 20:1-6. doi: 10.1080/00207454.2017.1411353. [Epub ahead of print]

Abstract

INTRODUCTION: Although studies have shown a potential association between extremely low frequency electromagnetic fields (ELF-EMFs) exposure and Alzheimer's disease (AD), few studies have been conducted to investigate the effects of weak magnetic fields on brain functions such as cognitive functions in animal models. Therefore, this study aimed to investigate the effect of ELF-EMF exposure (50 Hz, 10 mT) on spatial learning and memory changes in AD rats.

METHODS: Amyloid-β (Aβ) 1-42 was injected into lateral ventricle to establish an AD rat model. The rats were divided into six groups: Group I (control); Group II (surgical sham); Group III (AD) Alzheimer's rat model; Group IV (MF) rats exposed to ELF-MF for 14 consecutive days; Group V (Aβ injection+M) rats exposed to magnetic field for 14 consecutive days from day 0 to 14 days after the Aβ peptide injection; Group VI (AD+M) rats exposed to magnetic field for 14 consecutive days after 2 weeks of Aβ peptide injection from 14th to 28th day . Morris water maze investigations were performed.

RESULTS: AD rats showed a significant impairment in learning and memory compared to control rats. The results showed that ELF-MF improved the learning and memory impairments in Aβ injection+M and AD+M groups.

CONCLUSION: Our results showed that application of ELF-MF not only has improving effect on different cognitive disorder signs of AD animals, but also disrupts the processes of AD rat model formation.

https://www.ncbi.nlm.nih.gov/pubmed/29185809

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Impact of EMR emitted by monitors on cellular membrane structure and protective antioxidant effect of vitamin A - In vitro study

Lewicka M, Henrykowska G, Zawadzka M, Rutkowski M, Pacholski K, Buczyński A. Impact of electromagnetic radiation emitted by monitors on changes in the cellular membrane structure and protective antioxidant effect

of vitamin A - In vitro study. Int J Occup Med Environ Health. 2017 Jul 14;30(5):695-703. doi: 10.13075/ijomeh.1896.00851. Epub 2017 May 30.

Abstract

OBJECTIVES: The increasing number of devices emitting electromagnetic radiation (EMR) in people's everyday life attracted the attention of researchers because of possible adverse effects of this factor on living organisms. One of the EMR effect may be peroxidation of lipid membranes formed as a result of free radical process. The article presents the results of in vitro studies aimed at identifying changes in malondialdehyde (MDA) concentration - a marker of lipid peroxidation and antioxidant role of vitamin A during the exposure of blood platelets to electromagnetic radiation generated by liquid-crystal-display (LCD) monitors.

MATERIAL AND METHODS: Electromagnetic radiation emitted by LCD monitors is characterized by parameters: 1 kHz frequency and 220 V/m intensity (15 cm from display screen). The time of exposure was 30 and 60 min. The study was conducted on porcine blood platelets. The samples were divided into 6 groups: unexposed to radiation, unexposed + vitamin A, exposed for 30 min, exposed for 30 min + vitamin A, exposed for 60 min, exposed for 60 min + vitamin A.

RESULTS: The MDA concentration in blood platelets increases significantly as compared to control values after 60 min of exposure to EMR. A significant decrease in MDA concentration after the addition of vitamin A was noticed. In the blood samples exposed to EMR for 30 and 60 min the MDA concentration was significantly increased by addition of vitamin A.

CONCLUSIONS: The results show the possibly negative effect of electromagnetic radiation on the cellular membrane structure manifested by changes in malondialdehyde concentration and indicate a possible protective role of vitamin A in this process.

https://www.ncbi.nlm.nih.gov/pubmed/28584329

Mortazavi SMJ. Letter to the Editor (July 26, 2017) concerning the paper "Impact of electromagnetic radiation emitted by monitors on changes in the cellular membrane structure and protective antioxidant effect of vitamin A - In vitro study". Int J Occup Med Environ Health. 2018 Jan 15;31(3):371-372. doi: 10.13075/ijomeh.1896.01245. Epub 2017 Dec 5. http://ijomeh.eu/Comments-on-Impact-of-electromagnetic-radiation-emitted-by-monitors-on-changes-in,80565,0,2.html

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Behavioral testing of mice exposed to intermediate frequency magnetic fields indicates mild memory impairment

Kumari K, Koivisto H, Viluksela M, Paldanius KMA, Marttinen M, Hiltunen M, Naarala J, Tanila H, Juutilainen J. Behavioral testing of mice exposed to intermediate frequency magnetic fields indicates mild memory impairment. PLoS One. 2017 Dec 4;12(12):e0188880. doi: 10.1371/journal.pone.0188880.

Abstract

Human exposure to intermediate frequency magnetic fields (MF) is increasing due to applications like electronic article surveillance systems and induction heating cooking hobs. However, limited data is available on their possible health effects. The present study assessed behavioral and histopathological consequences of exposing mice to 7.5 kHz MF at 12 or 120 μT for 5 weeks. No effects were observed on body weight, spontaneous activity, motor coordination, level of anxiety or aggression. In the Morris swim task, mice in the 120 μT group showed less steep learning curve than the other groups, but did not differ from controls in their search bias in the probe test. The passive avoidance task indicated a clear impairment of memory over 48 h in the 120 μT group. No effects on astroglial activation or neurogenesis were observed in the hippocampus. The

mRNA expression of brain-derived neurotrophic factor did not change but expression of the proinflammatory cytokine tumor necrosis factor alpha mRNA was significantly increased in the 120 μT group. These findings suggest that 7.5 kHz MF exposure may lead to mild learning and memory impairment, possibly through an inflammatory reaction in the hippocampus.

Open Access Paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5714647/

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Behavioural phenotypes in mice after prenatal and early postnatal exposure to intermediate frequency magnetic fields

Kumari K, Koivisto H, Myles C, Jonne N, Matti V, Heikki T, Jukka J. Behavioural phenotypes in mice after prenatal and early postnatal exposure to intermediate frequency magnetic fields. Environ Res. 2017 Dec 22;162:27-34. doi: 10.1016/j.envres.2017.12.013.

Abstract

Electromagnetic fields are ubiquitous in the environment. Human exposure to intermediate frequency (IF) fields is increasing due to applications like electronic article surveillance systems, wireless power transfer, and induction heating cooking hobs. However, there are limited data on possible health effects of exposure to IF magnetic fields (MF). In the present study, we set out to assess cognitive and behavioural effects of IF MF in mice exposed during prenatal and early postnatal periods. Pregnant female mice were exposed continuously to 7.5kHz MFs at 12 and 120μT, from mating until weaning of pups. Sham exposed pregnant mice were used as a control group. A behavioural teratology study was conducted on the male offspring at two months of age to detect possible effects on the developing nervous system. Body weight development did not differ between the exposure groups. The exposure did not alter spontaneous motor activity when exploring a novel cage or anxiety in novelty-suppressed feeding or marble burying tests. Improved performance in the Rotarod task was observed in the 12μT group, while the 120μT exposure group swam more slowly than the sham exposed group in the Morris swim navigation task. However, indices of learning and memory (path length and escape latency during task acquisition and search bias during the probe test) did not differ between the exposure groups. Furthermore, the passive avoidance task did not indicate any impairment of long-term memory over a 48h interval in the exposed groups. In a post-mortem histopathological analysis, there was no evidence for an effect of IF MF exposure on astroglial reactivity or hippocampal neurogenesis. The results suggest that the IF MF used did not have detrimental effects on spatial learning and memory or histological markers of tissue reaction. The two statistically significant findings that were observed (improved performance in the Rotarod task in the 12μT group and decreased swimming speed in the 120μT group) are likely to be chance findings, as they do not form an internally consistent, dose-dependent pattern indicative of specific developmental effects.

https://www.ncbi.nlm.nih.gov/pubmed/29276976

==========2017==========

ICNIRP To Revise 1998 Radio Frequency Guidelines

ICNIRP continues to ignore the preponderance of the research which documents non-thermal biologic and health effects from radio frequency radiation exposure. Are conflicts of interest the reason?

Munich, Germany, December 7, 2017

The International Commission on Non-Ionizing Radiation Protection's (ICNIRP) current guidelines for the high-frequency (100 kHz – 300 GHz) portion of the electromagnetic spectrum were published in 1998. Given the large body of relevant research that has been generated since those 1998 guidelines, ICNIRP is now revising the guidelines to incorporate this literature.

The revision of the guidelines has been underway since 2014, and a public consultation version of the updated guidelines is expected within the first half of 2018. Given this timing, ICNIRP has been asked whether, in the interim period, the current guidelines can still be considered as protective. This is a very reasonable question, particularly given that changes are anticipated in the revised guidelines.

As part of the revision process ICNIRP has considered in detail whether the 1998 guidelines remain protective for current exposure scenarios, where it was noted that the anticipated changes relate primarily to the improvement of transparency and consistency across the exposure limits and the addition of new limits to account for exposure situations associated with potential technological advances, and further that the anticipated exposure limit changes are very small compared to the large degree of precaution that was built into the 1998 guidelines. ICNIRP therefore concluded that the 1998 guidelines do remain protective. That is, the 1998 guidelines still provide protection against all known health effects of high-frequency radiation within the frequency range 100 kHz – 300 GHz. However, if ICNIRP should discover aspects of the 1998 guidelines that are not sufficiently protective during the remainder of the high-frequency guidelines revision process, ICNIRP will immediately publish interim amendments that would remain in force until the revised guidelines are published.

ICNIRP is keen to obtain feedback on the upcoming high frequency guidelines, and will seek this feedback via a public consultation process. It is anticipated that the public consultation document will be completed mid-2018, with the associated public consultation period beginning thereafter.

Further updates on the high-frequency guidelines revision process, including publication of the public consultation document, will be made available through this website and via newsletter (www.icnirp.org; www.icnirp.org/en/contact/newsletter).

http://www.icnirp.org/en/activities/news/news-article/revision-of-hf-guidelines-2017.html

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EMF-Portal Stops Importing New Papers on Radio Frequency (RF) Radiation

Why did EMF-Portal's funders only stop funding the Portal's work on RF radiation?

EMF-Portal issued the following announcement on November 28:

"Due to a lack of financial resources, we unfortunately have to suspend the import of any new radio frequency and mobile phone-related articles as of now (November 27, 2017)."

The portal has continued to import other EMF papers.

This archive is an invaluable resource to the field. EMF-Portal has an extensive database which includes more than 25,000 publications and 6,000 summaries of scientific studies on the effects of electromagnetic fields.

The head of the project is Dr. rer. nat. Sarah Drießen (driessen@femu.rwth-aachen.de). Perhaps your letters of support can assist Dr. Drießen's efforts to find more funding.

I hope this problem is resolved quickly.

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Measurements of Radiofrequency Radiation with a Body-Borne Exposimeter in Swedish Schools with Wi-Fi

Lena K. Hedendahl, Michael Carlberg, Tarmo Koppel, Lennart Hardell. Measurements of Radiofrequency Radiation with a Body-Borne Exposimeter in Swedish Schools with Wi-Fi. Front. Public Health, 20 November 2017 | https://doi.org/10.3389/fpubh.2017.00279

Introduction: Wireless access to the Internet is now commonly used in schools. Many schools give each student their own laptop and utilize the laptops and wireless fidelity (Wi-Fi) connection for educational purposes. Most children also bring their own mobile phones to school. Since children are obliged by law to attend school, a safe environment is important. Lately, it has been discussed if radiofrequency (RF) radiation can have long-term adverse effects on children's health.

Method: This study conducted exposimetric measurements in schools to assess RF emissions in the classroom by measuring the teachers' RF exposure in order to approximate the children's exposure. Teachers in grades 7–12 carried a body-borne exposimeter, EME-Spy 200, in school during 1–4 days of work. The exposimeter can measure 20 different frequency bands from 87 to 5,850 MHz.

Results: Eighteen teachers from seven schools participated. The mean exposure to RF radiation ranged from 1.1 to 66.1 μW/m2. The highest mean level, 396.6 μW/m2, occurred during 5 min of a lesson when the teacher let the students stream and watch YouTube videos. Maximum peaks went up to 82,857 μW/m2 from mobile phone uplink.

Discussion: Our measurements are in line with recent exposure studies in schools in other countries. The exposure levels varied between the different Wi-Fi systems, and if the students were allowed to use their own smartphones on the school's Wi-Fi network or if they were connected to GSM/3G/4G base stations outside the school. An access point over the teacher's head gave higher exposure compared with a school with a wired Internet connection for the teacher in the classroom. All values were far below International Commission on Non-Ionizing Radiation Protection's reference values, but most mean levels measured were above the precautionary target level of 3–6 μW/m2 as proposed by the Bioinitiative Report. The length of time wireless devices are used is an essential determinant in overall exposure. Measures to minimize children's exposure to RF radiation in school would include preferring wired connections, allowing laptops, tablets and mobile phones only in flight mode and deactivating Wi-Fi access points, when not used for learning purposes.

In Conclusion

1. The ICNIRP guidelines are based on short-term heating (thermal) effects, and are therefore not relevant to decide on the appropriateness of long-term exposure.

2. The environmental exposure to RF radiation in some schools is higher than reported levels for non-thermal biological effects. In order to reduce children's exposure to RF radiation, schools should prefer wired network connections, allow laptop, tablets, and mobile phone usage only in flight mode and deactivate Wi-Fi access points when internet is not needed for learning purposes.

Open source paper: https://www.frontiersin.org/articles/10.3389/fpubh.2017.00279/full

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Exposure to extremely low frequency EMF during lessons in secondary schools

Silangam W, Yoosook W, Kongtip P, Kongtawelert A, Theppeang K. Exposure to extremely low frequency EMF during lessons in secondary schools. Radiat Prot Dosimetry. 2017 Dec 5:1-5.

Abstract

Schools are a significant location where children are exposed to electromagnetic fields (EMFs), which may cause adverse health effects. This cross-sectional study aimed to examine exposure levels to extremely low frequency magnetic fields (ELF-MFs) with a range of 5 Hz-32 kHz, and ELF-electric fields (ELF-EFs) with a range of 5 Hz-2 kHz in secondary schools in Bangkok, Thailand. This study was conducted in 60 classrooms from three schools during class hours. Spot measurements were taken with a Narda EFA 300 field analyzer to evaluate exposure levels. This study showed that ELF-EMF exposure levels are lower than ICNIRP guidelines, while 21.67% of classrooms had a magnetic field strength above 0.2 μT, and the main sources of ELF-EMFs were electrical equipment and electrical wiring. Future studies should measure ELF-EMF levels in other areas and evaluate the effects of long term exposure to ELF-EMFs on children's health.

https://www.ncbi.nlm.nih.gov/pubmed/29216404

In this study, exposure levels of ELF-MFs and ELF-EFs in classrooms during lessons at all three schools were lower than ICNIRP guideline recommendations. The dominant measured frequency was 50 Hz, and the main sources of ELF-EMFs were electrical equipment and electrical wiring. Future research should focus on the effect of ELF-EMF exposure during school time on children's health, should measure the ELF-EMF intensity in other areas of the school (e.g. library, canteen and walkways) to determine the level of ELF-EMFs both inside and outside the classroom. Moreover, to characterize the exposure of the children to ELF-EMF, measurements should be carried out in the children's bedrooms, where they sleep.

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Phenotypic and genotypic characterization of antioxidant enzyme system in human population exposed to mobile tower radiation

Gulati S, Yadav A, Kumar N, Priya K, Aggarwal NK, Gupta R. Phenotypic and genotypic characterization of antioxidant enzyme system in human population exposed to radiation from mobile towers.Mol Cell Biochem. 2017 Aug 17.

Abstract

In the present era, cellular phones have changed the life style of human beings completely and have become an essential part of their lives. The number of cell phones and cell towers are increasing in spite of their disadvantages. These cell towers transmit radiation continuously without any interruption, so people living within 100s of meters from the tower receive 10,000 to 10,000,000 times stronger signal than required for mobile communication. In the present study, we have examined superoxide dismutase (SOD) enzyme activity, catalase (CAT) enzyme activity, lipid peroxidation assay, and effect of functional polymorphism of SOD and CAT antioxidant genes against mobile tower-induced oxidative stress in human population. From our results, we have found a significantly lower mean value of manganese superoxide dismutase (MnSOD) enzyme activity, catalase (CAT) enzyme activity, and a high value of lipid peroxidation assay in exposed as compared to control subjects. Polymorphisms in antioxidant MnSOD and CAT genes significantly contributed to its phenotype. In the current study, a significant association of genetic polymorphism of antioxidant genes with genetic damage has been observed in human population exposed to radiations emitted from mobile towers.

https://www.ncbi.nlm.nih.gov/pubmed/28819931

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EMF Exposure Changes Due to the Digital Television Switchover in Thessaloniki, Greece

Gkonis F, Boursianis A, Samaras T. Electromagnetic Field Exposure Changes Due to the Digital Television Switchover in Thessaloniki, Greece. Health Phys. 2017 Nov;113(5):382-386.

Abstract

In the present work, the changes in the exposure to electromagnetic fields due to television signals incurred by the digital switchover in Thessaloniki, Greece, are investigated. It is shown that the measured electric fields comply with ICNIRP guidelines but are higher than those in the reported literature for other countries. However, this may be attributed to the selection of measurement points. Moreover, it is shown that the median value of the power density dropped from 60 μW m during analog broadcasting to 13.3 μW m for digital television. This finding indicates that the digital switchover has resulted in reduced exposure for the population to radiofrequency fields in the UHF range.

https://www.ncbi.nlm.nih.gov/pubmed/28961586

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RAPD Profiling, DNA Fragmentation, and Histomorphometric Examination in Brains of Wistar Rats Exposed to Indoor 2.5 Ghz Wi-Fi Devices Radiation

Ibitayo AO, Afolabi OB, Akinyemi AJ, Ojiezeh TI, Adekoya KO, Ojewunmi OO. RAPD Profiling, DNA Fragmentation, and Histomorphometric Examination in Brains of Wistar Rats Exposed to Indoor 2.5 Ghz Wi-Fi Devices Radiation. Biomed Res Int. 2017;2017:8653286.

Abstract

The advent of Wi-Fi connected high technology devices in executing day-to-day activities is fast evolving especially in developing countries of the world and hence the need to assess its safety among others. The present study was conducted to investigate the injurious effect of radiofrequency emissions from installed Wi-Fi devices in brains of young male rats. Animals were divided into four equal groups; group 1 served as control while groups 2, 3, and 4 were exposed to 2.5 Ghz at intervals of 30, 45, and 60 consecutive days with free access to food and water ad libitum. Alterations in harvested brain tissues were confirmed by histopathological analyses which showed vascular congestion and DNA damage in the brain was assayed using agarose gel electrophoresis. Histomorphometry analyses of their brain tissues showed perivascular congestion and tissue damage as well.

Conclusion

In this study, the effect of Wi-Fi radiation exposure as a threat to brain health was studied using genomic analysis and histopathological study which showed the high risk of its genotoxicity especially in prolonged exposure spectrum through the findings from this study. The genomic analysis confirmed DNA damage due to Wi-Fi radiation toxicity and DNA damage effect which was seen through the RAPD profiles of animals from the exposed groups. The histopathological analyses also confirmed significant deleterious alterations in the brain tissues of Wi-Fi-exposed animals. Hence, the need to exhibit caution in handling smart devices that are used from day to day is fast becoming a threat to human health and wellness.

Open Access Paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5585657/

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Histopathological, immunohistochemical, and stereological analysis of the effect of Gingko biloba (Egb761) on the hippocampus of rats exposed to long-term cellphone radiation

Gevrek F. Histopathological, immunohistochemical, and stereological analysis of the effect of Gingko biloba (Egb761) on the hippocampus of rats exposed to long-term cellphone radiation. Histol Histopathol. 2017 Nov 9:11943.

Abstract

Cellular phones are major sources of electromagnetic radiation (EMR) that can penetrate the human body and pose serious health hazards. The increasingly widespread use of mobile communication systems has raised concerns about the effects of cellphone radiofrequency (RF) on the hippocampus because of its close proximity to radiation during cellphone use. The effects of cellphone EMR exposure on the hippocampus of rats and the possible counteractive effects of ginkgo biloba (Egb761) were aimed to investigate. Rats were divided into three groups: Control, EMR, and EMR+Egb761. The EMR and EMR+Egb761 groups were exposed to cellphone EMR for one month. Egb761 was also administered to the EMR+Egb761 group. Specifically, we evaluated the effect of RF exposure on rat hippocampi at harmful EMR levels (0.96 W/kg specific absorption rate [SAR]) for one month and also investigated the possible impact of ginkgo biloba (Egb761) using stereological, TUNEL-staining, and immunohistochemical methods. An increase in apoptotic proteins (Bax, Acas-3) and a decrease in anti-apoptotic protein (Bcl-2) immunoreactivity along with a decrease in the total granule and pyramidal cell count were noted in the EMR group. A decrease in Bax and Acas-3 and an increase in Bcl-2 immunoreactivity were observed in rats treated with Egb761 in addition to a decrease in TUNEL-stained apoptotic cells and a higher total viable cell number. In conclusion, chronic cellphone EMR exposure may affect hippocampal cell viability, and Egb761 may be used to mitigate some of the deleterious effects.

https://www.ncbi.nlm.nih.gov/pubmed/29120031

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Changes in numbers and size of synaptic vesicles of cortical neurons induced by exposure to 835 MHz RF EMF

Kim JH, Kim HJ, Yu DH, Kweon HS, Huh YH, Kim HR. Changes in numbers and size of synaptic vesicles of cortical neurons induced by exposure to 835 MHz radiofrequency-electromagnetic field. PLoS One. 2017 Oct 18;12(10):e0186416.

Abstract

We studied the effects of radiofrequency electromagnetic fields (RF-EMFs) exposure on neuronal functions of mice. Particularly, we focused on RF-EMF effects on synaptic vesicles (SVs), which store neurotransmitters at axon terminals or synaptic boutons. C57 BL/6 mice were exposed to 835 MHz RF-EMF (4.0 W/kg SAR, for 5 h daily) and alterations in SVs at presynaptic terminals in the cerebral cortex were determined. Ultrastructure of randomly selected cortical neurons was observed using typical electron microscopy and bio-high voltage electron microscopy (Bio-HVEM) methods, which enable the estimation of the numbers and size of SVs. The density of the SVs (number /10 μm2 or 40 μm3) was significantly decreased in the presynaptic boutons of cortical neurons after RF-EMF exposure. Furthermore, qPCR and immunoblotting analyses revealed that the expression of synapsins I/II (Syns I/II) genes and proteins were significantly decreased in the cortical neurons of RF-EMF exposed mice. The present study suggested that alteration of SVs and Syn levels may result in alterations of neurotransmitters in the cerebral cortex following RF-EMF exposure.

https://www.ncbi.nlm.nih.gov/pubmed/29045446

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The effects of GSM cellphone radiation on rabbit's retina

Mohammad R. Talebnejad, Ali Sadeghi-Sarvestani, M. Hossein Nowroozzadeh, Seyed Mohammad J. Mortazavi, Mohammad R. Khalili. The effects of microwave radiation on rabbit's retina. Journal of Current Ophthalmology, Available online 9 October 2017.

Abstract

Purpose Mobile cell phones are used extensively these days, and their microwave (MW) radiation has been shown to affect the eye. The purpose of the present study was to evaluate the effects of MW radiation on rabbit retina.

Methods This experimental study (concluded in 2015) was conducted on 40 adult white New Zealand rabbits. A Global System for Mobile Communications (GSM) cell phone simulator was used for MW irradiation. The rabbits were randomized into five groups (8 in each) and treated as follows: Group 1: no irradiation (sham); Group 2: irradiation at 10 cm for 1 day; Group 3: irradiation at 30 cm for 1 day; Group 4: irradiation at 10 cm for 3 days; and Group 5: irradiation at 30 cm for 3 days. Scotopic and photopic electroretinography (ERG) responses were obtained at baseline and 7 days after the last exposure. Then all the rabbits were euthanized, and their eyes were enucleated and sent for pathology examination. Kruskal–Wallis and Chi-Square tests were used to evaluate intergroup differences in ERG parameters and histological findings, respectively.

Results ERG responses obtained 7 days after irradiation did not show any statistically significant difference between the groups ($P > 0.1$, for all tested parameters). There were statistically non-significant trends toward greater changes in the MW irradiated eyes. In pathological examination, retina was normal with no sign of degeneration or infiltration. Ciliary body congestion was observed in greater fraction of those who received higher MW doses. ($P = 0.005$).

Conclusions Histopathologically, cell phone simulated MW irradiation had no significant detrimental effect on the retina. However, ciliary body congestion was observed in greater fraction of those who received higher MW doses. Although there was no significant difference between post-treatment mean ERG values, there were statistically non-significant trends toward greater changes in the MW irradiated eyes.

http://www.sciencedirect.com/science/article/pii/S2452232517300562

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Extremely high-frequency electromagnetic radiation enhances neutrophil response to particulate agonists

Vlasova II, Mikhalchik EV, Gusev AA, Balabushevich NG, Gusev SA, Kazarinov KD. Extremely high-frequency electromagnetic radiation enhances neutrophil response to particulate agonists. Bioelectromagnetics. 2017 Nov 30. doi: 10.1002/bem.22103.

Abstract

The growing use of extremely high-frequency electromagnetic radiation (EHF EMR) in information and communication technology and in biomedical applications has raised concerns regarding the potential biological impact of millimeter waves (MMWs). Here, we elucidated the effects of MMW radiation on neutrophil activation induced by opsonized zymosan or E. coli in whole blood ex vivo. After agonist addition to blood, two samples were prepared. A control sample was incubated at ambient conditions without any treatment, and a test sample was exposed to EHF EMR (32.9-39.6 GHz, 100 W/m2). We used methods that allowed us to assess the functional status of neutrophils immediately after exposure: oxidant production levels were measured by luminol-dependent chemiluminescence, and morphofunctional changes to neutrophils were

observed in blood smears. Results revealed that the response of neutrophils to both agonists was intensified if blood was exposed to MMW radiation for 15 min. Neutrophils were intact in both the control and irradiated samples if no agonist was added to blood before incubation. Similarly, exposing suspensions of isolated neutrophils in plasma to MMW radiation.

https://www.ncbi.nlm.nih.gov/pubmed/29194676

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Spatial memory recovery in Alzheimer's rat model by electromagnetic field exposure

Akbarnejad Z, Esmaeilpour K, Shabani M, Asadi-Shekaari M, Saeedi-Goraghani M, Ahmadi M. Spatial memory recovery in Alzheimer's rat model by electromagnetic field exposure. Int J Neurosci. 2017 Nov 29:1-14. doi: 10.1080/00207454.2017.1411353.

Abstract

INTRODUCTION: Although studies have shown a potential association between extremely low frequency electromagnetic fields (ELF-EMFs) exposure and Alzheimer's disease (AD), few studies have been conducted to investigate the effects of weak magnetic fields on brain functions such as cognitive functions in animal models. Therefore, this study aimed to investigate the effect of ELF-EMF exposure (50 Hz, 10 mT) on spatial learning and memory changes in AD rats.

METHODS: Amyloid-β (Aβ) 1-42 (5 µl/ bilateral, single-dose) was injected into lateral ventricle to establish an AD rat model. The rats were divided into six groups: Group I (control); Group II (surgical sham); Group III (AD) Alzheimer's rat model; Group IV (MF) rats exposed to ELF-MF for 14 consecutive days; Group V (Aβ injection+M) rats exposed to magnetic field for 14 consecutive days from day 0-14 days after the Aβ peptide injection; Group VI (AD+M) rats exposed to magnetic field for 14 consecutive days after 2 weeks of Aβ peptide injection from 14th to 28th day. Morris water maze investigation were implemented and performed 24 h after termination of ELF-MF, respectively.

RESULTS: AD rats showed a significant impairment in learning and memory compared to control rats. The results showed that ELF-MF improved the learning and memory impairments in Aβ injection+M and AD+M groups.

CONCLUSION: Our results showed that application of ELF-MF not only has improving effect on different cognitive disorder signs of AD animals, but also disrupts the processes of AD rat model formation.

https://www.ncbi.nlm.nih.gov/pubmed/29185809

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Generation and propagation of yeast prion are elevated under ELF and 2.0 GHz RF EMF

Lian HY, Lin KW, Yang C, Cai P. Generation and propagation of yeast prion [URE3] are elevated under electromagnetic field. Cell Stress Chaperones. 2017 Dec 6. doi: 10.1007/s12192-017-0867-9.

Abstract

In this study, we studied the effect of 2.0 GHz radio frequency electromagnetic field (RF-EMF) and 50 Hz extremely low frequency electromagnetic field (ELF-EMF) exposure on prion generation and propagation using two budding yeast strains, NT64C and SB34, as model organisms. Under exposure to RF-EMF or ELF-EMF, the de novo generation and propagation of yeast prions [URE3] were elevated in both strains. The elevation

increased over time, and the effects of ELF-EMF occurred in a dose-dependent manner. The transcription and expression levels of the molecular chaperones Hsp104, Hsp70-Ssa1/2, and Hsp40-Ydj1 were not statistically significantly changed after exposure. Furthermore, the levels of ROS, as well as the activities of superoxide dismutase (SOD) and catalase (CAT), were significantly elevated after short-term, but not long-term exposure. This work demonstrated for the first time that EMF exposure could elevate the de novo generation and propagation of yeast prions and supports the hypothesis that ROS may play a role in the effects of EMF on protein misfolding. The effects of EMF on protein folding and ROS levels may mediate the broad effects of EMF on cell function.

https://www.ncbi.nlm.nih.gov/pubmed/29214607

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Biophysical control of the growth of Agrobacterium tumefaciens using ELF EMF at resonance frequency

Fadel MA, El-Gebaly RH, Mohamed SA, Abdelbacki AMM. Biophysical control of the growth of Agrobacterium tumefaciens using extremely low frequency electromagnetic waves at resonance frequency. Biochem Biophys Res Commun. 2017 Dec 9;494(1-2):365-371.

Abstract

Isolated Agrobacterium tumefaciens was exposed to different extremely low frequencies of square amplitude modulated waves (QAMW) from two generators to determine the resonance frequency that causes growth inhibition. The carrier was 10 MHz sine wave with amplitude ±10 Vpp which was modulated by a second wave generator with a modulation depth of ± 2Vpp and constant field strength of 200 V/m at 28 °C. The exposure of A. tumefaciens to 1.0 Hz QAMW for 90 min inhibited the bacterial growth by 49.2%. In addition, the tested antibiotics became more effective against A. tumefaciens after the exposure. Furthermore, results of DNA, dielectric relaxation and TEM showed highly significant molecular and morphological changes due to the exposure to 1.0 Hz QAMW for 90 min. An in-vivo study has been carried out on healthy tomato plants to test the pathogenicity of A. tumefaciens before and after the exposure to QAMW at the inhibiting frequency. Symptoms of crown gall and all pathological symptoms were more aggressive in tomato plants treated with non-exposed bacteria, comparing with those treated with exposed bacteria. We concluded that, the exposure of A. tumefaciens to 1.0 Hz QAMW for 90 min modified its cellular activity and DNA structure, which inhibited the growth and affected the microbe pathogenicity.

https://www.ncbi.nlm.nih.gov/pubmed/28988110

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Behavioral testing of mice exposed to intermediate frequency magnetic fields indicates mild memory impairment

Kumari K, Koivisto H, Viluksela M, Paldanius KMA, Marttinen M, Hiltunen M, Naarala J, Tanila H, Juutilainen J. Behavioral testing of mice exposed to intermediate frequency magnetic fields indicates mild memory impairment. PLoS One. 2017 Dec 4;12(12):e0188880.

Abstract

Human exposure to intermediate frequency magnetic fields (MF) is increasing due to applications like electronic article surveillance systems and induction heating cooking hobs. However, limited data is available on their possible health effects. The present study assessed behavioral and histopathological consequences of exposing mice to 7.5 kHz MF at 12 or 120 μT for 5 weeks. No effects were observed on body weight, spontaneous activity, motor coordination, level of anxiety or aggression. In the Morris swim task, mice in the

120 µT group showed less steep learning curve than the other groups, but did not differ from controls in their search bias in the probe test. The passive avoidance task indicated a clear impairment of memory over 48 h in the 120 µT group. No effects on astroglial activation or neurogenesis were observed in the hippocampus. The mRNA expression of brain-derived neurotrophic factor did not change but expression of the proinflammatory cytokine tumor necrosis factor alpha mRNA was significantly increased in the 120 µT group. These findings suggest that 7.5 kHz MF exposure may lead to mild learning and memory impairment, possibly through an inflammatory reaction in the hippocampus.

https://www.ncbi.nlm.nih.gov/pubmed/29206232

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Scientometric study of the effects of exposure to non-ionizing EMF on fertility: Understanding reasons of partial failure

Bernabò N, Ciccarelli R, Greco L, Ordinelli A, Mattioli M, Barboni B. Scientometric study of the effects of exposure to non-ionizing electromagnetic fields on fertility: A contribution to understanding the reasons of partial failure. PLoS One. 2017 Dec 6;12(12):e0187890.

Abstract

The exposure to Non-Ionizing-Electromagnetic Fields (NI-EMFs) is often indicated as a cofactor responsible for the fertility reduction, which has been described in recent years. Despite the great interest in this topic and the research effort in exploring it, to date, there are no reliable data. Therefore, we carried out a scientometric analysis of the scientific literature published in peer reviewed Journals concerning this topic to better understand the reasons of this partial failure. To this aim, we identified and analysed 104 papers, published in last 26 years in peer-reviewed Journals, present in ISI Web of Knowledge Core Collection. Then, we analysed the impact of the Journals in which the papers were published as well as that of the single papers, the paper citation dynamics, the keywords citation busts, the geographical localization of citations and the co-authorship dynamics of the Authors. As a result, we found that different animal models (rodent, rabbit, guinea pig, and swine) and different experimental approaches (epidemiological vs. experimental studies) have the same impact, highlighting the lack of universally adopted standard in research activity. The analysis of the temporal trend in keywords and the high differences in citations between the different countries (also in those belonging to the same geographical and socio-economical area) pointed out the difficulties in approaching this branch of study. Lastly, it was evident that the Authors did not behave as a connected community, but as unconnected clusters of very small size. In conclusion, based on the results of our analysis, we think that important efforts must be undertaken to adopt more standardized models and to improve the research quality and the information exchange within the scientific community, with the aim of improving the reliability and usefulness of the results of research regarding the effect of NI-EMFs on fertility.

https://www.ncbi.nlm.nih.gov/pubmed/29211813

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EMF-Portal, Nov 20, 2017

From November 8-10, 2017, the two international organizations responsible for developing the systems of radiation protection worldwide, the International Commission on Radiological Protection (ICRP), and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) exchanged information and views on the scientific basis, ethical basis, and basic principles of protection. The objectives of this meeting in Munich,

Germany, were to increase mutual understanding of the approaches to protection, to reach a common understanding of the state of the systems of protection and to explore possibilities for continued collaboration. Both organizations have reached an agreement in principle to strengthen communication and collaboration between them and with other organizations with similar interests.

There are many commonalities between the systems of protection used for ionizing and non-ionizing radiation. There are also differences, most stemming from different biological effects. Ionizing radiation can cause stochastic and deterministic effects, while most effects due to exposure from non-ionizing radiation appear to be deterministic. However, stochastic effects have been demonstrated due to exposure to ultraviolet radiation, which bridges the ionizing and non-ionizing parts of the electromagnetic spectrum. For ionizing radiation there is a greater emphasis on optimization of protection even at low levels of exposure, whereas for non-ionizing radiation there is a greater emphasis on keeping exposures below thresholds for observed effects.

You can download the official statement on the meeting from the ICNIRP homepage:
http://www.icnirp.org/cms/upload/doc/JointNoteSystemsofProtectionNov2017.pdf

My note: The statement above seems to reflect a fundamental misunderstanding about the biological effects of non-ionizing radiation. It is no wonder that ICNIRP's radiofrequency guidelines are inadequate to protect human health.

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NTP Study Update: https://ntp.niehs.nih.gov/results/areas/cellphones/

Two-year oncogenicity evaluations of cell phone radiofrequency radiation in Sprague-Dawley rats and B6C3F1 mice

McCormick D. Two-year oncogenicity evaluations of cell phone radiofrequency radiation in Sprague-Dawley rats and B6C3F1 mice. Toxicology Letters. 280 (Suppl. 1): S31. Oct 20, 2017.https://doi.org/10.1016/j.toxlet.2017.07.07

Epidemiology data concerning possible health effects of exposure to radiofrequency fields (RF) are conflicting. For this reason, well-designed and controlled studies in predictive laboratory animal models provide the best prospective opportunity to identify effects of RF exposure that may translate into human health hazards. The U.S. National Toxicology Program supported a program in our laboratory to identify and characterize effects of acute, subchronic, and chronic exposure to non-thermal levels of RF in Sprague-Dawley rats and B6C3F1 mice.

Five-day pilot studies were performed to identify the maximum Specific Absorption Ratios (SARs) to which juvenile, adult, and pregnant rodents can be exposed without increasing body temperature by >1.0 °C. Subsequent subchronic (ten-week) toxicity studies failed to identify any toxicologically significant effects of non-thermal RF on survival, body weight, clinical signs, hematology, or gross or microscopic pathology.

Two-year studies were performed to determine if exposure to non-thermal levels of RF increases the incidence of neoplasia in any site. Male rats exposed to RF demonstrated significantly increased incidences of glioma (brain) and schwannoma (heart); these increases were not seen in female rats or in either sex of mice.

Gliomas and schwannomas have been identified in some epidemiology studies as possible RF-induced neoplasms. Considering (a) the conflicting results of RF epidemiology studies and (b) the lack of generally accepted biophysical or molecular mechanisms through which RF could induce or promote neoplasia, data from animal bioassays will play a central role in “weight-of-the-evidence” assessments of the possible health effects of RF exposure.

http://www.sciencedirect.com/science/article/pii/S0378427417303120?via%3Dihub

Also see: **National Toxicology Program Finds Cell Phone Radiation Causes Cancer**

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Assessment of long-term spatio-temporal radiofrequency electromagnetic field exposure

Aerts S, Wiart J, Martens L, Joseph W. Assessment of long-term spatio-temporal radiofrequency electromagnetic field exposure. Environ Res. 2017 Nov 13;161:136-143. doi: 10.1016/j.envres.2017.11.003.

Abstract

As both the environment and telecommunications networks are inherently dynamic, our exposure to environmental radiofrequency (RF) electromagnetic fields (EMF) at an arbitrary location is not at all constant in time. In this study, more than a year's worth of measurement data collected in a fixed low-cost exposimeter network distributed over an urban environment was analysed and used to build, for the first time, a full spatio-temporal surrogate model of outdoor exposure to downlink Global System for Mobile Communications (GSM) and Universal Mobile Telecommunications System (UMTS) signals. Though no global trend was discovered over the measuring period, the difference in measured exposure between two instances could reach up to 42dB (a factor 12,000 in power density). Furthermore, it was found that, taking into account the hour and day of the measurement, the accuracy of the surrogate model in the area under study was improved by up to 50% compared to models that neglect the daily temporal variability of the RF signals. However, further study is required to assess the extent to which the results obtained in the considered environment can be extrapolated to other geographic locations.

https://www.ncbi.nlm.nih.gov/pubmed/29145005

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Prevalence of various environmental intolerances in a Swedish and Finnish general population

Karvala K, Sainio M, Palmquist E, Nyback MH, Nordin S. Prevalence of various environmental intolerances in a Swedish and Finnish general population. Environ Res. 2017 Nov 18;161:220-228. doi: 10.1016/j.envres.2017.11.014.

Abstract

OBJECTIVE: To determine the prevalence of various environmental intolerances (EIs), using several criteria in a Swedish and a Finnish general population. Ill-health attributed to low-level environmental exposures is a commonly encountered challenge in occupational and environmental medicine.

METHODS: In population-based questionnaire surveys, the Västerbotten Environmental Health Study (Sweden) and the Österbotten Environmental Health Study (Finland), EI was inquired by one-item questions on symptom attribution to chemicals, certain buildings, or electromagnetic fields (EMFs), and difficulties tolerating sounds. The respondents were asked whether they react with central nervous system (CNS) symptoms or have a physician-diagnosed EI attributed to the corresponding exposures. Prevalence rates were determined for different age and sex groups and the Swedish and Finnish samples in general.

RESULTS: In the **Swedish sample (n = 3406)**, 12.2% had self-reported intolerance to chemicals, 4.8% to certain buildings, **2.7% to EMFs,** and 9.2% to sounds. The prevalence rates for the **Finnish sample (n = 1535)** were 15.2%, 7.2%, **1.6%**, and 5.4%, respectively, differing statistically significantly from the Swedish. EI to chemicals and certain buildings was more prevalent in Finland, while **EI to EMFs** and sounds **more prevalent in Sweden**. The prevalence rates for EI with CNS-symptoms were lower and physician-diagnosed EIs considerably lower than self-reported EIs. Women reported EI more often than men and the young (18-39

years) to a lesser degree than middle-aged and elderly.

CONCLUSIONS: The findings reflect the heterogeneous nature of EI. The differences in EI prevalence between the countries might reflect disparities concerning which exposures people perceive harmful and focus their attention to.

https://www.ncbi.nlm.nih.gov/pubmed/29161654

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Assessment of exposure to RF EMF from smart meters in GB; part II) numerical assessment of SAR within human body

Qureshi MRA, Alfadhl Y, Chen X, Peyman A, Maslanyj M, Mann S. Assessment of exposure to radio frequency electromagnetic fields from smart utility meters in GB; part II) numerical assessment of induced SAR within the human body. Bioelectromagnetics. 2017 Nov 16.
Abstract

Human body exposure to radiofrequency electromagnetic waves emitted from smart meters was assessed using various exposure configurations. Specific energy absorption rate distributions were determined using three anatomically realistic human models. Each model was assigned with age- and frequency-dependent dielectric properties representing a collection of age groups. Generalized exposure conditions involving standing and sleeping postures were assessed for a home area network operating at 868 and 2,450 MHz. The smart meter antenna was fed with 1 W power input which is an overestimation of what real devices typically emit (15 mW max limit). The highest observed whole body specific energy absorption rate value was 1.87 mW kg^{-1}, within the child model at a distance of 15 cm from a 2,450 MHz device. The higher values were attributed to differences in dimension and dielectric properties within the model. Specific absorption rate (SAR) values were also estimated based on power density levels derived from electric field strength measurements made at various distances from smart meter devices. All the calculated SAR values were found to be very small in comparison to International Commission on Non-Ionizing Radiation Protection limits for public exposure.

https://www.ncbi.nlm.nih.gov/pubmed/29143352

Also see: **Health Experts Caution About Smart Meters**

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Acute effects of the electromagnetic waves emitted by mobile phones on attention in emergency physicians

Altuntas G, Sadoglu D, Ardic S, Yilmaz H, Imamoglu M, Turedi S.Acute effects of the electromagnetic waves emitted by mobile phones on attention in emergency physicians. Am J Emerg Med. 2017 Nov 13. pii: S0735-6757(17)30940-3. doi: 10.1016/j.ajem.2017.11.031.

Abstract

STUDY OBJECTIVE: The purpose of this study was to investigate the acute effects of the electromagnetic waves (EMW) emitted by mobile phones on attention in emergency physicians.

METHODS: This single-center, prospective, randomized, double-blinded clinical study was performed among emergency physicians in a tertiary hospital. Thirty emergency physicians were enrolled in the study. Initial d2 test was applied in the evaluation of attention and concentration of all the physicians, who were randomly assigned into one of two groups. The control group members hold mobile phones in 'off' mode to their left ears

for 15min. The members of the intervention group hold mobile phones in 'on' mode to their left ears for 15min, thus exposing them to 900-1800MHz EMW. The d2 test was re-applied to both groups after this procedure. Differences in attention and concentration levels between the groups were compared.

RESULTS: Difference between initial and final d2 test in total performance (TN-E, p=0.319), in total number of figures marked (TN, p=0.177), in test performance percentile (PR, p=0.619) and in attention fluctuation (FR, p=0.083) were similar between the groups. However, difference in the number of figures missed (E1 selective attention, p=0.025), difference between numbers of incorrectly marked figures (E2, p=0,018) and difference in focus levels (E, p=0.016) were significantly in favor of the intervention group.

CONCLUSION: According to our study findings, the EMW emitted by mobile phones has no deleterious effect on the attention and concentration levels of emergency physicians, and even has a positive impact on selective attention levels.

https://www.ncbi.nlm.nih.gov/pubmed/29157789

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Effects of 1.8 GHz Radiofrequency Fields on the Emotional Behavior and Spatial Memory of Adolescent Mice

Zhang JP, Zhang KY, Guo L, Chen QL, Gao P, Wang T, Li J, Guo GZ, Ding GR. Effects of 1.8 GHz Radiofrequency Fields on the Emotional Behavior and Spatial Memory of Adolescent Mice. Int J Environ Res Public Health. 2017 Nov 5;14(11). pii: E1344. doi: 10.3390/ijerph14111344.

Abstract

The increasing use of mobile phones by teenagers has raised concern about the cognitive effects of radiofrequency (RF) fields. In this study, we investigated the effects of 4-week exposure to a 1.8 GHz RF field on the emotional behavior and spatial memory of adolescent male mice. Anxiety-like behavior was evaluated by open field test (OFT) and elevated plus maze (EPM) test, while depression-like behavior was evaluated by sucrose preference test (SPT), tail suspension test (TST) and forced swim test (FST). The spatial learning and memory ability were evaluated by Morris water maze (MWM) experiments. The levels of amino acid neurotransmitters were determined by liquid chromatography-mass spectrometry (LC-MS). The histology of the brain was examined by hematoxylin-eosin (HE) staining. It was found that the depression-like behavior, spatial memory ability and histology of the brain did not change obviously after RF exposure. However, the anxiety-like behavior increased in mice, while, the levels of γ-aminobutyric acid (GABA) and aspartic acid (Asp) in cortex and hippocampus significantly decreased after RF exposure. These data suggested that RF exposure under these conditions do not affect the depression-like behavior, spatial memory and brain histology in adolescent male mice, but it may however increase the level of anxiety, and GABA and Asp were probably involved in this effect.

Note: The 1.8 GHz frequency field was not modulated like cellphone radiation.

Excerpts

Mice were exposed to 1.8 GHz frequency field for 28 days, 6 h/day (9:00 AM to 3:00 PM). During exposure, the animals had access to food and water. The SAR of whole body and brain were approximately 2.7 W/kg and 2.2 W/kg at a distance of 1 m from the antenna. Since the incidence and polarization of free movement mice kept changing during exposure, the deviation between the average SAR value and the maximum and the minimum of SAR was about 8%. The power density in this study was 530 μW/cm^2 ...

It was found that exposure to 2.70 W/kg RF field did not obviously affect the surface body temperature of mice (Figure 1), which suggested that no gross thermal effects were involved. Additionally, the air temperature of the

exposure cage with a temperature hygrometer was measured and the results showed that air temperature difference did not exceed 0.1 °C during 6 h exposure.

Effects of RF Exposure on Anxiety-Like Behaviors

The anxiety-like behaviors of mice were evaluated by OFT and EPM after RF exposure. OFT results showed that there were no significant differences in accumulative total distance traveled between the sham group and RF group (Figure 2a). However, the accumulative distance in the center area and the time spent in the central area decreased significantly in the RF group, compared with the sham group (Figure 2b,c), which indicated that 4-week RF exposure could increase the animals' anxiety-like behavior.

In addition, EPM results showed that there were no significant differences in the number of total entries into the arms between the sham group and RF group, which indicated that the locomotor activity in the mice did not change after RF exposure (Figure 3a). However, the percentage of the total time spent in the open arms and the percentage of the entries into the open arms decreased significantly in the RF group, compared with the sham group (Figure 3b,c). These results were consistent with that of OFT.

It was reported that GABA in mice brain, plays a key role in the modulation of anxiety response [40,41,42,43], and in this study, we found that the level of GABA in mice brain decreased significantly after RF exposure. Considering the OFT and EPM results, we speculated that the GABA probably was involved in RF induce anxiety in mice. Additionally, it was found that the level of Asp in mice brain significantly changed after RF exposure. Regarding the relationship between the behavior and Asp remains unclear.

In the present study, brain SAR 2.2 W/kg was selected based on the 2.0 W/kg limit by the International Commission on Nonionizing Radiation Protection (ICNIRP) and Institute of Electrical and Electronics Engineers (IEEE) [44,45]. It was found that after 6 h RF field exposure, the temperature of mice surface body did not change obviously compared with sham group, which suggested that no gross thermal effects were involved in RF-induced anxiety behavior in mice.

Conclusions

4-week exposure to 1.8 GHz RF field had no significant effect on depression-like behavior, spatial learning and memory ability or the histology of brain in adolescent male mice. However, it may increase the level of anxiety, and amino acid neurotransmitters such as GABA might be involved.

Open Access Paper: http://www.mdpi.com/1660-4601/14/11/1344

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Exposure to 835 MHz RF EMF induces autophagy in hippocampus but not in brain stem of mice

Kim JH, Yu DH, Kim HJ, Huh YH, Cho SW, Lee JK, Kim HG, Kim HR. Exposure to 835 MHz radiofrequency electromagnetic field induces autophagy in hippocampus but not in brain stem of mice. Toxicol Ind Health. 2017 Jan 1:748233717740066. doi: 10.1177/0748233717740066.

Abstract

The exploding popularity of mobile phones and their close proximity to the brain when in use has raised public concern regarding possible adverse effects from exposure to radiofrequency electromagnetic fields (RF-EMF) on the central nervous system. Numerous studies have suggested that RF-EMF emitted by mobile phones can influence neuronal functions in the brain. Currently, there is still very limited information on what biological mechanisms influence neuronal cells of the brain. In the present study, we explored whether autophagy is triggered in the hippocampus or brain stem after RF-EMF exposure. C57BL/6 mice were exposed to 835 MHz RF-EMF with specific absorption rates (SAR) of 4.0 W/kg for 12 weeks; afterward, the hippocampus and brain stem of mice were dissected and analyzed. Quantitative real-time polymerase chain reaction (qRT-PCR) analysis demonstrated that several autophagic genes, which play key roles in autophagy regulation, were significantly upregulated only in the hippocampus and not in the brain stem. Expression levels of LC3B-II protein and p62, crucial autophagic regulatory proteins, were significantly changed only in the hippocampus. In parallel, transmission electron microscopy (TEM) revealed an increase in the number of autophagosomes and autolysosomes in the hippocampal neurons of RF-EMF-exposed mice. The present study revealed that autophagy was induced in the hippocampus, not in the brain stem, in 835 MHz RF-EMF with an SAR of 4.0 W/kg for 12 weeks. These results could suggest that among the various adaptation processes to the RF-EMF exposure environment, autophagic degradation is one possible mechanism in specific brain regions.

https://www.ncbi.nlm.nih.gov/pubmed/29166827

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Rats exposed to 2.45 GHz of non-ionizing radiation exhibit behavioral changes with increased brain expression of apoptotic caspase 3

Varghese R, Majumdar A, Kumar G, Shukla A. Rats exposed to 2.45GHz of non-ionizing radiation exhibit behavioral changes with increased brain expression of apoptotic caspase 3. Pathophysiology. 2017 Nov 14. pii: S0928-4680(17)30052-4. doi: 10.1016/j.pathophys.2017.11.001.

Highlights

• The exposure to non-ionizing radiation of 2.45 GHz caused detrimental changes in rat brain leading to learning and memory decline and expression of anxiety behavior.
• The exposure to radiation induced oxidative stress and fall in brain antioxidants.
• The exposure triggered the gene expression of caspase 3.

Abstract

In recent years there has been a tremendous increase in use of Wi-Fi devices along with mobile phones, globally. Wi-Fi devices make use of 2.4 GHz frequency. The present study evaluated the impact of 2.45 GHz radiation exposure for 4h/day for 45 days on behavioral and oxidative stress parameters in female Sprague Dawley rats. Behavioral tests of anxiety, learning and memory were started from day 38. Oxidative stress parameters were estimated in brain homogenates after sacrificing the rats on day 45. In morris water maze, elevated plus maze and light dark box test, the 2.45 GHz radiation exposed rats elicited memory decline and anxiety behavior. Exposure decreased activities of super oxide dismutase, catalase and reduced glutathione levels whereas increased levels of brain lipid peroxidation was encountered in the radiation exposed rats, showing compromised anti-oxidant defense. Expression of caspase 3 gene in brain samples were quantified which unraveled notable increase in the apoptotic marker caspase 3 in 2.45 GHz radiation exposed group as compared to sham exposed group. No significant changes were observed in histopathological examinations and brain levels of TNF-α. Analysis of dendritic arborization of neurons showcased reduction in number of dendritic branching and intersections which corresponds to alteration in dendritic structure of neurons, affecting neuronal signaling. The study clearly indicates that exposure of rats to microwave radiation of 2.45GHz leads to detrimental changes in brain leading to lowering of learning and memory and expression of anxiety behavior in rats along with fall in brain antioxidant enzyme systems.

https://www.ncbi.nlm.nih.gov/pubmed/29153770

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Effects of exposure to EMF from 915 MHz RFID system on circulating blood cells in the healthy adult rat

Kim HS, Park JS, Jin YB, Do Choi H, Kwon JH, Pack JK, Kim N, Ahn YH. Effects of exposure to electromagnetic field from 915 MHz radiofrequency identification system on circulating blood cells in the healthy adult rat. Bioelectromagnetics. 2017 Nov 24. doi: 10.1002/bem.22093.

Abstract

We investigated whether exposure to the 915 MHz radiofrequency identification (RFID) signal affected circulating blood cells in rats. Sprague-Dawley rats were exposed to RFID at a whole-body specific absorption rate of 2 W/kg for 8 h per day, 5 days per week, for 2 weeks. Complete blood counts were performed after RFID exposure, and the CD4+ /CD8+ ratio was determined by flow cytometry. The number of red blood cells (RBCs) and the values of hemoglobin, hematocrit, and RBC indices were increased in the RFID-exposed group compared with those in the cage-control and sham-exposed groups ($P < 0.05$). However, the RBCs and platelet numbers were within normal physiologic response ranges. The number of white blood cells, including lymphocytes, was decreased in RFID-exposed rats. However, there was no statistically significant difference between the sham-exposed and RFID-exposed groups in terms of T-cell counts or CD4+ /CD8+.

https://www.ncbi.nlm.nih.gov/pubmed/29171038

Excerpts

A period of 2 weeks in rats corresponds to 1.5 years in human if calculated based on a human life expectancy of 80 years.

2 W/kg is about five times the occupational exposure limit 0.4 W/kg of ICNIRP/IEEE guidelines at the distance of 12 cm from RFID antenna.

As RF-EMF exposure can affect body temperature, we measured rectal temperature before and after RFID exposure; no statistically significant changes in temperature were found in our exposure system ....

... although circulating blood cell counts were significantly affected by exposure to 915 MHz RFID at a whole-body SAR of 2 W/kg for 2 weeks, these changes do not necessarily indicate that RFID exposure is harmful, as values remained within normal physiological response ranges.

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Exposure to a specific time-varying electromagnetic field inhibits cell proliferation via cAMP and ERK signaling in cancer cells

Buckner CA, Buckner AL, Koren SA, Persinger MA, Lafrenie RM. Exposure to a specific time-varying electromagnetic field inhibits cell proliferation via cAMP and ERK signaling in cancer cells. Bioelectromagnetics. 2017 Nov 10. doi: 10.1002/bem.22096.

Abstract

Exposure to specific electromagnetic field (EMF) patterns can affect a variety of biological systems. We have shown that exposure to Thomas-EMF, a low-intensity, frequency-modulated (25-6 Hz) EMF pattern, inhibited

growth and altered cell signaling in malignant cells. Exposure to Thomas-EMF for 1 h/day inhibited the growth of malignant cells including B16-BL6 mouse melanoma cells, MDA-MB-231, MDA-MB-468, BT-20, and MCF-7 human breast cancer and HeLa cervical cancer cells but did not affect non-malignant cells. The Thomas-EMF-dependent changes in cell proliferation were mediated by adenosine 3',5'-cyclic monophosphate (cAMP) and extracellular-signal-regulated kinase (ERK) signaling pathways. Exposure of malignant cells to Thomas-EMF transiently changed the level of cellular cAMP and promoted ERK phosphorylation. Pharmacologic inhibitors (SQ22536) and activators (forskolin) of cAMP production both blocked the ability of Thomas-EMF to inhibit cell proliferation, and an inhibitor of the MAP kinase pathway (PD98059) was able to partially block Thomas-EMF-dependent inhibition of cell proliferation. Genetic modulation of protein kinase A (PKA) in B16-BL6 cells also altered the effect of Thomas-EMF on cell proliferation. Cells transfected with the constitutively active form of PKA (PKA-CA), which interfered with ERK phosphorylation, also interfered with the Thomas-EMF effect on cell proliferation. The non-malignant cells did not show any EMF-dependent changes in cAMP levels, ERK phosphorylation, or cell growth. These data indicate that exposure to the specific Thomas-EMF pattern can inhibit the growth of malignant cells in a manner dependent on contributions from the cAMP and MAP kinase pathways.

https://www.ncbi.nlm.nih.gov/pubmed/29125193

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Oxidative stress response in SH-SY5Y cells exposed to short-term 1800 MHz radiofrequency radiation

Marjanovic Cermak AM, Pavicic I, Trosic I. Oxidative stress response in SH-SY5Y cells exposed to short-term 1800 MHz radiofrequency radiation. J Environ Sci Health A Tox Hazard Subst Environ Eng. 2017 Nov 17:1-7. doi: 10.1080/10934529.2017.1383124.

Abstract

The exact mechanism that could explain the effects of radiofrequency (RF) radiation exposure at non-thermal level is still unknown. Increasing evidence suggests a possible involvement of reactive oxygen species (ROS) and development of oxidative stress. To test the proposed hypothesis, human neuroblastoma cells (SH-SY5Y) were exposed to 1800 MHz short-term RF exposure for 10, 30 and 60 minutes. Electric field strength within Gigahertz Transverse Electromagnetic cell (GTEM) was 30 V m-1 and specific absorption rate (SAR) was calculated to be 1.6 W kg-1. Cellular viability was measured by MTT assay and level of ROS was determined by fluorescent probe 2',7'-dichlorofluorescin diacetate. Concentrations of malondialdehyde and protein carbonyls were used to assess lipid and protein oxidative damage and antioxidant activity was evaluated by measuring concentrations of total glutathione (GSH). After radiation exposure, viability of irradiated cells remained within normal physiological values. Significantly higher ROS level was observed for every radiation exposure time. After 60 min of exposure, the applied radiation caused significant lipid and protein damage. The highest GSH concentration was detected after 10 minute-exposure. The results of our study showed enhanced susceptibility of SH-SY5Y cells for development of oxidative stress even after short-term RF exposure.

https://www.ncbi.nlm.nih.gov/pubmed/29148897

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Effects of GSM and UMTS mobile telephony signals on neuron degeneration and blood-brain barrier permeation in the rat brain

Poulletier de Gannes F, Masuda H, Billaudel B, Poque-Haro E, Hurtier A, Lévêque P, Ruffié G, Taxile M, Veyret B, Lagroye I. Effects of GSM and UMTS mobile telephony signals on neuron degeneration and blood-brain barrier permeation in the rat brain. Sci Rep. 2017 Nov 14;7(1):15496. doi: 10.1038/s41598-017-15690-1.

Abstract

Blood-brain barrier (BBB) permeation and neuron degeneration were assessed in the rat brain following exposure to mobile communication radiofrequency (RF) signals (GSM-1800 and UMTS-1950). Two protocols were used: (i) single 2 h exposure, with rats sacrificed immediately, and 1 h, 1, 7, or 50 days later, and (ii) repeated exposures (2 h/day, 5 days/week, for 4 weeks) with the effects assessed immediately and 50 days after the end of exposure. The rats' heads were exposed at brain-averaged specific absorption rates (BASAR) of 0.026, 0.26, 2.6, and 13 W/kg. No adverse impact in terms of BBB leakage or neuron degeneration was observed after single exposures or immediately after the end of repeated exposure, with the exception of a transient BBB leakage (UMTS, 0.26 W/kg). Fifty days after repeated exposure, the occurrence of degenerating neurons was unchanged on average. However, a significant increased albumin leakage was detected with both RF signals at 13 W/kg. In this work, the strongest, delayed effect was induced by GSM-1800 at 13 W/kg. Considering that 13 W/kg BASAR in the rat head is equivalent to 4 times as much in the human head, deleterious effects may occur following repeated human brain exposure above 50 W/kg.

Excerpt

In the present work, BBB permeability in the whole rat brain increased significantly 50 days after repeated exposures: 3-fold for GSM and 2.4-fold for UMTS at 13 W/kg. **A similar significant effect was seen in the whole brain with GSM-1800 at 0.26 W/kg. However, while the mean number of spots was quite similar at different BASAR levels, their distribution among the animals varied.** For example, 20% of the 0.026 W/kg rats had between 4 and 5.5 spots, versus 45% of the 13 W/kg rats (data not shown). Thus, **the effect was much stronger and consistent at 13 W/kg than at 0.026 W/kg or 0.26 W/kg.** It is also noteworthy that the highest albumin levels were comparable to the highest background levels in cage-control rats (Fig. 3).

Open Access Paper: https://www.nature.com/articles/s41598-017-15690-1

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Exposure to 2100 MHz electromagnetic field radiations induces reactive oxygen species generation in Allium cepa roots

Shikha Chandel, Shalinder Kaur, Harminder Pal Singh, Daizy Rani Batish, Ravinder Kumar Kohli. Exposure to 2100 MHz electromagnetic field radiations induces reactive oxygen species generation in Allium cepa roots. Journal of Microscopy and Ultrastructure, 5(4):225-229. Dec 2017,

Abstract

During the last few decades there has been an enormous increase in the usage of cell phones as these are one of the most convenient gadgets and provide excellent mode of communication without evoking any hindrance to movement. However, these are significantly adding to the electromagnetic field radiations (EMF-r) in the environment and thus, are required to be analysed for their impacts on living beings. The present study investigated the role of cell phone EMF-r in inciting oxidative damage in onion (Allium cepa) roots at a frequency of 2100 MHz. Onion roots were exposed to continuous wave homogenous EMF-r for 1, 2 and 4 h for single day and generation of reactive oxygen species (ROS) in terms of malondialdehyde (MDA), hydrogen peroxide (H2O2) and superoxide anion (O2−) content and changes in the activities of antioxidant enzymes-superoxide dismutases (SOD) and catalases (CAT) were measured. The results showed that EMF-r exposure enhanced the content of MDA, H2O2 and O2−. Also, there was an upregulation in the activity of antioxidant enzymes− SOD and CAT− in onion roots. The study concluded that 2100 MHz cell phone EMF-r incite oxidative damage in onion roots by altering the oxidative metabolism.

Open Access Paper: http://www.sciencedirect.com/science/article/pii/S2213879X17300809

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Retrospective estimation of ELF & MF exposure in in vitro studies reveal considerable potential for uncertainty

Portelli LA, Falldorf K, Thuróczy G, Cuppen J. Retrospective estimation of the electric and magnetic field exposure conditions in in vitro experimental reports reveal considerable potential for uncertainty. Bioelectromagnetics. 2017 Nov 24. doi: 10.1002/bem.22099.

Abstract

Experiments on cell cultures exposed to extremely low frequency (ELF, 3-300 Hz) magnetic fields are often subject to multiple sources of uncertainty associated with specific electric and magnetic field exposure conditions. Here we systemically quantify these uncertainties based on exposure conditions described in a group of bioelectromagnetic experimental reports for a representative sampling of the existing literature. The resulting uncertainties, stemming from insufficient, ambiguous, or erroneous description, design, implementation, or validation of the experimental methods and systems, were often substantial enough to potentially make any successful reproduction of the original experimental conditions difficult or impossible. Without making any assumption about the true biological relevance of ELF electric and magnetic fields, these findings suggest another contributing factor which may add to the overall variability and irreproducibility traditionally associated with experimental results of in vitro exposures to low-level ELF magnetic fields.

https://www.ncbi.nlm.nih.gov/pubmed/29171034

Conclusions

In bioelectromagnetics experiments, the general aim of exposures is to increase the likelihood of evoking discernible low-level ELF magnetic field effects, even if they are small. It follows that all biologically relevant experimental conditions must be reasonably reproducible in order for any such effects to be consistently observed and mature into established scientific facts. This work shows that the potential electric and magnetic field exposure uncertainties associated with a considerable portion of the in vitro low-level ELF magnetic field experiments reported are substantial. For these cases, the uncertainties may exceed levels that would allow for satisfactory reproduction of such exposures in subsequent experimental attempts, and raise doubts about the quality of the reported data to reasonably assess the significance of the biological effects of such exposures, should they exist. Although the definitive importance of this study is contingent on the concrete biological relevance of low-level ELF electric and magnetic fields, these findings suggest another factor which may contribute to the overall variability and irreproducibility traditionally associated with experimental results in this area.

Therefore, it is imperative that the dedicated bioelectromagnetics researcher puts sufficient care into minimizing any potential sort of experimental exposure conditions uncertainty by designing, validating, executing, and reporting the experimental systems and methods carefully and completely from a replication perspective specifically. It is clear that individual experiments and protocols cannot be standardized as they differ in an endpoint-to-endpoint basis; nevertheless, it is the direct responsibility of the researcher to build the necessary framework that fits his specific experimental systems and procedures in a way that they may be replicated within reasonable bounds. For this, the resources presented in this manuscript and those provided by several other researchers in the community for more than 40 years can be useful [Bassett et al., 1974; Bassen et al., 1992; Valberg, 1995; Kuster and Schönborn, 2000; Vijayalaxmi, 2016; Markov, 2017]. Additionally, this endeavor may require the consideration of factors typically excluded from the standard dosimetric scope without proper justification other than for being difficult to characterize. For instance, in acknowledging the hard reality that cellular systems respond to diverse aspects of their immediate environment, the bioelectromagnetics community may embrace the need for complete uncertainty budgets based on computation and experimental validation of the electric and magnetic fields at the cellular level. This may result in the consideration of microdosimetric analysis as an additional (and perhaps indispensable)

approach to reduce uncertainty within reasonable levels, depending on the specific experimental conditions at play.

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Cellular Response to ELF-MF and Heat: Evidence for a Common Involvement of Heat Shock Proteins?

Zeni O, Simkó M, Rosaria Scarfi M, Mattsson MO.Cellular Response to ELF-MF and Heat: Evidence for a Common Involvement of Heat Shock Proteins? Public Health, 18 October 2017 | https://doi.org/10.3389/fpubh.2017.00280

It has been shown that magnetic fields in the extremely low frequency range (ELF-MF) can act as a stressor in various *in vivo* or *in vitro* systems, at flux density levels below those inducing excitation of nerve and muscle cells, which are setting the limits used by most generally accepted exposure guidelines, such as the ones published by the International Commission on Non-Ionizing Radiation Protection. In response to a variety of physiological and environmental factors, including heat, cells activate an ancient signaling pathway leading to the transient expression of heat shock proteins (HSPs), which exhibit sophisticated protection mechanisms. A number of studies suggest that also ELF-MF exposure can activate the cellular stress response and cause increased HSPs expression, both on the mRNA and the protein levels. In this review, we provide some of the presently available data on cellular responses, especially regarding HSP expression, due to single and combined exposure to ELF-MF and heat, with the aim to compare the induced effects and to detect possible common modes of action. Some evidence suggest that MF and heat can act as costressors inducing a kind of thermotolerance in cell cultures and in organisms. The MF exposure might produce a potentiated or synergistic biological response such as an increase in HSPs expression, in combination with a well-defined stress, and in turn exert beneficial effects during certain circumstances.

Open Access Paper: https://www.frontiersin.org/articles/10.3389/fpubh.2017.00280/full

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Effects of EMF emissions from undersea electric cables on coral reef fish

Kilfoyle AK, Jermain RF, Dhanak MR, Huston JP, Spieler RE. Effects of EMF emissions from undersea electric cables on coral reef fish. Bioelectromagnetics. 2017 Nov 9. doi: 10.1002/bem.22092.

Abstract

The objective of this study was to determine if electromagnetic field (EMF) emissions from undersea power cables impacted local marine life, with an emphasis on coral reef fish. The work was done at the South Florida Ocean Measurement Facility of Naval Surface Warfare Center in Broward County, Florida, which has a range of active undersea detection and data transmission cables. EMF emissions from a selected cable were created during non-destructive visual fish surveys on SCUBA. During surveys, the transmission of either alternating current (AC), direct current (DC), or none (OFF) was randomly initiated by the facility at a specified time. Visual surveys were conducted using standardized transect and point-count methods to acquire reef fish abundances and species richness prior to and immediately after a change in transmission frequency. The divers were also tasked to note the reaction of the reef fish to the immediate change in EMF during a power transition. In general, analysis of the data did not find statistical differences among power states and any variables. However, this may be a Type II error as there are strong indications of a potential difference of a higher abundance of reef fish at the sites when the power was off, and further study is warranted.

https://www.ncbi.nlm.nih.gov/pubmed/29119574

Conclusions

In conclusion, much of the literature dealing with EMF effects on marine vertebrates can be summed up as contradictory or inconclusive. This study is in some measures likewise. There are some caveats to consider. We did not see adequate numbers of some species, especially elasmobranchs, known to reside in or transit the area. Thus, some local species might be impacted but our results would not clearly show it. Also, we cannot discount the possibility that the time intervals between power states utilized here (approximately 30 min) to assess changes in reef fish populations was too short to capture slow changes that may be occurring as a result of altering the power state, and the low sample sizes and high count variability may be obscuring some statistical analyses. These caveats notwithstanding, we did not find that the EMF provided at the SFOMF had dramatic impact on the fish assemblage we examined. Nonetheless, although no behavioral effects were noted, the distribution data do provide evidence that the EMF may be eliciting some short-term impact on fish leading to their avoidance of both the AC- and DC-generated EMF. We are reluctant to say this impact is benign. Subtle changes in place preference may result from EMF-induced changes in orientation, anxiety, temperature, etc. The potential long-term effect of such impact, if any, on the distributions of fish populations and community structure is not known, and further research is needed. Additional studies involving larger sample sizes, longer time intervals with the power remaining constant for each particular current type (OFF vs. AC vs. DC), different power strengths, and sites are required. Because the potential sensitivity of most non-elasmobranch fish to EMFs appears low, combining such field studies in conjunction with laboratory behavioral studies would likely produce more conclusive results.

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News Item: International EMF Expert Group to Counter ICNIRP

ECERI Newsletter. No. 6, June 2017

Following a recent meeting with WHO representatives in Geneva, members of this ECERI group have decided to publish their own data in the form of a scientific consensus paper on the effects of non-thermal EMFs on behalf of the ECERI. Finally, since several ECERI scientists believe that environmental pollution may in fact be a cause of cancer and other diseases such as Alzheimer disease and autism, ECERI has proposed to create another international group comprising scientists and jurists to discuss the possibility that intentional massive pollution could be recognized by the International Criminal Court (ICC) as a true crime against health. This proposal will be discussed at the next ECERI Executive Committee and General Assembly in Brussels.

Following the meeting with WHO in Geneva on March, the 3rd, it was proposed to create an ECERI-related working group to oppose ICNIRP (International Commission on Non-Ionizing Radiation Protection), that might be termed “International commission of scientific expertise on non-thermal radiation effects (ICSENTRE). The members of this group so far are: Dominique Belpomme (France), Igor Belyaev (Slovakia), Ernesto Burgio (Italy), David Carpenter (USA), Lennart Hardell (Sweden), Magda Havas (Canada), SMJ Mortazavi (Iran), André Vander Vorst (Belgium) and Gérard Ledoigt (France). If you wish to join this group, please contact Christine Campagnac (sg.eceri@gmail.com).

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Thermal Modeling for the Next Generation of Radiofrequency Exposure Limits: Commentary

Foster KR, Ziskin MC, Balzano Q. Thermal Modeling for the Next Generation of Radiofrequency Exposure Limits: Commentary. Health Phys. 2017 Jul;113(1):41-53. doi: 10.1097/HP.0000000000000671.

Abstract

This commentary evaluates two sets of guidelines for human exposure to radiofrequency (RF) energy, focusing on the frequency range above the "transition" frequency at 3-10 GHz where the guidelines change their basic restrictions from specific absorption rate to incident power density, through the end of the RF band at 300 GHz. The analysis is based on a simple thermal model based on Pennes' bioheat equation (BHTE) (Pennes 1948) assuming purely surface heating; an Appendix provides more details about the model and its range of applicability. This analysis suggests that present limits are highly conservative relative to their stated goals of limiting temperature increase in tissue. As applied to transmitting devices used against the body, they are much more conservative than product safety standards for touch temperature for personal electronics equipment that are used in contact with the body. Provisions in the current guidelines for "averaging time" and "averaging area" are not consistent with scaling characteristics of the bioheat equation and should be refined. The authors suggest the need for additional limits on fluence for protection against brief, high intensity pulses at millimeter wave frequencies. This commentary considers only thermal hazards, which form the basis of the current guidelines, and excludes considerations of reported "non-thermal" effects of exposure that would have to be evaluated in the process of updating the guidelines.

https://www.ncbi.nlm.nih.gov/pubmed/28542010

Excerpts

"To avoid misinterpretation, the authors emphasize that they consider only thermal hazards and do not comment on the contentious issue of “non-thermal” effects, which would have to be evaluated by the expert panels that update the limits...."

"Low-level effects: Despite more than 50 years of RF research, low-level biological effects have not been established. No theoretical mechanism has been established that supports the existence of any effect characterized by trivial heating other than microwave hearing.”

"The technology for exposure assessment needs to be improved, particularly at frequencies between the transition (10 GHz for ICNIRP) and the beginning of the mm wave band (30 GHz) where the energy penetration depth in skin ranges from about 2 mm (10 GHz) to less than 1 mm (30 GHz) (Table A1, Appendix). The transition between use of SAR as the dosimetric quantity below the transition frequency to incident power density above it is not reflected in the physics of electromagnetic waves, which obey the same propagation laws at all frequencies."

"Moreover, thermal modeling remains problematic, particularly for long-term (several minutes or more) exposures. The applicability and accuracy of the BHTE for calculating skin temperature increases for general exposure situations (arbitrary exposed areas of skin, steady state temperatures) have been subjected to almost no experimental tests for RF exposures at any frequency. Absent experimental validation of a generally useful thermal model, this calls for caution in setting limits based on thermal modeling."

"The authors declare no conflicts of interest."

"Acknowledgments—This work was sponsored by Mobile Manufacturers Forum, which had no control over the contents of this paper. The authors thank Dr. C-K Chou for helpful suggestions on this work."

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Mobile phone use, school EMF levels & related symptoms: cross-sectional survey among high school students in Turkish city

Durusoy R, Hassoy H, Özkurt A, Karababa AO. Mobile phone use, school electromagnetic field levels and related symptoms: a cross-sectional survey among 2150 high school students in Izmir. Environ Health. 2017 Jun 2;16(1):51. doi: 10.1186/s12940-017-0257-x.

Abstract

BACKGROUND: Health outcomes of electromagnetic fields (EMF) from mobile phones and their base stations are of concern. Conducting multidisciplinary research, targeting children and exploring dose-response are recommended. Our objectives were to describe the mobile phone usage characteristics of high school students and to explore the association between mobile phone usage characteristics, high school EMF levels and self-reported symptoms.

METHODS: This cross-sectional study's data were collected by a survey questionnaire and by measuring school EMF levels between November 2009 and April 2011. A sample size of 2530 was calculated from a total of 20,493 students in 26 high schools and 2150 (85.0%) were included in the analysis. The frequencies of 23 symptoms were questioned and analysed according to 16 different aspects of mobile phone use and school EMF levels, exploring also dose-response. School EMF levels were measured with Aaronia Spectran HF-4060 device. Chi square and trend tests were used for univariate and logistic regression was used for multivariate analyses.

RESULTS: Among participants, 2021 (94.0%) were using mobile phones and 129 (6.0%) were not. Among users, 49.4% were speaking <10 min and 52.2% were sending/receiving 75 or more messages per day. Headache, fatigue and sleep disturbances were observed respectively 1.90 (95% CI 1.30-2.77), 1.78 (1.21-2.63) and 1.53 (1.05-2.21) times more among mobile phone users. Dose-response relationships were observed especially for the number of calls per day, total duration of calls per day, total number of text messages per day, position and status of mobile phone at night and making calls while charging as exposures and headache, concentration difficulties, fatigue and sleep disturbances as general symptoms and warming of the ear and flushing as local symptoms.

CONCLUSIONS: We found an association between mobile phone use and especially headache, concentration difficulties, fatigue, sleep disturbances and warming of the ear showing also dose-response. We have found limited associations between vicinity to base stations and some general symptoms; however, we did not find any association with school EMF levels. Decreasing the numbers of calls and messages, decreasing the duration of calls, using earphones, keeping the phone away from the head and body and similar precautions might decrease the frequencies or prevalence of the symptoms.

https://www.ncbi.nlm.nih.gov/pubmed/28577556

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On the biophysical mechanism of sensing atmospheric discharges by living organisms

Dimitris J. Panagopoulos, Alfonso Balmori. On the biophysical mechanism of sensing atmospheric discharges by living organisms. Science of the Total Environment. 599-600:2026-2034. Dec 1, 2017. https://doi.org/10.1016/j.scitotenv.2017.05.089• The symptoms are mainly headache, fatigue, sleep disorders etc.

• Sferics consist of partially polarized electromagnetic pulses.
• Sferics have adequate intensity and polarization to cause biological/health effects.
• We provide a novel biophysical explanation for sensing sferics by living organisms.

Abstract

Atmospheric electrical discharges during thunderstorms, and the related electromagnetic fields (EMFs)/waves called sferics, can be sensed by humans at long distances through a variety of symptoms, mainly headache, fatigue, etc. Up to today there is no explanation for this association. Sferics consist of partially polarized electromagnetic pulses with an oscillating carrier signal in the very low frequency (VLF) band and a pulse

repetition frequency in the extremely low frequency (ELF) band. Their ELF intensity may reach ~ 5 mV/m at global ranges, and ~ 0.5 V/m at ~ 1000 km from the lightning. The health symptoms associated with sferics are also associated with antennas of mobile telephony base stations and handsets, which emit radio frequency (RF) radiation pulsed on ELF, and expose humans at similar or stronger electric field intensities with sferics. According to the Ion Forced-Oscillation mechanism, polarized ELF EMFs of intensities down to 0.1–1 mV/m are able to disrupt any living cell's electrochemical balance and function by irregular gating of electro-sensitive ion channels on the cell membranes, and thus initiate a variety of health symptoms, while VLF EMFs need to be thousands of times stronger in order to be able to initiate health effects. We examine EMFs from sferics in terms of their bioactivity on the basis of this mechanism. We introduce the hypothesis that stronger atmospheric discharges may reasonably be considered to be ~ 70% along a straight line, and thus the associated EMFs (sferics) ~ 70% polarized. We find that sferics mainly in the ELF band have adequate intensity and polarization to cause biological/health effects. We provide explanation for the effects of sferics on human/animal health on the basis of this mechanism.

http://www.sciencedirect.com/science/article/pii/S0048969717311890

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Environmental Factors That Influence Stem Cell Migration: An "Electric Field"

Iwasa SN, Babona-Pilipos R, Morshead CM. Environmental Factors That Influence Stem Cell Migration: An "Electric Field". Stem Cells Int. 2017;2017:4276927. doi: 10.1155/2017/4276927. Epub 2017 May 15.

Abstract

Environmental Stimulus of Electric Fields on Stem Cell Migration. The movement of cells in response to electric potential gradients is called galvanotaxis. In vivo galvanotaxis, powered by endogenous electric fields (EFs), plays a critical role during development and wound healing. This review aims to provide a perspective on how stem cells transduce EFs into directed migration and an understanding of the current literature relating to the mechanisms by which cells sense and transduce EFs. We will comment on potential EF-based regenerative medicine therapeutics.

https://www.ncbi.nlm.nih.gov/pubmed/28588621

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RF EMF Risk Perception Revisited: Is the Focus on Concern Sufficient for Risk Perception Studies?

Wiedemann PM, Freudenstein F, Böhmert C, Wiart J, Croft RJ. RF EMF Risk Perception Revisited: Is the Focus on Concern Sufficient for Risk Perception Studies? Int J Environ Res Public Health. 2017 Jun 8;14(6). pii: E620. doi: 10.3390/ijerph14060620.

Abstract

An implicit assumption of risk perception studies is that concerns expressed in questionnaires reflect concerns in everyday life. The aim of the present study is to check this assumption, i.e., the extrapolability of risk perceptions expressed in a survey, to risk perceptions in everyday life. To that end, risk perceptions were measured by a multidimensional approach. In addition to the traditional focus on measuring the magnitude of risk perceptions, the thematic relevance (how often people think about a risk issue) and the discursive relevance (how often people think about or discuss a risk issue) of risk perceptions were also collected. Taking into account this extended view of risk perception, an online survey was conducted in six European countries with 2454 respondents, referring to radio frequency electromagnetic field (RF EMF) risk potentials from base stations, and access points, such as WiFi routers and cell phones. The findings reveal that the present study's multidimensional approach to measuring risk perception provides a more differentiated understanding of RF

EMF risk perception. High levels of concerns expressed in questionnaires do not automatically imply that these concerns are thematically relevant in everyday life. We use thematic relevance to distinguish between enduringly concerned (high concern according to both questionnaire and thematic relevance) and not enduringly concerned participants (high concern according to questionnaire but no thematic relevance). Furthermore, we provide data for the empirical value of this distinction: Compared to other participants, enduringly concerned subjects consider radio frequency electromagnetic field exposure to a greater extent as a moral and affective issue. They also see themselves as highly exposed to radio frequency electromagnetic fields. However, despite these differences, subjects with high levels of thematic relevance are nevertheless sensitive to exposure reduction as a means for improving the acceptance of base stations in their neighborhood. This underlines the value of exposure reduction for the acceptance of radio frequency electromagnetic field communication technologies.

https://www.ncbi.nlm.nih.gov/pubmed/28594366

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Microwave-induced Apoptosis and Cytotoxicity of NK Cells through ERK1/2 Signaling

Zhao L, Li J, Hao YH, Gao YB, Wang SM, Zhang J, Dong J, Zhou HM, Liu SC, Peng RY. Microwave-induced Apoptosis and Cytotoxicity of NK Cells through ERK1/2 Signaling. Biomed Environ Sci. 2017 May;30(5):323-332. doi: 10.3967/bes2017.043.

Abstract

OBJECTIVE: To investigate microwave-induced morphological and functional injury of natural killer (NK) cells and uncover their mechanisms.

METHODS: NK-92 cells were exposed to 10, 30, and 50 mW/cm2 microwaves for 5 min. Ultrastructural changes, cellular apoptosis and cell cycle regulation were detected at 1 h and 24 h after exposure. Cytotoxic activity was assayed at 1 h after exposure, while perforin and NKG2D expression were detected at 1 h, 6 h, and 12 h after exposure. To clarify the mechanisms, phosphorylated ERK (p-ERK) was detected at 1 h after exposure. Moreover, microwave-induced cellular apoptosis and cell cycle regulation were analyzed after blockade of ERK signaling by using U0126.

RESULTS: Microwave-induced morphological and ultrastructural injury, dose-dependent apoptosis ($P < 0.001$) and cell cycle arrest ($P < 0.001$) were detected at 1 h after microwave exposure. Moreover, significant apoptosis was still detected at 24 h after 50 mW/cm2 microwave exposure ($P < 0.01$). In the 30 mW/cm2 microwave exposure model, microwaves impaired the cytotoxic activity of NK-92 cells at 1 h and down regulated perforin protein both at 1 h and 6 h after exposure ($P < 0.05$). Furthermore, p-ERK was down regulated at 1 h after exposure ($P < 0.05$), while ERK blockade significantly promoted microwave-induced apoptosis ($P < 0.05$) and downregulation of perforin ($P < 0.01$).

CONCLUSION: Microwave dose-dependently induced morphological and functional injury in NK-92 cells, possibly through ERK-mediated regulation of apoptosis and perforin expression.

https://www.ncbi.nlm.nih.gov/pubmed/28549488

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Resveratrol may reverse effects of long-term occupational exposure to EMF on power plant workers

Zhang D, Zhang Y, Zhu B, Zhang H, Sun Y, Sun C. Resveratrol may reverse the effects of long-term occupational exposure to electromagnetic fields on workers of a power plant. Oncotarget. 2017 May 7. doi: 10.18632/oncotarget.17668. [Epub ahead of print]

Abstract

High-voltage electricity lines are known to generate extremely low-frequency electromagnetic fields (ELF-EMFs). With the process of urbanization, increasing concerns has been focused on the potentially hazardous impacts of ELF-EMF on human health, and the conclusions are controversial. Little is known about the method of prevention against ELF-EMF induced healthy problems. A total of 186 male workers with occupational exposure to high-voltage electricity lines, and 154 male subjects with insignificant exposure as reference control were enrolled in this study. Resveratrol or placebo was given as dietary supplements (500 mg twice daily), and several inflammatory biomarkers and biomarkers of oxidative stress were assessed. Workers who had long-term exposure to high-voltage electricity lines exhibited elevated urinary levels of 8-hydroxy-2-deoxy-guanosine (8-OHdG) and F2-isoprostane, compared to the reference group. Lower plasma nuclear factor kappa B (NF-κB) and interleukin (IL)-6 were observed in exposed workers compared to the reference group. Resveratrol significantly reversed the adverse impacts of ELF-EMF. Stimulated cytokine production by resveratrol was found in exposed workers but not in the reference group. This study supported that occupational and long-term exposure to high-voltage electricity lines has an adverse effect on homeostasis of human body, and resveratrol supplement could be an effective protection strategy against the adverse effects induced by ELF-EMFs.

https://www.ncbi.nlm.nih.gov/pubmed/28537898

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Exposure to magnetic fields from power lines & childhood asthma in Danish National Birth Cohort

Sudan M, Arah OA, Becker T, Levy Y, Sigsgaard T, Olsen J, Vergara X, Kheifets L. Re-examining the association between residential exposure to magnetic fields from power lines and childhood asthma in the Danish National Birth Cohort. PLoS One. 2017 May 17;12(5):e0177651. doi: 10.1371/journal.pone.0177651.

Abstract

BACKGROUND: A study reported an increased risk of asthma in children whose mothers were exposed to magnetic field (MF) levels above 0.2 μT during pregnancy. We re-examined this association using data from mothers and children in the Danish National Birth Cohort (DNBC).

METHODS: This study included 92,676 singleton-born children and their mothers from the DNBC. MF exposure from power lines was estimated for all residences where the mothers lived during pregnancy and for all children from birth until the end of follow up. Exposure was categorized into 0 μT, 0.1 μT, and ≥ 0.2 μT for analysis. Definitive and possible asthma cases were identified using data from three independent data sources: 1) mothers' reports, 2) a national hospitalization register, 3) a national prescription drug register. We calculated hazard ratios (HR) and 95% confidence intervals (CI) for the association between the highest level of exposure during pregnancy and asthma in children, adjusting for several potential confounding factors. We also examined the sensitivity of the risk estimates to changes in exposure and outcome definitions.

RESULTS: No differences or trends in the risk of asthma development were detected between children with different levels of MF exposure regardless of the asthma case definition or outcome data source. For definitive cases, the HR (95% CI) for those with any exposure was 0.72 (0.27-1.92), and it was 0.41 (0.06-2.92) for those

exposed to ≥ 0.2 μT. Adjustments for confounding and variations in the exposure definition did not appreciably alter the results.

CONCLUSION: We did not find evidence that residential exposure to MF during pregnancy or early childhood increased the risk of childhood asthma. This interpretation is in line with the lack of an established biological mechanism directly linking MF exposure to asthma, but high exposure was very rare in this cohort.

https://www.ncbi.nlm.nih.gov/pubmed/28545137

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Exposure to ELF and IF magnetic and electric fields among children from the INMA-Gipuzkoa cohort

Gallastegi M, Jiménez-Zabala A, Santa-Marina L, Aurrekoetxea JJ, Ayerdi M, Ibarluzea J, Kromhout H, González J, Huss A. Exposure to extremely low and intermediate-frequency magnetic and electric fields among children from the INMA-Gipuzkoa cohort.Environ Res. 2017 May 30;157:190-197. doi: 10.1016/j.envres.2017.05.027. [Epub ahead of print]

Abstract

Detailed assessment of exposure to extremely low frequency (ELF) and intermediate frequency (IF) fields is essential in order to conduct informative epidemiological studies of the health effects from exposure to these fields. There is limited information available regarding ELF electric fields and on both magnetic and electric field exposures of children in the IF range. The aim of this study was to characterize ELF and IF exposure of children in the Spanish INMA cohort. A combination of spot and fixed measurements was carried out in 104 homes, 26 schools and their playgrounds and 105 parks. Low levels of ELF magnetic fields (ELF-MF) were observed (with the highest 24-h time-weighted average (TWA) exposure being 0.15μT in one home). The interquartile range (IQR) of ELF electric fields (ELF-EF) ranged from 1 to 15V/m indoors and from 0.3 to 1.1V/m outdoors and a maximum value observed was 55.5V/m in one school playground. IQR ranges for IF magnetic and electric fields were between 0.02 and 0.23μT and 0.2 and 0.5V/m respectively and maximum values were 0.03μT and 1.51V/m in homes. Correlations between magnetic and electric fields were weak for ELF (Spearman 0.04-0.36 in different settings) and moderate for IF (between 0.28 and 0.75). Children of INMA-Gipuzkoa cohort were exposed to very low levels of ELF-MF in all settings and to similar levels of ELF-EF compared to the range of previously reported levels, although somewhat higher exposures occurred at home. Children enrolled to our study were similarly exposed to IF in all settings.

https://www.ncbi.nlm.nih.gov/pubmed/28575784

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Effects of acute & chronic exposure to 900 MHz & 2100 MHz EMR on glutamate receptor signaling pathway

Gökçek-Saraç Ç, Er H, Kencebay Manas C, Kantar Gök D, Özen Ş, Derin N. Effects of acute and chronic exposure to both 900 MHz and 2100 MHz electromagnetic radiation on glutamate receptor signaling pathway. Int J Radiat Biol. 2017 Jun 1:1-29. doi: 10.1080/09553002.2017.1337279. [Epub ahead of print]

Abstract

PURPOSE: To demonstrate molecular effects of acute and chronic exposure to both 900 MHz and 2100 MHz radiofrequency electromagnetic radiation (RF-EMR) on the hippocampal level/activity of some of the enzymes - including PKA, CaMKIIα, CREB, and p44/42 MAPK - from N-methyl-D-aspartate receptor (NMDAR) related signaling pathways.

MATERIALS AND METHODS: Rats were divided into following groups: Sham rats, rats exposed to 900 MHz and 2100 MHz RF-EMR for 2 h/day for acute (1 week) or chronic (10 weeks), respectively. The Western Blotting and activity measurement assays were used to assess the level/activity of the selected enzymes.

RESULTS: The obtained results have revealed that the hippocampal level/activity of selected enzymes was significantly higher in chronic groups as compared to acute groups at both 900 MHz and 2100 MHz RF-EMR exposure. In addition, hippocampal level/activity of selected enzymes was significantly higher at 2100 MHz RF-EMR than 900 MHz RF-EMR in both acute and chronic groups.

CONCLUSION: The present study provides experimental evidence that both exposure duration (1 week versus 10 weeks) and different carrier frequencies (900 MHz versus 2100 MHz) had different effects on protein expression of hippocampus in Wistar rats, which might encourage further research on protection against RF-EMR exposure.

https://www.ncbi.nlm.nih.gov/pubmed/28565929

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Adaptive Response Induced by Pre-Exposure to 915 MHz RF: A Possible Role for Antioxidant Enzyme Activity

Mortazavi SMJ, Mostafavi-Pour Z, Daneshmand M, Zal F, Zare R, Mosleh-Shirazi MA. Adaptive Response Induced by Pre-Exposure to 915 MHz Radiofrequency: A Possible Role for Antioxidant Enzyme Activity. J Biomed Phys Eng. 2017 Jun 1;7(2):137-142.

Abstract

BACKGROUND: Over the past few years, the rapid use of high frequency electromagnetic fields like mobile phones has raised global concerns about the negative health effects of its use. Adaptive response is the ability of a cell or tissue to better resist stress damage by prior exposure to a lesser amount of stress. This study aimed to assess whether radiofrequency radiation can induce adaptive response by changing the antioxidant balance.

MATERIALS AND METHODS: In order to assess RF-induced adaptive response in tissues, we evaluated the level of GSH and the activity of GR in liver. 50 rats were divided into 5 groups. Three groups were pre-exposed to 915 MHz RF radiation, 4 hours per day for one week at different powers, as low, medium and high. 24 hours after the last exposure to radiation, they were exposed to 4 Gy sublethal dose of gamma radiation and then sacrificed after 5 hours. Their livers were removed, washed and were kept at -80o C until used.

RESULTS: Our finding showed that pre-exposure to 915 MHz radiofrequency radiation with specific power could induce adaptive response in liver by inducing changes in the activity and level of antioxidant enzymes.

CONCLUSION: It can be concluded that pre-exposure to microwave radiation could increase the level of GSH and the activity of GR enzyme, although these increases were seen just in low power group, and the GR activity was indicated in medium power group. This increase protects tissue from oxidative damage induced by sublethal dose of gamma radiation.

https://www.ncbi.nlm.nih.gov/pubmed/28580335

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Alterations of thymic morphology and antioxidant biomarkers in male rats following exposure to continuous 900 MHz EMF during adolescence

Kulaber A, Kerimoğlu G, Ersöz Ş, Çolakoğlu S, Odacı E. Alterations of thymic morphology and antioxidant biomarkers in 60-day-old male rats following exposure to a continuous 900 MHz electromagnetic field during adolescence. Biotech Histochem. 2017 Jun 9:1-7. doi: 10.1080/10520295.2017.1312525.

Abstract

We investigated changes in thymic tissue of male rats exposed to a 900 megahertz (MHz) electromagnetic field (EMF) on postnatal days 22-59. Three groups of six 21-day-old male Sprague-Dawley rats were allocated as: control (CG), sham (SG) and EMF (EMFG) groups. No procedure was performed on the CG rats. SG rats were placed in a Plexiglas cage for 1 h every day between postnatal days 22 and 59 without exposure to EMF. EMFG rats were placed in the same cage for the same periods as the SG rats and were exposed to 900 MHz EMF. Rats were sacrificed on postnatal day 60. Sections of thymus were stained for histological assessment. Oxidant/antioxidant parameters were investigated biochemically. Malondialdehyde (MDA) levels in EMFG increased compared to the other groups. Extravascular erythrocytes were observed in the medullary/corticomedullary regions in EMFG sections. We found that 900 MHz EMF applied for 1 h/day on postnatal days 22-59 can increase tissue MDA and histopathological changes in male rat thymic tissue.

https://www.ncbi.nlm.nih.gov/pubmed/28598680

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Warburg effect-damping of electromagnetic oscillations

Pokorný J, Pokorný J, Borodavka F. Warburg effect-damping of electromagnetic oscillations. Electromagn Biol Med. 2017 Jun 2:1-9. doi: 10.1080/15368378.2017.1326933.

Abstract

Mitochondrial dysfunction is a central defect in cells creating the Warburg and reverse Warburg effect cancers. However, the link between mitochondrial dysfunction and cancer has not yet been clearly explained. Decrease of mitochondrial oxidative energy production to about 50 % in comparison with healthy cells may be caused by inhibition of pyruvate transfer into mitochondrial matrix and/or disturbed H+ ion transfer across inner mitochondrial membrane into cytosol. Lowering of the inner membrane potential and shifting of the working point of mitochondria to high values of pH above an intermediate point causes reorganization of the ordered water layer at the mitochondrial membrane. The reorganized ordered water layers at high pH values release electrons which are transferred to the cytosol rim of the layer. The electrons damp electromagnetic activity of Warburg effect cancer cells or fibroblasts associated with reverse Warburg effect cancer cells leading to lowered electromagnetic activity, disturbed coherence, increased frequency of oscillations and decreased level of biological functions. In reverse Warburg effect cancers, associated fibroblasts supply energy-rich metabolites to the cancer cell resulting in increased power of electromagnetic field, fluctuations due to shift of oscillations to an unstable nonlinear region, decreased frequency and loss of coherence.

https://www.ncbi.nlm.nih.gov/pubmed/28574758

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Electrical Grounding Improves Vagal Tone in Preterm Infants

Passi R, Doheny KK, Gordin Y, Hinssen H, Palmer C. Electrical Grounding Improves Vagal Tone in Preterm Infants. Neonatology. 2017 Jun 10;112(2):187-192. doi: 10.1159/000475744.

Abstract

BACKGROUND: Low vagal tone (VT) is a marker of vulnerability to stress and the risk of developing necrotizing enterocolitis in preterm infants. Electric fields produced by equipment in the neonatal intensive care unit (NICU) induce an electric potential measurable on the skin in reference to ground. An electrical connection to ground reduces the skin potential and improves VT in adults.

OBJECTIVES: We aimed to measure the electric field strengths in the NICU environment and to determine if connecting an infant to electrical ground would reduce the skin potential and improve VT. We also wished to determine if the skin potential correlated with VT.

METHODS: Environmental magnetic flux density (MFD) was measured in and around incubators. Electrical grounding (EG) was achieved with a patch electrode and wire that extended to a ground outlet. We measured the skin potential in 26 infants and heart rate variability in 20 infants before, during, and after grounding. VT was represented by the high-frequency power of heart rate variability.

RESULTS: The background MFD in the NICU was below 0.5 mG, but it ranged between 1.5 and 12.7 mG in the closed incubator. A 60-Hz oscillating potential was recorded on the skin of all infants. With EG, the skin voltage dropped by about 95%. Pre-grounding VT was inversely correlated with the skin potential. VT increased by 67% with EG. After grounding, the VT fell to the pre-grounding level.

CONCLUSION: The electrical environment affects autonomic balance. EG improves VT and may improve resilience to stress and lower the risk of neonatal morbidity in preterm infants.

https://www.ncbi.nlm.nih.gov/pubmed/28601861

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ELF EMFs Affect Myogenic Processes in C2C12 Myoblasts: Role of Gap-Junction-Mediated Intercellular Communication

Morabito C, Steimberg N, Rovetta F, Boniotti J, Guarnieri S, Mazzoleni G, Mariggiò MA. Extremely Low-Frequency Electromagnetic Fields Affect Myogenic Processes in C2C12 Myoblasts: Role of Gap-Junction-Mediated Intercellular Communication. Biomed Res Int. 2017;2017:2460215. doi: 10.1155/2017/2460215.

Abstract

Extremely low-frequency electromagnetic fields (ELF-EMFs) can interact with biological systems. Although they are successfully used as therapeutic agents in physiatrics and rehabilitative practice, they might represent environmental pollutants and pose a risk to human health. Due to the lack of evidence of their mechanism of action, the effects of ELF-EMFs on differentiation processes in skeletal muscle were investigated. C2C12 myoblasts were exposed to ELF-EMFs generated by a solenoid. The effects of ELF-EMFs on cell viability and

on growth and differentiation rates were studied using colorimetric and vital dye assays, cytomorphology, and molecular analysis of MyoD and myogenin expression, respectively. The establishment of functional gap junctions was investigated analyzing connexin 43 expression levels and measuring cell permeability, using microinjection/dye-transfer assays. The ELF-EMFs did not affect C2C12 myoblast viability or proliferation rate. Conversely, at ELF-EMF intensity in the mT range, the myogenic process was accelerated, through increased expression of MyoD, myogenin, and connexin 43. The increase in gap-junction function suggests promoting cell fusion and myotube differentiation. These data provide the first evidence of the mechanism through which ELF-EMFs may provide therapeutic benefits and can resolve, at least in part, some conditions of muscle dysfunction.

https://www.ncbi.nlm.nih.gov/pubmed/28607928

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World Health Organization, radiofrequency radiation and health - a hard nut to crack (Review)

Hardell L. World Health Organization, radiofrequency radiation and health - a hard nut to crack (Review). International Journal of Oncology. Published online on: June 21, 2017. https://doi.org/10.3892/ijo.2017.4046

Abstract

In May 2011 the International Agency for Research on Cancer (IARC) evaluated cancer risks from radiofrequency (RF) radiation. Human epidemiological studies gave evidence of increased risk for glioma and acoustic neuroma. RF radiation was classified as Group 2B, a possible human carcinogen. Further epidemiological, animal and mechanistic studies have strengthened the association. In spite of this, in most countries little or nothing has been done to reduce exposure and educate people on health hazards from RF radiation. On the contrary ambient levels have increased. In 2014 the WHO launched a draft of a Monograph on RF fields and health for public comments. It turned out that five of the six members of the Core Group in charge of the draft are affiliated with International Commission on Non-Ionizing Radiation Protection (ICNIRP), an industry loyal NGO, and thus have a serious conflict of interest. Just as by ICNIRP, evaluation of non-thermal biological effects from RF radiation are dismissed as scientific evidence of adverse health effects in the Monograph. This has provoked many comments sent to the WHO. However, at a meeting on March 3, 2017 at the WHO Geneva office it was stated that the WHO has no intention to change the Core Group.

Open Access Paper: https://www.spandidos-publications.com/10.3892/ijo.2017.4046

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Use of cell phones and brain tumors: a true association?

Mortazavi, S.A.R., Mortazavi, G. & Mortazavi, S.M.J. Letter to the Editor: Use of cell phones and brain tumors: a true association? Neurol Sci (2017). doi:10.1007/s10072-017-3055-x.

Dear Editor:

With great interest, we have read the editorial by Beghi entitled “Use of cell phones and brain tumors: a true association?” that is published in the journal of Neurol Sci 2017 doi: 10.1007/s10072-017-2992-8 [1]. In this article, the author confirms the lack of robust evidence of association between use of cell phones and brain tumors. However, Beghi mentions that absence of evidence does not necessarily mean that there is no any association. The editorial authored by Beghi addresses a very challenging issue. However, this editorial cannot be considered as a good contribution in the field of radiofrequency exposure and cancer. Over the past several years, our team has conducted several studies on the possible association of exposure to radiofrequency electromagnetic fields (RF-EMFs) and adverse health effects. Beghi claims that the findings of case–control

studies have not been confirmed by cohort studies “First of all, the positive results of some case–control studies have not been confirmed by cohort studies. Case–control studies, even when methodologically robust, cannot replace cohort studies in confirming or disproving an association between a given exposure and a disease. ….In this context, none of the cohort studies found an increased risk of brain tumors in people exposed to cell phones.” Although what he claims about the advantages of cohort studies seems to be right, his conclusion is problematic. Beghi does not mention that the number of cohort studies conducted on this topic so far is drastically low and all of these studies had some basic limitations. Therefore, the absence of cohort-proven findings does not necessarily mean that there is no detrimental effect. In this light, as free radical formation after exposure to RF-EMF is confirmed in many studies, even without firm conclusions from cohort studies, these exposures should be limited.

Furthermore, Beghi claims that “Second, the increased risk of brain tumors in case–control studies, if proven, is at best modest and, as brain tumors are rare diseases, the total number of tumors appears only slightly increased.” It is worth mentioning that a systematic review and meta-analysis recently published by Yang et al. could not find a link between mobile phone use of any duration and the odds of high-grade glioma. However, there was a 2.22 times greater odds of the occurrence of low-grade glioma for long-term mobile phone use (OR = 2.22, 95% CI = 1.69–2.92) [2]. Beghi also claims that a clear dose–response effect has never been confirmed. Over the past several years, our team has conducted several studies on the possible association of RF-EMFs and adverse health effects. Mortazavi et al. have also recently addressed the shortcoming of some of the papers claiming lack of association between exposure to RF-EMF and cancer. They have provided evidence showing that exposure to RF-EMFs, at least at high levels and long durations, can increase the risk of cancer [3]. Substantial evidence now indicates that the current controversy regarding the carcinogenesis of RF-EMFs might be caused by the lack of accurate information regarding the magnitude of exposure to RF-EMFs which possibly plays a basic role in RF-induced carcinogenesis [4]. We have also provided evidence which shows that, in a similar pattern with ionizing radiation, the carcinogenesis of non-ionizing RF-EMF may have a nonlinear J-shaped dose–response relationship [4].

https://www.ncbi.nlm.nih.gov/pubmed/28689225

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Use of mobile and cordless phones and change in cognitive function: a prospective cohort analysis of Australian primary school children

Bhatt CR, Benke G, Smith CL, Redmayne M, Dimitriadis C, Dalecki A, Macleod S, Sim MR, Croft RJ, Wolfe R, Kaufman J, Abramson MJ Use of mobile and cordless phones and change in cognitive function: a prospective cohort analysis of Australian primary school children. Environ Health. 2017 Jun 19;16(1):62. doi: 10.1186/s12940-017-0250-4.

Abstract

BACKGROUND: Some previous studies have suggested an association between children's use of mobile phones (MPs)/cordless phones (CPs) and development of cognitive function. We evaluated possible longitudinal associations between the use of MPs and CPs in a cohort of primary school children and effects on their cognitive function.

METHODS: Data on children's socio-demographics, use of MPs and CPs, and cognitive function were collected at baseline (2010-2012) and follow-up (2012-2013). Cognitive outcomes were evaluated with the CogHealth™ test battery and Stroop Color-Word test. The change in the number of MP/CP voice calls weekly from baseline to follow-up was dichotomized: "an increase in calls" or a "decrease/no change in calls". Multiple linear regression analyses, adjusting for confounders and clustering by school, were performed to evaluate the associations between the change in cognitive outcomes and change in MP and CP exposures.

RESULTS: Of 412 children, a larger proportion of them used a CP (76% at baseline and follow-up), compared

to a MP (31% at baseline and 43% at follow-up). Of 26 comparisons of changes in cognitive outcomes, four demonstrated significant associations. The increase in MP usage was associated with larger reduction in response time for response inhibition, smaller reduction in the number of total errors for spatial problem solving and larger increase in response time for a Stroop interference task. Except for the smaller reduction in detection task accuracy, the increase in CP usage had no effect on the changes in cognitive outcomes.

CONCLUSION: Our study shows that a larger proportion of children used CPs compared to MPs. We found limited evidence that change in the use of MPs or CPs in primary school children was associated with change in cognitive function.

https://www.ncbi.nlm.nih.gov/pubmed/28629417

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Patterns of cellular phone use among young people in 12 countries: Implications for RF exposure

Langer CE, de Llobet P, Dalmau A, Wiart J, Goedhart G, Hours M, et al. (32 authors). Patterns of cellular phone use among young people in 12 countries: Implications for RF exposure. Environ Int. 2017 Jun 29;107:65-74. doi: 10.1016/j.envint.2017.06.002.

Highlights

• Number and duration of calls varied by sex, age range, and socioeconomic status
• Laterality and hands-free use were less influenced by user characteristics
• Country of origin explained most of the variance in number and duration of calls, as well as SMS and data/Wi-Fi

Abstract

Characterizing exposure to radiofrequency (RF) fields from wireless telecommunications technologies during childhood and adolescence is a research priority in investigating the health effects of RF. The Mobi-Expo study aimed to describe characteristics and determinants of cellular phone use in 534 young people (10-24years) in 12 countries. The study used a specifically designed software application installed on smartphones to collect data on the use of wireless telecommunications devices within this age group. The role of gender, age, maternal education, calendar period, and country was evaluated through multivariate models mutually adjusting for all variables. Call number and duration were higher among females compared to males (geometric mean (GM) ratio 1.17 and 1.42, respectively), among 20-24year olds compared to 10-14year olds (GM ratio 2.09 and 4.40, respectively), and among lowest compared to highest social classes (GM ratio 1.52 and 1.58, respectively). The number of SMS was higher in females (GM ratio 1.46) and the middle age group (15-19year olds: GM ratio 2.21 compared to 10-14year olds) and decreased over time. Data use was highest in the oldest age group, whereas Wi-Fi use was highest in the middle age group. Both data and Wi-Fi use increased over time. Large differences in the number and duration of calls, SMS, and data/Wi-Fi use were seen by country, with country and age accounting for up to 50% of the variance. Hands-free and laterality of use did not show significant differences by sex, age, education, study period, or country. Although limited by a convenience sample, these results provide valuable insights to the design, analysis, and interpretation of future epidemiological studies concerning the health effects of exposure resulting from cellular phone use in young people. In addition, the information provided by this research may be used to design strategies to minimize RF exposure.

https://www.ncbi.nlm.nih.gov/pubmed/28668725

Excerpts

Participants made on average 30.6 calls per week (median 20.9) and spent 60.8 min per week making or

receiving calls (median 34.3; Table 2).

A total of 248 (46.4%) subjects had usable data for laterality. For these participants, 18.8% of total call time was “hands-free” on average (median 10.6%), i.e. using the speaker phone, a hands-free kit, or holding the phone away from the head (Table 2). Out of the total call time near the head (not “hands-free”), participants used the phone on the right side of the head in 63.8% of the time on average (median 70.8% - Table 2). With respect to gender, there was no statistically significant difference between males and females for hands-free usage, although females tended to speak somewhat less on their right-hand side (68% in males versus 61% in females, adj OR 0.75; 95% CI 0.54, 1.03).

Overall, UMTS (3G) was the most commonly used communication protocol with 37% of voice calls occurring using UMTS. HSDPA (3G transitional) was the next most common, with 32% of voice calls. UMTS was the most common communication protocol in Canada, France, Greece, Italy, and The Netherlands (80%, 30%, 36%, 41%, and 55%, respectively) (Fig. 2). In contrast, HSDPA was the most common network in Australia, Germany, Israel, Japan, New Zealand, and Spain (69%, 36%, 68%, 51%, 46%, and 33%, respectively). The most common network in Korea was “other” (43%). GPRS and EDGE (both 2G transitional) were not commonly used in any of the countries during our study period; use ranged from 0% (Japan and Korea) to 32% (The Netherlands) GPRS and 22% (France and Germany) EDGE, respectively.

In comparison with our findings, CEFALO, a study among 7–19 year old children and adolescents investigating possible associations between cellular phone use and brain tumors, had a much lower level of phone use among controls during a period from early 2004 through mid-2008 (Aydin et al., 2011). The top quartile of controls had a cumulative lifetime use of 2638 calls and 144 h spent on voice calls. Using the mean number and duration of calls, it would take the participants in our study less than three years to reach the lifetime use of the highest quartile of CEFALO controls.

First, the handset is not near the head for the full call duration, but rather for about 83% of the time. In addition to intentional hands-free device or speaker phone usage, this is explained by other hands-free use such as answering and ending a call. Furthermore, the time spent with the phone on one side of the head was not as high as the 90% assigned to the self-reported predominant side within the RF dose algorithm used in the INTERPHONE study (Cardis et al., 2011a), but that was a study of older adults.

A major limitation of this study is that it is a convenience sample, limiting the generalizability of the results. Given that most of the volunteers were found through friends and/or colleagues of the research team, the education level and in turn socioeconomic status is likely higher than that of the general population.

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Functional brain MRI in patients complaining of EHS after long term exposure to EMF

Heuser G, Heuser SA. Functional brain MRI in patients complaining of electrohypersensitivity after long term exposure to electromagnetic fields. Rev Environ Health. 2017 Jul 5.

Abstract

INTRODUCTION: Ten adult patients with electromagnetic hypersensitivity underwent functional magnetic resonance imaging (fMRI) brain scans. All scans were abnormal with abnormalities which were consistent and similar. It is proposed that fMRI brain scans be used as a diagnostic aid for determining whether or not a patient has electromagnetic hypersensitivity. Over the years we have seen an increasing number of patients who had developed multi system complaints after long term repeated exposure to electromagnetic fields (EMFs). These complaints included headaches, intermittent cognitive and memory problems, intermittent disorientation, and also sensitivity to EMF exposure. Regular laboratory tests were within normal limits in these patients. The patients refused to be exposed to radioactivity. This of course ruled out positron emission tomography (PET) and single-photon emission computed tomography (SPECT) brain scanning. This is why we

ordered fMRI brain scans on these patients. We hoped that we could document objective abnormalities in these patients who had often been labeled as psychiatric cases.

MATERIALS AND METHODS: Ten patients first underwent a regular magnetic resonance imaging (MRI) brain scan, using a 3 Tesla Siemens Verio MRI open system. A functional MRI study was then performed in the resting state using the following sequences: A three-dimensional, T1-weighted, gradient-echo (MPRAGE) Resting state network. The echo-planar imaging (EPI) sequences for this resting state blood oxygenation level dependent (BOLD) scan were then post processed on a 3D workstation and the independent component analysis was performed separating out the various networks. Arterial spin labeling. Tractography and fractional anisotropy.

RESULTS: All ten patients had abnormal functional MRI brain scans. The abnormality was often described as hyper connectivity of the anterior component of the default mode in the medial orbitofrontal area. Other abnormalities were usually found. Regular MRI studies of the brain were mostly unremarkable in these patients.

CONCLUSION: We propose that functional MRI studies should become a diagnostic aid when evaluating a patient who claims electrohypersensitivity (EHS) and has otherwise normal studies. Interestingly, the differential diagnosis for the abnormalities seen on the fMRI includes head injury. It turns out that many of our patients indeed had a history of head injury which was then followed sometime later by the development of EHS. Many of our patients also had a history of exposure to potentially neurotoxic chemicals, especially mold. Head injury and neurotoxic chemical exposure may make a patient more vulnerable to develop EHS.

https://www.ncbi.nlm.nih.gov/pubmed/28678737

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An off-the-shelf meter for measuring body amperage: A new gold standard for epidemiologic studies?

Milham S. An off-the-shelf meter for measuring body amperage: A new gold standard for epidemiologic studies? Electromagn Biol Med. 2017 Jun 26:1. doi: 10.1080/15368378.2017.1336101.

No Abstract (letter)

https://www.ncbi.nlm.nih.gov/pubmed/28650676

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Effects of folic acid on rat kidney exposed to 900 MHz EMR

Ömür Gülsüm Deniz, Elfide Gizem Kıvrak, Arife Ahsen Kaplan, Berrin Zuhal Altunkaynak. Effects of folic acid on rat kidney exposed to 900 MHz electromagnetic radiation. Journal of Microscopy and Ultrastructure. Available online 17 June 2017.

Highlights

• The kidneys of adult male rats were investigated after exposure to 900-MHz electromagnetic radiation.

• Folic acid exhibited protective effects in the kidney against the side-effects of electromagnetic radiation exposure.
• Changes in volume and numbers of glomeruli in the kidney were analyzed using unbiased stereological methods.

Abstract

Because of increased use of cell phones, the purpose of this study was to investigation of the oxidative damage caused by electromagnetic radiation (EMR) emitted by cell phones and histological and morphometrical determination of the possible protective role of folic acid (FA) in preventing the detrimental effects of EMR on the kidney. Twenty-four adult male Wistar albino rats were divided into control (Cont), EMR, EMR + FA and FA groups, each containing six rats. The EMR and EMR + FA groups were exposed to EMR for 60 min a day over a period of 21 days, while no EMR exposure was applied to the Cont and FA groups. The source of the EMR was an EMR device which emits a digital signal producing 900-MHz frequency radiation. The generator connected to a one-monopole antenna was used in this study and the rats were placed in the plexiglass restrainer at an equal distance from the monopole antenna. Following the experimental period, and after tissue processing, a physical disector-Cavalieri method combination was applied to the sections. The mean volume of the cortex, medulla, proximal and distal tubules increased significantly in the EMR groups compared to the Cont group ($p < 0.01$). Contrarily, the total number of glomeruli in the EMR group decreased compared to the Cont group ($p < 0.01$). The protective effects of FA was observed in the kidney ($p < 0.05$).

In conclusion, the 900-MHz EMR leads to kidney damage. FA may exhibit a protective effect against the adverse effects of EMR exposure in terms of the total number of glomeruli.

http://www.sciencedirect.com/science/article/pii/S2213879X17300500

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Changes in locomotor activity in mice due to low-intensity microwaves amplitude modulated in the EEG spectral domain

Eeghem VV, Arfani AE, Anthoula A, Walrave L, Pourkazemi A, Bentea E, Demuyser T, Smolders I, Stiens J. Selective changes in locomotor activity in mice due to low-intensity microwaves amplitude modulated in the EEG spectral domain. Neuroscience. 2017 Jul 4. pii: S0306-4522(17)30461-X. doi: 10.1016/j.neuroscience.2017.06.056.

Abstract

Despite the numerous benefits of microwave applications in our daily life, microwaves were associated with diverse neurological complaints such as headaches and impaired sleep patterns, and changes in the electroencephalogram (EEG). To which extent microwaves influence the brain function remains unclear. This exploratory study assessed the behavior and neurochemistry in mice immediately or 4 weeks after a 6-day exposure to low-intensity 10 GHz microwaves with an amplitude modulation (AM) of 2 or 8 Hz. These modulation frequencies of 2 and 8 Hz are situated within the delta and theta-alpha frequency bands in the EEG spectrum and are associated with sleep and active behavior, respectively. During these experiments, the specific absorbance rate was 0.3 W/kg increasing the brain temperature with 0.23°C. For the first time, exposing mice to 8 Hz AM significantly reduced locomotor activity in an open field immediately after exposure which normalized after 4 weeks. This in contrast to 2 Hz AM which didn't induce significant changes in locomotor activity immediately and 4 weeks after exposure. Despite this difference in motor behavior, no significant changes in striatal dopamine and DOPAC levels and DOPAC/dopamine turnover nor in cortical glutamate concentrations were detected. In all cases, no effects on motor coordination on a rotarod, spatial working memory, anxiety nor depressive-like behavior were observed. The outcome of this study indicates that exposing mice to low-intensity 8 Hz AM microwaves can alter the locomotor activity in contrast to 2 Hz AM which did not affect the tested behaviors.

https://www.ncbi.nlm.nih.gov/pubmed/28687311

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Influence of RF EMF from 3rd-generation cellular phones on fertilization and embryo development in mice (W-CDMA study)

Suzuki S, Okutsu M, Suganuma R, Komiya H, Nakatani-Enomoto S, Kobayashi S, Ugawa Y, Tateno H, Fujimori K.Influence of radiofrequency-electromagnetic waves from 3rd-generation cellular phones on fertilization and embryo development in mice. Bioelectromagnetics. 2017 Jun 19. doi: 10.1002/bem.22063.

Abstract

The purpose of this study was to evaluate the effects of 3rd-generation (3G) cellular phone radiofrequency-electromagnetic wave (RF-EMW) exposure on fertilization and embryogenesis in mice. Oocytes and spermatozoa were exposed to 3G cellular phone RF-EMWs, 1.95 GHz wideband code division multiple access, at a specific absorption rate of 2 mW/g for 60 min, or to sham exposure. After RF-EMW exposure, in vitro fertilization and intracytoplasmic sperm injection were performed. Rates of fertilization, embryogenesis (8-cell embryo, blastocyst), and chromosome aberration were compared between the combined spermatozoa and oocyte groups: both exposed, both non-exposed, one exposed, and the other non-exposed. Rates of fertilization, embryogenesis, and blastocyst formation did not change significantly across the four groups. Considering that the degree of exposure in the present study was ≥100 times greater than daily exposure of human spermatozoa and even greater than daily exposure of oocytes, the present results indicate safety of RF-EMW exposure in humans.

https://www.ncbi.nlm.nih.gov/pubmed/28628221

Also see:
Pregnancy & Wireless Radiation Risks
Female Infertility & Cell Phone Radiation

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The Effects of Exposure to ELF EMF on Male Fertility

Darbandi M, Darbandi S, Agarwal A, Henkle R, Sadeghi MR. The Effects of Exposure to Low Frequency Electromagnetic Fields on Male Fertility. Altern Ther Health Med. 2017 Jun 23. pii: AT5423. [Epub ahead of print]

Abstract

Context • People are increasingly exposed to low frequency (LF) electromagnetic fields (EMFs), mainly from electricity distribution networks and electronic devices. Critics of this widespread exposure believe that it can have detrimental effects on the human body. On the other hand, many in vivo and in vitro studies have claimed that low frequency electromagnetic therapy can function as a form of alternative medicine and that therapists can treat disease by applying electromagnetic radiation or pulsed EMFs to the body or cells. It is not yet entirely clear, however, whether LF-EMF is beneficial or harmful.
Objectives • This study aimed to examine the effects of LF-EMFs on men's reproductive functions, according to the types of waveform and the frequency and duration of exposure.
Design • The study reviewed all available research, both human and animal, on the effects of LF-EMFs on male reproductive functions, covering the literature from January 1978 to June 2016. The documents were obtained from PubMed, Science Direct, and Google Scholar, and any article that was irrelevant or a duplicate was excluded. A total of 61 articles were found, and 27 articles were reviewed.

Setting • This project was performed at the Avicenna Research Center (Tehran, Iran).
Participants • Literature included human and animal studies conducted on rabbits, mice, rats, and boars.
Intervention • Among these studies, any article that was irrelevant, a duplicate, or published with duplicate data was excluded. At the end, 27 articles were checked.
Outcome Measures • Outcome measures included testing related to reproductive organ weights, reproductive endocrinal hormones, fetal development, and spermatogenesis as well as sperm motility, morphology, and vitality.
Results • The reviewed studies provided contradictory results that were highly dependent on the exposure parameters, such as the shape and frequency of wave, intensity, duration, and timing of the exposure.
Conclusions • LF-EMF at 15 Hz with a peak intensity of 8 Gauss, with a square waveform of 50 Hz frequency and a duration of a few hours or less can have a positive effect on sperm quality, motility, and fertility. Exposures at other frequencies either had no effects on the sperm's performance and quality or held biological hazard for cells. It appears that there is still little understanding of how EMF affects cellular functions. Therefore, more standardized and controlled studies should be carried out to understand the effects of EMF on the body.

https://www.ncbi.nlm.nih.gov/pubmed/28646801

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Proteomic Analysis of the Effect of ELF-EMF With Different Intensities in SH-SY5Y Neuroblastoma Cell Line

Rezaie-Tavirani M, Hasanzadeh H, Seyyedi S, Zali H.Proteomic Analysis of the Effect of Extremely Low-Frequency Electromagnetic Fields (ELF-EMF) With Different Intensities in SH-SY5Y Neuroblastoma Cell Line.J Lasers Med Sci. 2017 Spring;8(2):79-83. doi: 10.15171/jlms.2017.14.

Abstract

Introduction: During the last 3 decades, human is exposed to extremely low frequency electromagnetic fields (ELF-EMF) emitted by power lines and electronic devices. It is now well accepted that ELF-EMF are able to produce a variety of biological effects, although the molecular mechanism is unclear and controversial. Investigation of different intensities effects of 50 Hz ELF-EMF on cell morphology and protein expression is the aim of this study.
Methods: SH-SY5Y human neuroblastoma cell line was exposed to 0.5 and 1 mT 50 Hz (ELF-EMF) for 3 hours. Proteomics techniques were used to determine the effects of these fields on protein expression. Bioinformatic and statistical analysis of proteomes were performed using Progensis SameSpots software.
Results: Our results showed that exposure to ELF-EMF changes cell morphology and induces a dose-dependent decrease in the proliferation rate of the cells. The proteomic studies and bioinformatic analysis indicate that exposure to 50 Hz ELF-EMF leads to alteration of cell protein expression in both dose-dependent and intensity dependent manner, but the later is more pronounced.
Conclusion: Our data suggests that increased intensity of ELF-EMF may be associated with more alteration in cell protein expression, as well as effect on cell morphology and proliferation.

https://www.ncbi.nlm.nih.gov/pubmed/28652900

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The bee, the flower, and the electric field: electric ecology and aerial electroreception

Clarke D, Morley E, Robert D. The bee, the flower, and the electric field: electric ecology and aerial electroreception. J Comp Physiol A Neuroethol Sens Neural Behav Physiol. 2017 Jun 24. doi: 10.1007/s00359-017-1176-6.

Abstract

Bees and flowering plants have a long-standing and remarkable co-evolutionary history. Flowers and bees evolved traits that enable pollination, a process that is as important to plants as it is for pollinating insects. From the sensory ecological viewpoint, bee-flower interactions rely on senses such as vision, olfaction, humidity sensing, and touch. Recently, another sensory modality has been unveiled; the detection of the weak electrostatic field that arises between a flower and a bee. Here, we present our latest understanding of how these electric interactions arise and how they contribute to pollination and electroreception. Finite-element modelling and experimental evidence offer new insights into how these interactions are organised and how they can be further studied. Focusing on pollen transfer, we deconstruct some of the salient features of the three ingredients that enable electrostatic interactions, namely the atmospheric electric field, the capacity of bees to accumulate positive charge, and the propensity of plants to be relatively negatively charged. This article also aims at highlighting areas in need of further investigation, where more research is required to better understand the mechanisms of electrostatic interactions and aerial electroreception.

https://www.ncbi.nlm.nih.gov/pubmed/28647753

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Biological effects related to geomagnetic activity and possible mechanisms

Krylov VV. Biological effects related to geomagnetic activity and possible mechanisms. Bioelectromagnetics. 2017 Jun 21. doi: 10.1002/bem.22062. [Epub ahead of print]

Abstract

This review presents contemporary data on the biological effects of geomagnetic activity. Correlations between geomagnetic indices and biological parameters and experimental studies that used simulated geomagnetic storms to detect possible responses of organisms to these events in nature are discussed. Possible mechanisms by which geomagnetic activity influences organisms are also considered. Special attention is paid to the idea that geomagnetic activity is perceived by organisms as a disruption of diurnal geomagnetic variation. This variation, in turn, is viewed by way of a secondary zeitgeber for biological circadian rhythms. Additionally, we discuss the utility of cryptochrome as a biological detector of geomagnetic storms. The possible involvement of melatonin and protein coding by the CG8198 gene in the biological effects of geomagnetic activity are discussed. Perspectives for studying mechanisms by which geomagnetic storms affect organisms are suggested.

https://www.ncbi.nlm.nih.gov/pubmed/28636777

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Canadian data from INTERPHONE study of mobile phone use and head tumor risk reported for the first time

Since the 13-nation Interphone study was published in 2010, several methods papers have been published that reanalyze the data to correct for biases in the original paper. In most instances the glioma risk estimates increased after adjustment for study biases among long term or heavy mobile phone users.

The following paper just published in the ***American Journal of Epidemiology*** applies statistical adjustments to the Interphone data from Canada. The authors found that the risk estimate for glioma among the highest

quartile of cell phone users increased after adjustment. Risk estimates for other types of head tumors did not change.

The substantive results reported for glioma risk in Canada should be of interest to Health Canada. The original Canadian Interphone study data which had not been reported previously found a statistically significant doubling of risk for glioma among the highest **quartile** of cell phone users (over 558 lifetime hours). In contrast, the original 13-nation Interphone study found a 1.4-fold increase in glioma among the highest **decile** of use (1640 or more lifetime hours). After adjustment for selection and recall bias, the 2.0 odds ratio originally found in Canada increased to 2.2. Among the potential explanations the authors provided for this disparity between Canada and the 13-nation study (which included Canadian data):

"real differences in risk related to different communication technologies between Canada and other INTERPHONE countries."

Momoli F, Siemiatycki J, McBride ML, Parent MÉ, Richardson L, Bedard D, Platt R, Vrijheid M, Cardis E, Krewski D. Probabilistic multiple-bias modelling applied to the Canadian data from the INTERPHONE study of mobile phone use and risk of glioma, meningioma, acoustic neuroma, and parotid gland tumors. Am J Epidemiol. 2017 May 23. doi: 10.1093/aje/kwx157. [Epub ahead of print]

Abstract

We undertook a re-analysis of the Canadian data from the thirteen-country INTERPHONE case-control study (2001-2004), which evaluated the association between mobile phone use and risk of brain, acoustic neuroma, and parotid gland tumors. The main publication of the multinational INTERPHONE study concluded that "biases and errors prevent a causal interpretation". We applied a probabilistic multiple-bias model to address possible biases simultaneously, using validation data from billing records and non-participant questionnaires as information on recall error and selective participation. Our modelling sought to adjust for these sources of uncertainty and to facilitate interpretation. For glioma, the odds ratio comparing highest quartile of use (over 558 lifetime hours) to non-regular users was 2.0 (95% confidence interval: 1.2, 3.4). The odds ratio was 2.2 (95% confidence interval: 1.3, 4.1) when adjusted for selection and recall biases. There was little evidence of an increase in the risk of meningioma, acoustic neuroma, or parotid gland tumors in relation to mobile phone use. Adjustments for selection and recall biases did not materially affect interpretation in our Canadian results.

https://www.ncbi.nlm.nih.gov/pubmed/28535174

Excerpts

The OR of 2.0 for glioma in the highest cumulative exposure category (558+ hours of cumulative call time) in the Canadian study is higher than the value of 1.4 in the highest cumulative exposure category (1640+ hours) in the international study (4). This may simply reflect sampling variability, differential biases between study centers, matching strategies, or real differences in risk related to different communication technologies between Canada and other INTERPHONE countries (see appendix of (27)).

Unlike in the Canadian data, the INTERPHONE multinational study found marked decreased risk associated with most measures of phone use and an increased risk only in the highest decile of use. The study Group concluded that “biases and errors prevent a causal interpretation” (4, pg.1). To the extent that the bias model applied in the present re-analysis of the Canadian data is reasonable, conventional modelling of existing data

likely resulted in slight underestimation of the magnitude of associations; however, interpretation of bias-adjusted results would not have materially changed from the original Canadian results.

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Mobile phone use and glioma risk: A systematic review and meta-analysis

Yang M, Guo W, Yang C, Tang J, Huang Q, Feng S, Jiang A, Xu X, Jiang G. Mobile phone use and glioma risk: A systematic review and meta-analysis. PLoS One. 2017 May 4;12(5):e0175136. doi: 10.1371/journal.pone.0175136.

Abstract

OBJECTIVE: Many studies have previously investigated the potential association between mobile phone use and the risk of glioma. However, results from these individual studies are inconclusive and controversial. The objective of our study was to investigate the potential association between mobile phone use and subsequent glioma risk using meta-analysis.

METHODS: We performed a systematic search of the Science Citation Index Embase and PubMed databases for studies reporting relevant data on mobile phone use and glioma in 1980-2016. The data were extracted and measured in terms of the odds ratio (OR) and 95% confidence interval (CI) using the random effects model. Subgroup analyses were also carried out. This meta-analysis eventually included 11 studies comprising a total 6028 cases and 11488 controls.

RESULTS: There was a significant positive association between long-term mobile phone use (minimum, 10 years) and glioma (OR = 1.44, 95% CI = 1.08-1.91). And there was a significant positive association between long-term ipsilateral mobile phone use and the risk of glioma (OR = 1.46, 95% CI = 1.12-1.92). Long-term mobile phone use was associated with 2.22 times greater odds of low-grade glioma occurrence (OR = 2.22, 95% CI = 1.69-2.92). Mobile phone use of any duration was not associated with the odds of high-grade glioma (OR = 0.81, 95% CI = 0.72-0.92). Contralateral mobile phone use was not associated with glioma regardless of the duration of use. Similarly, this association was not observed when the analysis was limited to high-grade glioma.

CONCLUSIONS: Our results suggest that long-term mobile phone use may be associated with an increased risk of glioma. There was also an association between mobile phone use and low-grade glioma in the regular use or long-term use subgroups. However, current evidence is of poor quality and limited quantity. It is therefore necessary to conduct large sample, high quality research or better characterization of any potential association between long-term ipsilateral mobile phone use and glioma risk.

Open Access Paper: http://bit.ly/2peeylc

Three additional reviews of mobile phone use and brain tumor research published in 2017: http://bit.ly/2mg6NFg

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Neurodevelopment for first 3 years following prenatal mobile phone use, RF radiation & lead exposure

Kyung-Hwa Choi, Mina Ha, Eun-Hee Ha, Hyesook Park, Yangho Kim, Yun-Chul Hong, Ae-Kyoung Lee, Jong Hwa Kwon, Hyung-Do Choi, Nam Kim, Suejin Kim, Choonghee Park. Neurodevelopment for the first three years following prenatal mobile phone use, radio frequency radiation and lead exposure. Environmental Research, 156:810-817, July 2017.

Highlights

• RFR exposure was measured by mobile phone use questionnaire and 24-h personal exposure meter among pregnant women.
• Child neurodevelopment was assessed by trained examiners at 6, 12, 24, and 36 months of age.
• Associations were not observed between prenatal exposure to RFR and child neurodevelopment during the first three years.
• A potential combined effect of prenatal exposure to lead and mobile phone use was suggested.

Abstract

Background Studies examining prenatal exposure to mobile phone use and its effect on child neurodevelopment show different results, according to child's developmental stages.

Objectives To examine neurodevelopment in children up to 36 months of age, following prenatal mobile phone use and radiofrequency radiation (RFR) exposure, in relation to prenatal lead exposure.

Methods We analyzed 1198 mother-child pairs from a prospective cohort study (the Mothers and Children's Environmental Health Study). Questionnaires were provided to pregnant women at ≤20 weeks of gestation to assess mobile phone call frequency and duration. A personal exposure meter (PEM) was used to measure RFR exposure for 24 h in 210 pregnant women. Maternal blood lead level (BLL) was measured during pregnancy. Child neurodevelopment was assessed using the Korean version of the Bayley Scales of Infant Development-Revised at 6, 12, 24, and 36 months of age. Logistic regression analysis applied to groups classified by trajectory analysis showing neurodevelopmental patterns over time.

Results The psychomotor development index (PDI) and the mental development index (MDI) at 6, 12, 24, and 36 months of age were not significantly associated with maternal mobile phone use during pregnancy. However, among children exposed to high maternal BLL in utero, there was a significantly increased risk of having a low PDI up to 36 months of age, in relation to an increasing average calling time (p-trend=0.008). There was also a risk of having decreasing MDI up to 36 months of age, in relation to an increasing average calling time or frequency during pregnancy (p-trend=0.05 and 0.007 for time and frequency, respectively). There was no significant association between child neurodevelopment and prenatal RFR exposure measured by PEM in all subjects or in groups stratified by maternal BLL during pregnancy.

Conclusions We found no association between prenatal exposure to RFR and child neurodevelopment during the first three years of life; however, a potential combined effect of prenatal exposure to lead and mobile phone use was suggested.

https://www.ncbi.nlm.nih.gov/pubmed/28511138

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Multiple assessment methods of prenatal exposure to radio frequency radiation from telecommunication in the Mothers and Children's Environmental Health (MOCEH) study

Choi KH, Ha M, Burm E, Ha EH, Park H, Kim Y, Lee AK, Kwon JH, Choi HD, Kim N. Multiple assessment methods of prenatal exposure to radio frequency radiation from telecommunication in the Mothers and Children's Environmental Health (MOCEH) study. Int J Occup Med Environ Health. 2016 Nov 18;29(6):959-972. doi: 10.13075/ijomeh.1896.00803. Epub 2016 Nov 3.

Abstract

OBJECTIVES: To evaluate prenatal exposure to radiofrequency radiation (RFR) from telecommunication using a mobile phone questionnaire, operator data logs of mobile phone use and a personal exposure meter (PEM).

MATERIAL AND METHODS: The study included 1228 mother-infants pairs from the Mothers and Children's Environmental Health (MOCEH) study - a multicenter prospective cohort study ongoing since 2006, in which participants were enrolled at ≤ 20 weeks of pregnancy, with a follow-up of a child birth and growth to assess the association between prenatal environmental exposure and children's health. The questionnaire included the average calling frequency per day and the average calling time per day. An EME Spy 100 PEM was used to measure RFR among 269 pregnant women from November 2007 to August 2010. The operators' log data were obtained from 21 participants. The Spearman's correlation test was performed to evaluate correlation coefficient and 95% confidence intervals between the mobile phone use information from the questionnaire, operators' log data, and data recorded by the PEM.

RESULTS: The operators' log data and information from the self-reported questionnaire showed significantly high correlations in the average calling frequency per day ($\rho = 0.6$, $p = 0.004$) and average calling time per day ($\rho = 0.5$, $p = 0.02$). The correlation between information on the mobile phone use in the self-reported questionnaire and exposure index recorded by the PEM was poor. But correlation between the information of the operators' log data and exposure index for transmission of mobile communication was significantly high: correlation coefficient (p-value) was 0.44 (0.07) for calling frequency per day, and it was 0.49 (0.04) for calling time per day.

CONCLUSIONS: The questionnaire information on the mobile phone use showed moderate to high quality. Using multiple methods for exposure assessment might be better than using only one method.

https://www.ncbi.nlm.nih.gov/pubmed/27869246

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Mobile phone use, blood lead levels, and attention deficit hyperactivity symptoms in children: a longitudinal study

Byun YH, Ha M, Kwon HJ, Hong YC, Leem JH, Sakong J, Kim SY, Lee CG, Kang D, Choi HD, Kim N. Mobile phone use, blood lead levels, and attention deficit hyperactivity symptoms in children: a longitudinal study. PLoS One. 2013;8(3):e59742. doi: 10.1371/journal.pone.0059742.

Abstract

BACKGROUND: Concerns have developed for the possible negative health effects of radiofrequency electromagnetic field (RF-EMF) exposure to children's brains. The purpose of this longitudinal study was to investigate the association between mobile phone use and symptoms of Attention Deficit Hyperactivity

Disorder (ADHD) considering the modifying effect of lead exposure.

METHODS: A total of 2,422 children at 27 elementary schools in 10 Korean cities were examined and followed up 2 years later. Parents or guardians were administered a questionnaire including the Korean version of the ADHD rating scale and questions about mobile phone use, as well as socio-demographic factors. The ADHD symptom risk for mobile phone use was estimated at two time points using logistic regression and combined over 2 years using the generalized estimating equation model with repeatedly measured variables of mobile phone use, blood lead, and ADHD symptoms, adjusted for covariates.

RESULTS: The ADHD symptom risk associated with mobile phone use for voice calls but the association was limited to children exposed to relatively high lead.

CONCLUSIONS: The results suggest that simultaneous exposure to lead and RF from mobile phone use was associated with increased ADHD symptom risk, although possible reverse causality could not be ruled out.

Open Access Paper: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0059742

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Pulsed radiofrequency radiation, and epigenetics: How wireless technologies may affect childhood development

Sage C, Burgio E. Electromagnetic Fields, Pulsed radiofrequency radiation, and epigenetics: How wireless technologies may affect childhood development. Child Development. Published online May 15, 2017.

Abstract

Mobile phones and other wireless devices that produce electromagnetic fields (EMF) and pulsed radiofrequency radiation (RFR) are widely documented to cause potentially harmful health impacts that can be detrimental to young people. New epigenetic studies are profiled in this review to account for some neurodevelopmental and neurobehavioral changes due to exposure to wireless technologies. Symptoms of retarded memory, learning, cognition, attention, and behavioral problems have been reported in numerous studies and are similarly manifested in autism and attention deficit hyperactivity disorders, as a result of EMF and RFR exposures where both epigenetic drivers and genetic (DNA) damage are likely contributors. Technology benefits can be realized by adopting wired devices for education to avoid health risk and promote academic achievement.

Conclusions

Public health implications of wireless technologies are enormous because there has been a very rapid global deployment in homes, education, transportation, and health care in the last two decades. Even a small risk from chronic use wireless technologies may have a profound global health impact. Impacts on the fetus via parental exposures to wireless devices preconception and during in utero development, infant rearing (baby monitors, wireless surveillance, Wi-Fi routers, DECT cordless phones, etc.), and childhood preschool and academic environments all may contribute in incremental ways to a perpetually saturated habitat of wireless emissions, and health impacts from the chronic, stressful body burden of EMF and RFR.

The wide array of pathophysiological effects of EMF and RFR exposures from wireless sources do not require “the breaking of molecular bonds” as done by ionizing radiation in order for physiologically damaging effects to

occur. Epigenetic mechanisms alone can change fetal development in profound ways, disrupting health by causing changes in gene activation and expression without change in gene sequences. Environmental epigenetic influences in the fetal and neonatal development (i.e., epigenetic regulation of genes rather than direct genetic effects by gene mutation) have been plausibly established to cause pathophysiological changes that can result in altered neurological development. Symptoms of neurodevelopmental problems in children like retarded memory, learning, cognition, attention, and behavioral aberrations that are similarly expressed in autism and ADHD have been reported in numerous scientific studies to occur as a result of EMF and RFR exposures, where epigenetic drivers are the most likely causes, and persistent exposures contribute to chronic dysfunction, overwhelming adaptive biological responses.

Electronic educational technologies have not resulted in better academic achievement globally and lend support to scientific studies showing adverse health and developmental impacts (OECD, 2015). Reductions in preventable exposures to EMF and RFR should be a top public health and school district priority. Technology benefits can be realized by adopting wired devices for education, to avoid health risk and promote academic achievement. Wider recognition that epigenetic factors are a plausible mechanism for EMF/RFR to regulate expression of DNA and thus impact child development is a critical need. Whether future research can identify safe levels of wireless exposures is unknown, but further investigation of epigenetic markers related to EMF/RFR exposure in child development and disease is warranted.

http://onlinelibrary.wiley.com/doi/10.1111/cdev.12824/abstract

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Effects of Mobile Phones on Children's and Adolescents' Health: A Commentary

Lennart Hardell. Effects of Mobile Phones on Children's and Adolescents' Health: A Commentary. Child Development. Published online May 15, 2017.

Abstract

The use of digital technology has grown rapidly during the last couple of decades. During use, mobile phones and cordless phones emit radiofrequency (RF) radiation. No previous generation has been exposed during childhood and adolescence to this kind of radiation. The brain is the main target organ for RF emissions from the handheld wireless phone. An evaluation of the scientific evidence on the brain tumor risk was made in May 2011 by the International Agency for Research on Cancer at World Health Organization. The scientific panel reached the conclusion that RF radiation from devices that emit nonionizing RF radiation in the frequency range 30 kHz–300 GHz is a Group 2B, that is, a "possible" human carcinogen. With respect to health implications of digital (wireless) technologies, it is of importance that neurological diseases, physiological addiction, cognition, sleep, and behavioral problems are considered in addition to cancer. Well-being needs to be carefully evaluated as an effect of changed behavior in children and adolescents through their interactions with modern digital technologies.

http://onlinelibrary.wiley.com/doi/10.1111/cdev.12831/abstract

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Can Non-Ionizing Radiation Cause Cancer?

Magda Havas. Can Non-Ionizing Radiation Cause Cancer? Archives of Physics Research, 2017, 8 (1):1-2.

Abstract

Our exposure to non-ionizing radiation (NIR) has been increasing steadily with our use of electricity, electronic equipment and-more recently-with our use of wireless technology. Concurrently, epidemiological studies have been documenting an increased cancer risk for people who use cell phones for 10 years or more [1,2] and for those who live near cell phone base stations [3,4,5], broadcast antennas [6,7], radar installations [8], or powerlines [9]. Health care authorities and physicists dismiss these studies because non-ionizing radiation doesn't have enough energy to break chemical bonds and, hence cannot cause cancer. Right? Wrong!

Open Access Paper: http://www.scholarsresearchlibrary.com/articles/can-nonionizing-radiation-cause-cancer.pdf

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Increasing levels of saliva alpha amylase in electrohypersensitive (EHS) patients

Andrianome S, Hugueville L, de Seze R, Selmaoui B. Increasing levels of saliva alpha amylase in electrohypersensitive (EHS) patients.Int J Radiat Biol. 2017 May 3:1-24. doi: 10.1080/09553002.2017.1325971. [Epub ahead of print].

Abstract

THE PURPOSE: The objective of this study was to assess the level of various salivary and urinary markers of patients with EHS and to compare them with those of the healthy control group.

MATERIALS AND METHODS: We analyzed samples from 30 EHS individuals and a matched control group of 25 individuals (non EHS) aged between 22 and 66. We quantified cortisol both in saliva and urine, alpha amylase (sAA), immunoglobulin A and C Reactive Protein levels in saliva and neopterin in urine (uNeopterin).

RESULTS: sAA was found to be significantly higher ($p < 0.005$) in the EHS group. uNeopterin and sAA analysis showed a significant difference based on the duration of EHS.

CONCLUSION: Higher level of sAA in EHS participants may suggest that the sympathetic adrenal medullar system is activated. However, most of the analyzed markers of the immune system, sympathetic activity and circadian rhythm did not vary significantly in EHS group. There is a trend to the higher levels of some variables in subgroups according to the EHS duration.

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Long-term exposure to continuous 900 MHz EMF disrupts cerebellar morphology in young adult male rats

Aslan A, İkinci A, Baş O, Sönmez OF, Kaya H, Odacı E. Long-term exposure to a continuous 900 MHz electromagnetic field disrupts cerebellar morphology in young adult male rats. Biotech Histochem. 2017 May

16:1-7. doi: 10.1080/10520295.2017.1310295. [Epub ahead of print]

Abstract

The pathological effects of exposure to an electromagnetic field (EMF) during childhood and adolescence may be greater than those from exposure during adulthood. We investigated possible pathological changes in the cerebellum of adolescent rats exposed to 900 MHz EMF daily for 25 days. We used three groups of six 21-day-old male rats as follows: unexposed control group (Non-EG), sham-exposed group (Sham-EG) and an EMF-exposed group (EMF-EG). EMF-EG rats were exposed to EMF in an EMF cage for 1 h daily from postnatal days 21 through 46. Sham-EG rats were placed in the EMF cage for 1 h daily, but were not subjected to EMF. No procedures were performed on the Non-EG rats. The cerebellums of all animals were removed on postnatal day 47, sectioned and stained with cresyl violet for histopathological and stereological analyses. We found significantly fewer Purkinje cells in the EMF-EG group than in the Non-EG and Sham-EG groups. Histopathological evaluation revealed alteration of normal Purkinje cell arrangement and pathological changes including intense staining of neuron cytoplasm in the EMF-EG group. We found that exposure to continuous 900 MHz EMF for 1 h/day during adolescence can disrupt cerebellar morphology and reduce the number of Purkinje cells in adolescent rats.

https://www.ncbi.nlm.nih.gov/pubmed/28506085

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Ten gigahertz microwave radiation impairs spatial memory, enzymes activity, and histopathology of developing mice brain

Sharma A, Kesari KK, Saxena VK, Sisodia R. Ten gigahertz microwave radiation impairs spatial memory, enzymes activity, and histopathology of developing mice brain. Mol Cell Biochem. 2017 May 3. doi: 10.1007/s11010-017-3051-8.

Abstract

For decades, there has been an increasing concern about the potential hazards of non-ionizing electromagnetic fields that are present in the environment and alarming as a major pollutant or electro-pollutant for health risk and neuronal diseases. Therefore, the objective of the present study was to explore the effects of 10 GHz microwave radiation on developing mice brain. Two weeks old mice were selected and divided into two groups (i) sham-exposed and (ii) microwave-exposed groups. Animals were exposed for 2 h/day for 15 consecutive days. After the completion of exposure, within an hour, half of the animals were autopsied immediately and others were allowed to attain 6 weeks of age for the follow-up study. Thereafter results were recorded in terms of various biochemical, behavioral, and histopathological parameters. Body weight result showed significant changes immediately after treatment, whereas non-significant changes were observed in mice attaining 6 weeks of age. Several other endpoints like brain weight, lipid peroxidation, glutathione, protein, catalase, and superoxide dismutase were also found significantly ($p < 0.05$) altered in mice whole brain. These significant differences were found immediately after exposure and also in follow-up on attaining 6 weeks of age in microwave exposure group. Moreover, statistically significant ($p < 0.001$) effect was investigated in spatial memory of the animals, in learning to locate the position of platform in Morris water maze test. Although in probe trial test, sham-exposed animals spent more time in searching for platform into

the target quadrant than in opposite or other quadrants. Significant alteration in histopathological parameters (qualitative and quantitative) was also observed in CA1 region of the hippocampus, cerebral cortex, and ansiform lobule of cerebellum. Results from the present study concludes that the brain of 2 weeks aged mice was very sensitive to microwave exposure as observed immediately after exposure and during follow-up study at 6 weeks of age.

https://www.ncbi.nlm.nih.gov/pubmed/28470342

Excerpt

All animals were kept in such position, where the head of animals faced the horn antenna. The horn antenna was kept in H (Magnetic field) plane configuration, where electric field was perpendicular to the ground surface. Field was almost uniform because the dimension of the cage was of the order of wavelength. The maximum power density 0.25 mW/cm2 was recorded at the near field distance from the horn antenna. A power meter measured the emitted power of microwaves, which was a peak sensitive device ... The whole body specific absorption rate (SAR) was estimated to be 0.1790 W/kg ... Similar experiment with same number of sham-exposed animals was performed without energizing the microwave exposure system.

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Ameliorative effect of gallic acid on pancreas lesions induced by 2.45 GHz Wi-Fi in young rats

Senay Topsakal, Ozlem Ozmen, Ekrem Cicek, Selcuk Comlekci. The ameliorative effect of gallic acid on pancreas lesions induced by 2.45 GHz electromagnetic radiation (Wi-Fi) in young rats. Journal of Radiation Research and Applied Sciences, Available online 4 May 2017.

Highlights

• Effects of electromagnetic radiation (EMR) on pancreata examined by immunohistochemical level.
• EMR exposure has been caused both endocrine and endocrine pancreas problems.
• Our results indicate that possible relation with EMR and pancreatic lesions in developmental ages.

Abstract

The aim of this study was to investigate the effects of electromagnetic radiation (EMR) on the pancreas tissue of young rats and the ameliorative effect of Gallic acid (GA). Six-week-old, 48 male rats were equally divided into four groups: Sham group, EMR group (2.45 GHz), EMR (2.45 GHz)+GA group (30 mg/kg/daily) orally and GA group (30 mg/kg/daily). After 30 days, serum and pancreatic tissue samples were harvested for biochemical, histopathological and immunohistochemical analysis. Serum amylase, lipase, glucose, and tissue malondialdehyde, total oxidant status and oxidative stress index were increased, whereas total antioxidant status decreased in the EMR group. The histopathological examination of the pancreases indicated slight degenerative changes in some pancreatic endocrine and exocrine cells and slight inflammatory cell infiltrations in the EMR group. At the immunohistochemical examination, marked increase was observed in calcitonin gene related protein and Prostaglandin E2 expressions in pancreatic cells in this group. There were no changes in interleukin-6 expirations. GA ameliorated biochemical and pathological findings in the EMR+GA group. These findings clearly demonstrate that EMR can cause degenerative changes in both endocrine and exocrine pancreas cells in rats during the developmental period and GA has an ameliorative effect.

http://www.sciencedirect.com/science/article/pii/S1687850717300468

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Effects of Intermittent and Continuous Magnetic Fields on Trace Element Levels in Guinea Pigs

Erdem O, Akay C, Cevher SC, Canseven AG, Aydın A, Seyhan N. Effects of Intermittent and Continuous Magnetic Fields on Trace Element Levels in Guinea Pigs.Biol Trace Elem Res. 2017 May 22. doi: 10.1007/s12011-017-1053-8. [Epub ahead of print]

Abstract

Electromagnetic fields (EMFs) can affect living cells due to biochemical changes, followed by changes in levels of trace elements in serum and different organs. This study focuses on the effect of whole body exposure to EMF, presented everywhere in our environment, and on the levels of trace elements in serum, femur, brain, kidney, and liver tissues. The analyses performed on 29 guinea pigs were divided into five groups. Guinea pigs were exposed to a magnetic field of 50 Hz of 1.5 mT. Groups A and B were exposed to the magnetic field for a period of 4 h/day continuously (4 h/day) for 4 and 7 days, respectively. Groups C and D were exposed to the magnetic field for a period of 4 h/day intermittently for 4 and 7 days, respectively. Group E animals were enrolled as control. Copper (Cu), zinc (Zn), calcium (Ca), and magnesium (Mg) levels were determined by atomic absorption spectroscopy in serum, femur, brain, kidney, and liver tissues in all guinea pigs. When compared to the control groups, the changes in the levels of Cu in serum samples, femur, and kidney tissues of the treated groups were statistically significant. The same was also true for the levels of Mg in the brain, kidney, and lung tissues. Our results suggest that in vivo continuous and intermittent exposure to EMF may cause disturbances in homeostasis of bioelements. These effects could be important risk factors for toxic effects of EMF, especially in relation to deterioration of bioelements.

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Preterm birth among women living within 600 meters of high voltage overhead Power Lines: a case-control study

Sadeghi T, Ahmadi A, Javadian M, Gholamian SA, Delavar MA, Esmailzadeh S, Ahmadi B, Hadighi MSH. Preterm birth among women living within 600 meters of high voltage overhead Power Lines: a case-control study. Rom J Intern Med. 2017 Apr 18. [Epub ahead of print]

Abstract

AIM: The issue of preterm birth due to exposure to magnetic fields from power lines is unclear. Exposure to electromagnetic field in uterus has been hypothesized as possible preterm birth. The aim of the present study was to determine whether living closer to high voltage power lines increased the risk of preterm labor.

METHODS: In a nested case-control study, 135 cases of singleton live spontaneous preterm birth in Rohani hospital, Babol, Iran, during the period between 2013 and 2014 were studied. The 150 control subjects were singleton term live birth in the same year of birth and city of residence using randomized-digit dialing. The shortest distance to any of the high voltage power lines to the maternal residence during pregnancy was measured using ArcGIS software for every case and control. To test the association between the preterm births and the residential proximity to power lines, stepwise multiple logistic regression was used.

RESULTS: There were 28 households, 20 cases (14.8%) and 8 controls (5.3%) were situated within 600

meters of a high voltage power lines. The adjusted OR for spontaneous preterm birth and birth defect in women who were living in less than 600 meters from high voltage power lines was higher compared to those living in farther distance (OR=3.28, CI: 1.37 to 7.85) and (OR=5.05, CI: 1.52 to 16.78), respectively.

CONCLUSIONS: Therefore, installing overhead power lines and stations within 600 meters or making overhead underground would be useful in the prevention of the both preterm birth and birth defect.

https://www.ncbi.nlm.nih.gov/pubmed/28422709

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Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation

Carlberg M, Hardell L. Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation. Biomed Res Int. 2017;2017:9218486. doi: 10.1155/2017/9218486. Epub 2017 Mar 16.

Abstract

Objective. Bradford Hill's viewpoints from 1965 on association or causation were used on glioma risk and use of mobile or cordless phones. Methods. All nine viewpoints were evaluated based on epidemiology and laboratory studies. Results. Strength: meta-analysis of case-control studies gave odds ratio (OR) = 1.90, 95% confidence interval (CI) = 1.31-2.76 with highest cumulative exposure. Consistency: the risk increased with latency, meta-analysis gave in the 10+ years' latency group OR = 1.62, 95% CI = 1.20-2.19. Specificity: increased risk for glioma was in the temporal lobe. Using meningioma cases as comparison group still increased the risk. Temporality: highest risk was in the 20+ years' latency group, OR = 2.01, 95% CI =1.41-2.88, for wireless phones. Biological gradient: cumulative use of wireless phones increased the risk. Plausibility: animal studies showed an increased incidence of glioma and malignant schwannoma in rats exposed to radiofrequency (RF) radiation. There is increased production of reactive oxygen species (ROS) from RF radiation. Coherence: there is a change in the natural history of glioma and increasing incidence. Experiment: antioxidants reduced ROS production from RF radiation. Analogy: there is an increased risk in subjects exposed to extremely low-frequency electromagnetic fields. Conclusion. RF radiation should be regarded as a human carcinogen causing glioma.

https://www.ncbi.nlm.nih.gov/pubmed/28401165

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Asociación entre las radiaciones de teléfonos móviles y el riesgo tumoral en personas adultas

Bielsa-Fernández P, Rodríguez-Martín B. Asociación entre las radiaciones de teléfonos móviles y el riesgo tumoral en personas adultas. Gaceta Sanitaria, Available online 13 April 2017. (Review paper written in Spanish.)

Abstract

Objective To synthesize and analyse systematic reviews, case-control studies, cohort studies and meta-analysis that investigate the association between exposure to radiofrequency from mobile phones and the appearance of tumours in adults.

Methods A systematic search was conducted in Scopus, Web of Science, The Cochrane Library, Medline and Cinahl of articles published in English and Spanish between January 2005 and February 2016 that analyse the risk of tumour associated with exposure to radiofrequency from mobile phones in adults. The

recommendations of the PRISMA Declaration were followed, and the quality of the articles was analysed with the AMSTAR tool and the Newcastle-Ottawa Scale.

Results 1034 studies were found, fourteen of which were included. Most studies agree that it is not possible to determine a relationship in the short term, although long-term (over 10 years) radiofrequency emitted by mobile phones can cause tumour effects, with an increased risk by ipsilateral exposure and latency.

Conclusions Although radiofrequency from mobile phones has tumour effects on humans, the available scientific evidence is not robust. More rigorous follow-up studies with larger sample sizes and broader periods are necessary to learn more about the long-term effects.

http://bit.ly/2qzgnPV

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Acute effects of mobile phone radiation on brain function

Zhang J, Sumich A, Wang GY. Acute effects of radiofrequency electromagnetic field emitted by mobile phone on brain function. Bioelectromagnetics. 2017 Apr 20. doi: 10.1002/bem.22052. [Epub ahead of print]

Abstract

Due to its attributes, characteristics, and technological resources, the mobile phone (MP) has become one of the most commonly used communication devices. Historically, ample evidence has ruled out the substantial short-term impact of radiofrequency electromagnetic field (RF-EMF) emitted by MP on human cognitive performance. However, more recent evidence suggests potential harmful effects associated with MP EMF exposure. The aim of this review is to readdress the question of whether the effect of MP EMF exposure on brain function should be reopened. We strengthen our argument focusing on recent neuroimaging and electroencephalography studies, in order to present a more specific analysis of effects of MP EMF exposure on neurocognitive function. Several studies indicate an increase in cortical excitability and/or efficiency with EMF exposure, which appears to be more prominent in fronto-temporal regions and has been associated with faster reaction time. Cortical excitability might also underpin disruption to sleep. However, several inconsistent findings exist, and conclusions regarding adverse effects of EMF exposure are currently limited. It also should be noted that the crucial scientific question of the effect of longer-term MP EMF exposure on brain function remains unanswered and essentially unaddressed.

https://www.ncbi.nlm.nih.gov/pubmed/28426166

Conclusion

While several studies suggest an effect of EMF exposure on brain function, there is little evidence of the harmful nature of these effects, and greater understanding is needed of their functional significance. To date, the crucial scientific question of the effect of longer-term MP EMF exposure on brain function remains unanswered and essentially unaddressed. The potential health effects of MP EMF exposure in children and adolescents have been identified by the World Health Organization (WHO) as a high priority research area, since they have longer lifetime exposure to MP [van Deventure et al., 2011]. Prior to establishing a clear picture of a cause-effect relationship on MPs, it is safer to minimize the MP use. It has been suggested to reduce the potential harm induced by MPs by restricting call length, or by using hands-free devices [Valentini et al., 2010]. Furthermore, more people have problems with MP use [Billieux et al., 2015], and addictive consumption styles and problematic behavior have been observed. In order to minimize possible negative consequences caused by excessive usage, further research is required to clarify neurophysiological changes associated with long-term MP EMF exposure and the impact of different behavioral characteristics of MP use on cognitive function.

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Cell phone use may increase the risk of developing parotid gland tumors

Brignardello-Petersen R. Cell phone use may increase the risk of developing parotid gland tumors. J Am Dent Assoc. 2017 May;148(5):e61. doi: 10.1016/j.adaj.2017.02.045.

No Abstract

Also see: de Siqueira EC, de Souza FT, Gomez RS, Gomes CC, de Souza RP. Does cell phone use increase the chances of parotid gland tumor development? A systematic review and meta-analysis [published online ahead of print December 9, 2016]. J Oral Pathol Med. http://dx.doi.org/10.1111/jop.12531.

https://www.ncbi.nlm.nih.gov/pubmed/28449765

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Modeled & Perceived Exposure to RF EMF From Mobile-Phone Base Stations & Development of Symptoms Over Time in General Population Cohort

Martens AL, Slottje P, Timmermans DR, Kromhout H, Reedijk M, Vermeulen RC, Smid T. Modeled and Perceived Exposure to Radio-Frequency Electromagnetic Fields From Mobile-Phone Base Stations and the Development of Symptoms Over Time in a General Population Cohort. Am J Epidemiol. 2017 Apr 7:1-10. doi: 10.1093/aje/kwx041.

Abstract

We assessed associations between modeled and perceived exposure to radio-frequency electromagnetic fields (RF-EMF) from mobile-phone base stations and the development of nonspecific symptoms and sleep disturbances over time. A population-based Dutch cohort study, the Occupational and Environmental Health Cohort Study (AMIGO) (n = 14,829; ages 31-65 years), was established in 2011/2012 (T0), with follow-up of a subgroup (n = 3,992 invited) in 2013 (T1; n = 2,228) and 2014 (T2; n = 1,740). We modeled far-field RF-EMF exposure from mobile-phone base stations at the home addresses of the participants using a 3-dimensional geospatial model (NISMap). Perceived exposure (0 = not at all; 6 = very much), nonspecific symptoms, and sleep disturbances were assessed by questionnaire. We performed cross-sectional and longitudinal analyses, including fixed-effects regression. We found small correlations between modeled and perceived exposure in AMIGO participants at baseline (n = 14,309; rSpearman = 0.10). For 222 follow-up participants, modeled exposure increased substantially (>0.030 mW/m2) between T0 and T1. This increase in modeled exposure was associated with an increase in perceived exposure during the same time period. In contrast to modeled RF-EMF exposure from mobile-phone base stations, perceived exposure was associated with higher symptom reporting scores in both cross-sectional and longitudinal analyses, as well as with sleep disturbances in cross-sectional analyses.

https://www.ncbi.nlm.nih.gov/pubmed/28398549

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Radiofrequency exposure levels in Amsterdam schools

van Wel L, Vermeulen R, van Eijsden M, Vrijkotte T, Kromhout H, Huss A. Radiofrequency exposure levels in Amsterdam schools. Bioelectromagnetics. 2017 Apr 25. doi: 10.1002/bem.22053.

No Abstract

https://www.ncbi.nlm.nih.gov/pubmed/28444698

This letter to the editor reports the results of RF exposure levels in 102 primary schools in Amsterdam. GSM base stations (900 + 1800 MHz downlink) provided the largest contribution to the total average RF power density (38.0%), followed by DECT cordless phones (27.3%) and GSM mobile devices (11.1%), Although WiFi contributed only 4.5% of the total average power density, the assessments were conducted after school so it was unlikely that any wireless laptops or tablets were being used at the time.

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High RF radiation at Stockholm Old Town: An exposimeter study

Hardell L, Carlberg M, Koppel T, Hedendahl L. High radiofrequency radiation at Stockholm Old Town: An exposimeter study including the Royal Castle, Supreme Court, three major squares and the Swedish Parliament. Mol Clin Oncol. 2017 Apr;6(4):462-476. doi: 10.3892/mco.2017.1180. Epub 2017 Mar 3.

Abstract

Exposure to radiofrequency (RF) radiation was classified as a possible human carcinogen, Group 2B, by the International Agency for Research on Cancer at WHO in 2011. The exposure pattern is changing due to the rapid development of technology. Outdoor RF radiation level was measured during five tours in Stockholm Old Town in April, 2016 using the EME Spy 200 exposimeter with 20 predefined frequencies. The results were based on 10,437 samples in total. The mean level of the total RF radiation was 4,293 µW/m2 (0.4293 µW/cm2). The highest mean levels were obtained for global system for mobile communications (GSM) + universal mobile telecommunications system (UMTS) 900 downlink and long-term evolution (LTE) 2600 downlink (1,558 and 1,265 µW/m2, respectively). The town squares displayed highest total mean levels, with the example of Järntorget square with 24,277 µW/m2 (min 257, max 173,302 µW/m2). These results were in large contrast to areas with lowest total exposure, such as the Supreme Court, with a mean level of 404 µW/m2 (min 20.4, max 4,088 µW/m2). In addition, measurements in the streets surrounding the Royal Castle were lower than the total for the Old Town, with a mean of 756 µW/m2 (min 0.3, max 50,967 µW/m2). The BioInitiative 2012 Report defined the scientific benchmark for possible health risks as 30-60 µW/m2. Our results of outdoor RF radiation exposure at Stockholm Old Town are significantly above that level. The mean exposure level at Järntorget square was 405-fold higher than 60 µW/m2. Our results were below the reference level on 10,000,000 µW/m2 established by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), which, however, are less credible, as they do not take non-thermal effects into consideration and are not based on sound scientific evaluation. Our highest measured mean level at Järntorget was 0.24% of the ICNIRP level. A number of studies have found adverse, non-thermal (no measurable temperature increase) health effects far below the ICNIRP guidelines.

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Effect of 900 MHz GSM Mobile Phone RF Radiation on Estrogen Receptor Methylation Status in Colon Cells

Mokarram P, Sheikhi M, Mortazavi SMJ, Saeb S, Shokrpour N. Effect of Exposure to 900 MHz GSM Mobile Phone Radiofrequency Radiation on Estrogen Receptor Methylation Status in Colon Cells of Male Sprague Dawley Rats. J Biomed Phys Eng. 2017 Mar 1;7(1):79-86. eCollection 2017.

Abstract

BACKGROUND: Over the past several years, the rapidly increasing use of mobile phones has raised global concerns about the biological effects of exposure to radiofrequency (RF) radiation. Numerous studies have shown that exposure to electromagnetic fields (EMFs) can be associated with effects on the nervous, endocrine, immune, cardiovascular, hematopoietic and ocular systems. In spite of genetic diversity, the onset and progression of cancer can be controlled by epigenetic mechanisms such as gene promoter methylation. There are extensive studies on the epigenetic changes of the tumor suppressor genes as well as the identification of methylation biomarkers in colorectal cancer. Some studies have revealed that genetic changes can be induced by exposure to RF radiation. However, whether or not RF radiation is capable of inducing epigenetic alteration has not been clarified yet. To date, no study has been conducted on the effect of radiation on epigenetic alterations in colorectal cancer (CRC). Several studies have also shown that methylation of estrogen receptor α (ERα), MYOD, MGMT, SFRP2 and P16 play an important role in CRC. It can be hypothesized that RF exposure can be a reason for the high incidence of CRC in Iran. This study aimed to investigate whether epigenetic pattern of ERα is susceptible to RF radiation and if RF radiation can induce radioadaptive response as epigenetic changes after receiving the challenge dose (γ-ray).

MATERIAL AND METHOD: 40 male Sprague-Dawley rats were divided into 4 equal groups (Group I: exposure to RF radiation of a GSM cell phone for 4 hours and sacrificed after 24 hours; Group II: RF exposure for 4 hours, exposure to Co-60 gamma radiation (3 Gy) after 24 hours and sacrificed after 72 hrs; Group III: only 3Gy gamma radiation; Group 4: control group). DNA from colon tissues was extracted to evaluate the methylation status by methylation specific PCR.

RESULTS: Our finding showed that exposure to GSM cell phone RF radiation was capable of altering the pattern of ERα gene methylation compared to that of non-exposed controls. Furthermore, no adaptive response phenomenon was induced in the pattern of ERα gene methylation after exposure to the challenging dose of Co-60 γ-rays.

CONCLUSION: It can be concluded that exposure to RF radiation emitted by GSM mobile phones can lead to epigenetic detrimental changes in ERα promoter methylation pattern.

Open Access Paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5401136/

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Proteomic analysis of continuous 900-MHz RF EMF exposure in testicular tissue: a rat model of human cell phone exposure

Sepehrimanesh M, Kazemipour N, Saeb M, Nazifi S, Davis DL.Proteomic analysis of continuous 900-MHz radiofrequency electromagnetic field exposure in testicular tissue: a rat model of human cell phone exposure. Environ Sci Pollut Res Int. 2017 Apr 10. doi: 10.1007/s11356-017-8882-z.

Abstract

Although cell phones have been used worldwide, some adverse and toxic effects were reported for this communication technology apparatus. To analyze in vivo effects of exposure to radiofrequency-electromagnetic field (RF-EMF) on protein expression in rat testicular proteome, 20 Sprague-Dawley rats were exposed to 900 MHz RF-EMF for 0, 1, 2, or 4 h/day for 30 consecutive days. Protein content of rat testes was separated by high-resolution two-dimensional electrophoresis using immobilized pH gradient (pI 4-7, 7 cm) and 12% acrylamide and identified by MALDI-TOF/TOF-MS. Two protein spots were found differentially overexpressed ($P < 0.05$) in intensity and volume with induction factors 1.7 times greater after RF-EMF exposure. After 4 h of daily exposure for 30 consecutive days, ATP synthase beta subunit (ASBS) and hypoxia up-regulated protein 1 precursor (HYOU1) were found to be significantly up-regulated. These proteins affect

signaling pathways in rat testes and spermatogenesis and play a critical role in protein folding and secretion in the endoplasmic reticulum. Our results indicate that exposure to RF-EMF produces increases in testicular proteins in adults that are related to carcinogenic risk and reproductive damage. In light of the widespread practice of men carrying phones in their pockets near their gonads, where exposures can exceed as-tested guidelines, further study of these effects should be a high priority.

https://www.ncbi.nlm.nih.gov/pubmed/28397118

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Exposure to mobile phone (900-1800 MHz) during pregnancy: tissue oxidative stress after childbirth

Bahreyni Toossi MH, Sadeghnia HR, Mohammad Mahdizadeh Feyzabadi M, Hosseini M, Hedayati M, Mosallanejad R, Beheshti F, Alizadeh Rahvar Z.
Exposure to mobile phone (900-1800 MHz) during pregnancy: tissue oxidative stress after childbirth. J Matern Fetal Neonatal Med. 2017 Apr 23:1-6. doi: 10.1080/14767058.2017.1315657. [Epub ahead of print]

Abstract

BACKGROUND: The present study has investigated the effects of mobile phone (900-1800 MHz)-induced electromagnetic radiation on redox status in the heart, liver, kidney, cerebellum, and hippocampus of dams and the offspring mice.

MATERIALS AND METHODS: Pregnant Balb/C were divided into two groups including the control and the experimental group. The experimental group was exposed to mobile phone (900-1800 MHz), during pregnancy (2 h/d for 20 d). The dams and the offspring of both groups were sacrificed and tissues of interest were harvested immediately after delivery. Malondialdehyde (MDA) concentration, total thiol groups (TTG) content, superoxide dismutase (SOD), and catalase (CAT) activities were determined in the tissues.

RESULTS: In the experimental groups, MDA levels were significantly increased, while TTG, SOD, and CAT were significantly decreased in the total tissues of dams and their offspring.

CONCLUSION: Exposure to mobile phone (900-1800 MHz) during pregnancy induced oxidative stress in tissues of dams and their offspring.

https://www.ncbi.nlm.nih.gov/pubmed/28434276

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Postnatal development & behavior effects of in-utero exposure of rats to RF emitted from WiFi devices

Othman H, Ammari M, Rtibi K, Bensaid N, Sakly M, Abdelmelek H. Postnatal development and behavior effects of in-utero exposure of rats to radiofrequency waves emitted from conventional WiFi devices.Environ Toxicol Pharmacol. 2017 Apr 22;52:239-247. doi: 10.1016/j.etap.2017.04.016.

Highlights

• Effects of gestational exposure to 2.45 GHz WiFi signal for 2 h/day along gestation period on the offspring were studied.
• Offspring showed neurodevelopment impairments but no behavior alteration at adult age.
• Cerebral oxidative stress equilibrium as well as cholinesterase activity in brain and serum were altered.

Abstract

The present work investigated the effects of prenatal exposure to radiofrequency waves of conventional WiFi devices on postnatal development and behavior of rat offspring. Ten Wistar albino pregnant rats were randomly assigned to two groups (n=5). The experimental group was exposed to a 2.45GHz WiFi signal for 2h a day throughout gestation period. Control females were subjected to the same conditions as treated group without applying WiFi radiations. After delivery, the offspring was tested for physical and neurodevelopment during its 17 postnatal days (PND), then for anxiety (PND 28) and motricity (PND 40-43), as well as for cerebral oxidative stress response and cholinesterase activity in brain and serum (PND 28 and 43). Our main results showed that the in-utero WiFi exposure impaired offspring neurodevelopment during the first seventeen postnatal days without altering emotional and motor behavior at adult age. Besides, prenatal WiFi exposure induced cerebral oxidative stress imbalance (increase in malondialdehyde level (MDA) and hydrogen peroxide (H2O2) levels and decrease in catalase (CAT) and superoxide dismutase (SOD) activities) at 28 but not 43days old, also the exposure affected acethylcolinesterase activity at both cerebral and seric levels. Thus, the current study revealed that maternal exposure to WiFi radiofrequencies led to various adverse neurological effects in the offspring by affecting neurodevelopment, cerebral stress equilibrium and cholinesterase activity.

https://www.ncbi.nlm.nih.gov/pubmed/28458069

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Effect of long-term exposure of mice to 900 MHz GSM radiation on cutaneous candidiasis

Bayat M, Hemati S, Soleimani-Estyar R, Shahin-Jafari A. Effect of long-term exposure of mice to 900 MHz GSM radiation on experimental cutaneous candidiasis. Saudi Journal of Biological Sciences. 24(4):907-914. May 2017.

Abstract

Mobile phones communicate with base stations using 900 MHz microwaves. The current study was aimed to survey the effects of long-term 900 MHz microwave exposure of mice on experimentally induced cutaneous candidiasis. Forty inbred, male, BALB/c mice were randomly divided into four groups. Cutaneous lesions with Candida albicans were experimentally induced on the lateral-back skin of the 20 mice. One group of the diseased mice were exposed (6 h per day and 7 d per week) to 900 MHz microwave radiation, while the other groups were not exposed. Two unexposed control groups were also included. The skin lesions were regularly monitored and the live candida cell density was enumerated using the colony-forming unit (CFU) assay. The process was repeated after a one week resting interval. One week later, all mice were challenged through intra tail veins using LD90 dose of C. albicans. Mortality of the mice was recorded and the candida load of the kidney homogenates from died animals was counted. 900 MHz microwave exposed mice had 1.5 day and 3.7 day delays on wound healing in stages two. Live Candida inoculated Wave exposed (LCW) mice also showed higher yeast loads in skin lesions at days 5, 7 and 9 post inoculation. Survival analysis of live candida challenged mice showed the radiation exposed group is prone to death induced by systemic infection and candida enumeration from the kidney homogenates showed radiation exposed animals have had significantly higher yeast load in the tissue. In collection, long-term 900 MHz radiation exposure of mice led to longevity of skin wounds and susceptibility of the animals to systemic challenge and higher incidences of microorganisms in internal tissues.

http://bit.ly/2p8URXX

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RF radiation induced genotoxic & carcinogenic effects on chickpea root tip cells

Qureshi ST , Memon SA, Abassi AR, Sial MA, Bughio FA. Radiofrequency radiations induced genotoxic and carcinogenic effects on chickpea (Cicer arietinum L.) root tip cells. Saudi Journal of Biological Sciences, 24(4):883-391. May 2017.

Abstract

Present study was under taken to predict the possible DNA damages (genotoxicity) and carcinogenicity caused by radiofrequency radiations (RF) to living tissue. Dry seeds of chickpea were treated with GSM cell phone (900 MHz) and laptop (3.31 GHz) as RF source for 24 and 48 h. Untreated seeds were used as (0 h) negative control and Gamma rays (250 Gray) as positive control. Plant chromosomal aberration assay was used as genotoxicity marker. All the treatment of RF inhibits seed germination percentage. 48 h laptop treatment has the most negative effect as compared to untreated control. A decrease was observed in mitotic index (M.I) and increase in abnormality index (A.I) with the increase in exposure duration and frequency in (Hz). Cell membrane damages were also observed only in 48 h exposure of cell phone and laptop (RF). Maximum nuclear membrane damages and ghost cells were again recorded in 48 h exposure of cell phone and laptop. The radiofrequency radiations (900 MHz and 3.31 GHz) are only genotoxic as they induce micronuclei, bi-nuclei, multi-nuclei and scattered nuclei but could be carcinogenic as 48 h incubation of RF induced fragmentation and ghost cells. Therefore cell phones and laptop should not be used unnecessarily to avoid possible genotoxic and carcinogenic effects.

http://bit.ly/2pYJXrU

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Biological effects of exposure to static electric fields in humans and vertebrates: a systematic review

Petri AK, Schmiedchen K, Stunder D, Dechent D, Kraus T, Bailey WH, Driessen S. Biological effects of exposure to static electric fields in humans and vertebrates: a systematic review. Environ Health. 2017 Apr 17;16(1):41. doi: 10.1186/s12940-017-0248-y.

Abstract

BACKGROUND: High-voltage direct current (HVDC) lines are the technology of choice for the transport of large amounts of energy over long distances. The operation of these lines produces static electric fields (EF), but the data reviewed in previous assessments were not sufficient to assess the need for any environmental limit. The aim of this systematic review was to update the current state of research and to evaluate biological effects of static EF.

METHODS: Using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) recommendations, we collected and evaluated experimental and epidemiological studies examining biological effects of exposure to static EF in humans (n = 8) and vertebrates (n = 40).

RESULTS: There is good evidence that humans and animals are able to perceive the presence of static EF at sufficiently high levels. Hair movements caused by electrostatic forces may play a major role in this perception. A large number of studies reported responses of animals (e.g., altered metabolic, immunologic or developmental parameters) to a broad range of static EF strengths as well, but these responses are likely secondary physiological responses to sensory stimulation. Furthermore, the quality of many of the studies reporting physiological responses is poor, which raises concerns about confounding.

CONCLUSION: The weight of the evidence from the literature reviewed did not indicate that static EF have adverse biological effects in humans or animals. The evidence strongly supported the role of superficial sensory stimulation of hair and skin as the basis for perception of the field, as well as reported indirect behavioral and physiological responses. Physical considerations also preclude any direct effect of static EF on internal physiology, and reports that some physiological processes are affected in minor ways may be

explained by other factors. While this literature does not support a level of concern about biological effects of exposure to static EF, the conditions that affect thresholds for human detection and possible annoyance at suprathreshold levels should be investigated.

https://www.ncbi.nlm.nih.gov/pubmed/28416002

Excerpt

The vast majority of the evaluated studies dealt with static EF influences on health and physiological functions in humans and animals. An experimental study in visual display unit users found indications that a combination of static EF exposure and high dust concentrations might induce external facial skin irritation [33]. Two other human studies reported that static EF did not induce facial skin symptoms [32] or impair cardiovascular, hematologic, or psychomotor functions [28]. Neither were adverse health effects reported upon long-term exposure to a HVDC power line [35]. A great many of the animal studies reported effects on metabolic activity [49, 56, 60, 62, 68], collagen synthesis [59, 63, 64, 65], bone density [61], expression of oxidative stress markers [66, 67, 70, 71, 76], hematologic and immunologic blood parameters [41, 42, 43, 50, 69, 70, 71, 72, 74, 75, 76, 77, 78], neurotransmitter concentrations [56], brain activity [58], litter number [52], genotoxicity [69, 79], and tumor regression [37]. However, the results regarding these parameters were not always consistent and partially contradictory. Some studies could not confirm static EF influences on metabolic functions [52], histological appearance of diverse organ systems [43, 50, 69], neurotransmitter concentrations in the brain [38, 40, 57], functions of the immune system [73] or reproductive and developmental parameters [44].

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Absorption of millimeter waves by human beings and its biological implications
A classic paper that has implications for 5G wireless technology

Gandhi OP, Riazi A. Absorption of millimeter waves by human beings and its biological implications. IEEE Transactions on Microwave Theory and Techniques. MTT-34(2):228-235. 1986. http://bit.ly/2oS3rKD

Also see: http://www.saferemr.com/2016/08/is-5g-cellular-technology-harmful-to.html

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Prospects for Millimeter-Wave Compliance Measurement Technologies

Alon L, Gabriel S, Cho GY, Brown R, Deniz CM. Prospects for Millimeter-Wave Compliance Measurement Technologies [Measurements Corner]. IEEE Antennas Propag Mag 2017; 59 (2).

http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7892071

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Maternal cell phone use during pregnancy and child behavioral problems in five birth cohorts

Laura Birks, Mònica Guxens, Eleni Papadopoulou, Jan Alexander, Ferran Ballester, Marisa Estarlich, Mara Gallastegi, Mina Ha, Margaretha Haugen, Anke Huss, Leeka Kheifets et al. Maternal cell phone use during pregnancy and child behavioral problems in five birth cohorts. Environment International. Published online April 7, 2017. http://doi.org/10.1016/j.envint.2017.03.024

"This is the largest study to date to evaluate these associations and to show mostly consistent results across cohorts with retrospectively and prospectively assessed maternal cell phone use."

Highlights

• Largest study to date to use prenatal cell phone use data collected prospectively.
• High prenatal cell phone use linked to hyperactivity/inattention problems in child.
• No prenatal cell phone use linked to low risk for any behavioral problems in child.
• Analysis adjusted for many confounders, but associations cannot be judged causal.
• Future research should adjust for parenting style, maternal hyperactivity, and more.

Introduction Previous studies have reported associations between prenatal cell phone use and child behavioral problems, but findings have been inconsistent and based on retrospective assessment of cell phone use. This study aimed to assess this association in a multi-national analysis, using data from three cohorts with prospective data on prenatal cell phone use, together with previously published data from two cohorts with retrospectively collected cell phone use data.

Methods We used individual participant data from 83,884 mother-child pairs in the five cohorts from Denmark (1996–2002), Korea (2006–2011), the Netherlands (2003–2004), Norway (2004–2008), and Spain (2003–2008). We categorized cell phone use into none, low, medium, and high, based on frequency of calls during pregnancy reported by the mothers. Child behavioral problems (reported by mothers using the Strengths and Difficulties Questionnaire or Child Behavior Checklist) were classified in the borderline/clinical and clinical ranges using validated cut-offs in children aged 5–7 years. Cohort specific risk estimates were meta-analyzed.

Results Overall, 38.8% of mothers, mostly from the Danish cohort, reported no cell phone use during pregnancy and these mothers were less likely to have a child with overall behavioral, hyperactivity/inattention or emotional problems. Evidence for a trend of increasing risk of child behavioral problems through the maternal cell phone use categories was observed for hyperactivity/inattention problems (OR for problems in the clinical range: 1.11, 95% CI 1.01, 1.22; 1.28, 95% CI 1.12, 1.48, among children of medium and high users, respectively). This association was fairly consistent across cohorts and between cohorts with retrospectively and prospectively collected cell phone use data.

Conclusions Maternal cell phone use during pregnancy may be associated with an increased risk for behavioral problems, particularly hyperactivity/inattention problems, in the offspring. The interpretation of these results is unclear as uncontrolled confounding may influence both maternal cell phone use and child behavioral problems.

https://www.ncbi.nlm.nih.gov/pubmed/28392066

Also see:
Pregnancy & Wireless Radiation Risks

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Effects of prenatal exposure to WiFi signal on postnatal development and behavior in rat: Influence of maternal restraint

Haifa Othman, Mohamed Ammari, Mohsen Sakly, Hafedh Abdelmelek. Effects of prenatal exposure to WiFi signal (2.45 GHz) on postnatal development and behavior in rat: Influence of maternal restraint. Behavioural Brain Research. 36:291-302. May 2017. http://dx.doi.org/10.1016/j.bbr.2017.03.011

Highlights

• Effects of gestational exposure to WiFi signal and restraint along gestation period on the offspring were studied.
• The pups were evaluated for physical development and neuromotor maturation.
• Gestational WiFi exposure and restraint, adversely affected offspring neurodevelopment and behavior at adulthood.

• Progeny brain oxidative balance and serum biochemistry were disrupted.

Abstract

The present study was carried out to investigate the potential combined influence of maternal restraint stress and 2.45 GHz WiFi signal exposure on postnatal development and behavior in the offspring of exposed rats. 24 pregnant albino Wistar rats were randomly assigned to four groups: Control, WiFi-exposed, restrained and both WiFi-exposed and restrained groups. Each of WiFi exposure and restraint occurred 2 h/day along gestation till parturition. The pups were evaluated for physical development and neuromotor maturation. Moreover, elevated plus maze test, open field activity and stationary beam test were also determined on postnatal days 28, 30 and 31, respectively. After behavioral tests, the rats were anesthetized and their brains were removed for biochemical analysis. Our main findings showed no detrimental effects on gestation progress and outcomes at delivery in all groups. Subsequently, WiFi and restraint, *per se* and mainly *in concert* altered physical development of pups with slight differences between genders. Behaviorally, the gestational WiFi irradiation, restraint and especially the associated treatment affected the neuromotor maturation mainly in male progeny. At adult age, we noticed anxiety, motor deficit and exploratory behavior impairment in male offspring co-exposed to WiFi radiation and restraint, and in female progeny subjected to three treatments. The biochemical investigation showed that, all three treatments produced global oxidative stress in brain of both sexes. As for serum biochemistry, phosphorus, magnesium, glucose, triglycerides and calcium levels were disrupted. Taken together, prenatal WiFi radiation and restraint, alone and combined, provoked several behavioral and biochemical impairments at both juvenile and adult age of the offspring.

http://www.sciencedirect.com/science/article/pii/S0166432816313018

Also see:
Pregnancy & Wireless Radiation Risks

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The effect of cell phone usage on semen quality and fertility among Jordanian males

Nahla Al-Bayyari. Middle East Fertility Society Journal. The effect of cell phone usage on semen quality and fertility among Jordanian males. Published online Apr 7, 2017. http://doi.org/10.1016/j.mefs.2017.03.006

Abstract

Background and objective Cell phones emit radiofrequency electromagnetic radiation are prejudicial to human fertility. The objective was to study the effect of cell phone usage on semen quality and men's fertility.

Materials and methods A cross-sectional observational study conducted on 159 men attending infertility clinics at North, Middle and South Governorates in Jordan and undergoing infertility evaluation were divided into two groups according to their active cell phone use: group A: ≤1 h/day and group B: >1 h/day. No interventions were given to patients and semen samples were collected by masturbation in a sterile container after an abstinence period of 5 days. The main outcome measures were sperm volume, liquefaction time, pH, viscosity, count, motility and morphology.

Results There were no statistical significance differences ($p > 0.05$) between both groups regarding sperm quality parameters according to cell phone use, but there were statistical differences in the frequencies of sperm concentration, volume, viscosity, liquefaction time and means of immotile sperms and abnormal morphology. In addition, time spend on watching television and using wireless phones were significantly ($p \leq 0.05$) associated with decreasing mean percentages of normal morphology. The distance from telecommunication tower was significantly ($p \leq 0.05$) associated with decreasing sperms volume. Meanwhile, the time spend on sending or receiving messages was significantly ($p \leq 0.05$) associated with decreasing sperms count and carrying mobile phone in trouser pocket was significantly associated with increasing means

of immotile sperms.

Conclusion Cell phone use might have a negative effect on semen quality parameters and further research is needed.

http://www.sciencedirect.com/science/article/pii/S1110569017300602

Also see:
Effect of Mobile Phones on Sperm Quality

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Behavioral risk factors of breast cancer in Bangui of Central African Republic: A retrospective case-control study

Balekouzou A, Yin P, Afewerky HK, Bekolo C, Pamatika CM, Nambei SW, et al. Behavioral risk factors of breast cancer in Bangui of Central African Republic: A retrospective case-control study. PLoS One. 2017 Feb 8;12(2):e0171154. doi: 10.1371/journal.pone.0171154.

Abstract

Breast cancer is recognized as a major public health problem in developing countries; however, there is very little evidence of behavioral factors associated with breast cancer risk. This study was conducted to identify lifestyles as risk factors for breast cancer among Central African women. A case-control study was conducted with 174 cases confirmed histologically by the pathology unit of the National Laboratory and 348 age-matched controls. Data collection tools included a questionnaire with interviews and medical records of patients. Data were analyzed using SPSS software version 20. Odd ratio (OR) and 95% confidence intervals (95% CI) were obtained by unconditional logistic regression. In total, 522 women were studied with a mean age of 45.8 (SD = 13.4) years. By unconditional logistic regression model, women with breast cancer were more likely to have attained illiterate and elementary education level [11.23 (95% CI, 4.65-27.14) and 2.40 (95% CI, 1.15-4.99)], married [2.09 (95% CI, 1.18-3.71)], positive family history [2.31 (95% CI, 1.36-3.91)], radiation exposure [8.21 (95% CI, 5.04-13.38)], consumption charcuterie [10.82 (95% CI, 2.39-48.90)], fresh fish consumption [4.26 (95% CI, 1.56-11.65)], groundnut consumption [6.46 (95% CI, 2.57-16.27)], soybean consumption [16.74 (95% CI, 8.03-39.84)], alcohol [2.53 (95% CI, 1.39-4.60)], habit of keeping money in bras[3.57 (95% CI, 2.24-5.69)], overweight [5.36 (95% CI, 4.46-24.57)] and obesity [3.11(95% CI, 2.39-20.42)]. However, decreased risk of breast cancer was associated with being employed [0.32 (95% CI, 0.19-0.56)], urban residence [0.16 (95% CI, 0.07-0.37)], groundnut oil consumption [0.05 (95% CI, 0.02-0.14)], wine consumption [0.16 (95% CI, 0.09-0.26)], **non habit of keeping cell phone in bras [0.56 (95% CI, 0.35-0.89)]** and physical activity [0.71(95% CI, 0.14-0.84)]. The study showed that little or no education, marriage, positive family history of cancer, radiation exposure, charcuterie, fresh fish, groundnut, soybean, alcohol, habit of keeping money in bras, overweight and obesity were associated with breast cancer risk among Central African women living in Bangui. Women living in Bangui should be more cautious on the behavioral risk associated with breast cancer.

http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0171154

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Ecological momentary assessments integrating real-time exposure measurements & health assessment using a smartphone application

van Wel L, Huss A, Bachmann P, Zahner M, Kromhout H, Fröhlich J, Vermeulen R. Context-sensitive ecological momentary assessments; integrating real-time exposure measurements, data-analytics and health assessment using a smartphone application. Environ Int. 2017 Mar 25;103:8-12. doi: 10.1016/j.envint.2017.03.016. [Epub ahead of print]

Abstract

INTRODUCTION: Modern sensor technology makes it possible to collect vast amounts of environmental, behavioural and health data. These data are often linked to contextual information on for example exposure sources which is separately collected with considerable lag time, leading to complications in assessing transient and/or highly spatially variable environmental exposures. Context-Sensitive Ecological Momentary Assessments1 (CS-EMAs) could be used to address this. We present a case study using radiofrequency-electromagnetic fields (RF-EMF) exposure as an example for implementing CS-EMA in environmental research.

METHODS: Participants were asked to install a custom application on their own smartphone and to wear an RF-EMF exposimeter for 48h. Questionnaires were triggered by the application based on a continuous data stream from the exposimeter. Triggers were divided into four categories: relative and absolute exposure levels, phone calls, and control condition. After the two days of use participants filled in an evaluation questionnaire.

RESULTS: 74% of all CS-EMAs were completed, with an average time of 31s to complete a questionnaire once it was opened. Participants reported minimal influence on daily activities. There were no significant differences found between well-being and type of RF-EMF exposure.

CONCLUSIONS: We show that a CS-EMA based method could be used in environmental research. Using several examples involving environmental stressors, we discuss both current and future applications of this methodology in studying potential health effects of environmental factors.

https://www.ncbi.nlm.nih.gov/pubmed/28351768

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Tumor-treating fields elicit a conditional vulnerability to ionizing radiation via the downregulation of BRCA1 signaling and reduced DNA double-strand break repair capacity in non-small cell lung cancer cell lines

Karanam NK, Srinivasan K, Ding L, Sishc B, Saha D, Story MD. Tumor-treating fields elicit a conditional vulnerability to ionizing radiation via the downregulation of BRCA1 signaling and reduced DNA double-strand break repair capacity in non-small cell lung cancer cell lines. Cell Death Dis. 2017 Mar 30;8(3):e2711. doi: 10.1038/cddis.2017.136.

Abstract

The use of tumor-treating fields (TTFields) has revolutionized the treatment of recurrent and newly diagnosed glioblastoma (GBM). TTFields are low-intensity, intermediate frequency, alternating electric fields that are applied to tumor regions and cells using non-invasive arrays. The predominant mechanism by which TTFields are thought to kill tumor cells is the disruption of mitosis. Using five non-small cell lung cancer (NSCLC) cell lines we found that there is a variable response in cell proliferation and cell killing between these NSCLC cell lines that was independent of p53 status. TTFields treatment increased the G2/M population, with a concomitant reduction in S-phase cells followed by the appearance of a sub-G1 population indicative of apoptosis. Temporal changes in gene expression during TTFields exposure was evaluated to identify molecular signaling changes underlying the differential TTFields response. The most differentially expressed genes were associated with the cell cycle and cell proliferation pathways. However, the expression of genes found within the BRCA1 DNA-damage response were significantly downregulated ($P<0.05$) during TTFields treatment. DNA double-strand break (DSB) repair foci increased when cells were exposed to TTFields as did the appearance of chromatid-type aberrations, suggesting an interphase mechanism responsible for cell death involving DNA repair. Exposing cells to TTFields immediately following ionizing radiation resulted in increased chromatid aberrations and a reduced capacity to repair DNA DSBs, which were likely responsible for at least a

portion of the enhanced cell killing seen with the combination. These findings suggest that TTFields induce a state of 'BRCAness' leading to a conditional susceptibility resulting in enhanced sensitivity to ionizing radiation and provides a strong rationale for the use of TTFields as a combined modality therapy with radiation or other DNA-damaging agents.

https://www.ncbi.nlm.nih.gov/pubmed/28358361

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Are media reports able to cause somatic symptoms attributed to WiFi radiation? An experimental test of the negative expectation hypothesis

Bräscher AK, Raymaekers K, Van den Bergh O, Witthöft M. Are media reports able to cause somatic symptoms attributed to WiFi radiation? An experimental test of the negative expectation hypothesis. Environ Res. 2017 Mar 31;156:265-271. doi: 10.1016/j.envres.2017.03.040.

Abstract

People suffering from idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF) experience numerous non-specific symptoms that they attribute to EMF. The cause of this condition remains vague and evidence shows that psychological rather than bioelectromagnetic mechanisms are at work. We hypothesized a role of media reports in the etiology of IEI-EMF and investigated how somatosensory perception is affected. 65 healthy participants were instructed that EMF exposure can lead to enhanced somatosensory perception. Participants were randomly assigned to watch either a television report on adverse health effects of EMF or a neutral report. During the following experiment, participants rated stimulus intensities of tactile (electric) stimuli while being exposed to a sham WiFi signal in 50% of the trials. Sham WiFi exposure led to increased intensity ratings of tactile stimuli in the WiFi film group, especially in participants with higher levels of somatosensory amplification. Participants of the WiFi group reported more anxiety concerning WiFi exposure than the Control group and tended to perceive themselves as being more sensitive to EMF after the experiment compared to before. Sensational media reports can facilitate enhanced perception of tactile stimuli in healthy participants. People tending to perceive bodily symptoms as intense, disturbing, and noxious seem most vulnerable. Receiving sensational media reports might sensitize people to develop a nocebo effect and thereby contribute to the development of IEI-EMF. By promoting catastrophizing thoughts and increasing symptom-focused attention, perception might more readily be enhanced and misattributed to EMF.

https://www.ncbi.nlm.nih.gov/pubmed/28371755

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Mitochondrial hyperpolarization and cytochrome-c release in microwave-exposed MCF-7 cells

Esmekaya MA, Canseven AG, Kayhan H, Tuysuz MZ, Sirav B, Seyhan N. Mitochondrial hyperpolarization and cytochrome-c release in microwave-exposed MCF-7 cells. Gen Physiol Biophys. 2016 Sep 12. [Epub ahead of print]

Abstract

This study examines the effects of a 2.1-GHz WCDMA-modulated microwave (MW) radiation on apoptotic activity and mitochondrial membrane potential (ΔΨm) in MCF-7 cells. The cells were exposed to the MW at a specific absorption rate (SAR) of 0.528 W/kg for 4 or 24 h. The antiproliferative effect of MW exposure was determined by the MTT test. Cytochrome-c and p53 levels were determined by an ELISA method. The relative ΔΨm was analysed by JC-1 staining using flow cytometer. Apoptotic rate of the cells was measured by Annexin-V-FITC staining. All assays were performed after certain time of incubations (15 min-4 h) following MW exposure. MW-exposed cells showed a significant decrease in viability when compared to unexposed

cells. A significantly larger decrease was observed after longer exposure. The percentage of apoptotic cells, amount of cytochrome-c, and relative ΔΨm were significantly higher in MW-exposed cells. The percent of apoptotic cells and relative ΔΨm in 24 h MW-exposed group was significantly higher than those in 4 h MW-exposed group. However, no significant change was observed in p53 levels. These results demonstrated that exposure to 2.1-GHz WCDMA-modulated MW radiation caused hyperpolarization of mitochondria that in turn induced apoptosis in MCF-7 cells.

https://www.ncbi.nlm.nih.gov/pubmed/27615380

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Case-control study on occupational exposure to extremely low-frequency electromagnetic fields and glioma risk

Carlberg M, Koppel T, Ahonen M, Hardell L. Case-control study on occupational exposure to extremely low-frequency electromagnetic fields and glioma risk. Am J Ind Med. 2017 Apr 10. doi: 10.1002/ajim.22707. [Epub ahead of print]

Abstract

BACKGROUND: Exposure to extremely low-frequency electromagnetic fields (ELF-EMF) was in 2002 classified as a possible human carcinogen, Group 2B, by the International Agency for Research on Cancer at WHO.

METHODS: Life time occupations were assessed in case-control studies during 1997-2003 and 2007-2009. An ELF-EMF Job-Exposure Matrix was used for associating occupations with ELF exposure (μT). Cumulative exposure (μT-years), average exposure (μT), and maximum exposed job (μT) were calculated.

RESULTS: Cumulative exposure gave for astrocytoma grade IV (glioblastoma multiforme) in the time window 1-14 years odds ratio (OR) = 1.9, 95% confidence interval (CI) = 1.4-2.6, p linear trend <0.001, and in the time window 15+ years OR = 0.9, 95%CI = 0.6-1.3, p linear trend = 0.44 in the highest exposure categories 2.75+ and 6.59+ μT years, respectively.

CONCLUSION: An increased risk in late stage (promotion/progression) of astrocytoma grade IV for occupational ELF-EMF exposure was found.

https://www.ncbi.nlm.nih.gov/pubmed/28394434

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Occupational exposure and amyotrophic lateral sclerosis in a prospective cohort

Koeman T, Slottje P, Schouten LJ, Peters S, Huss A, Veldink JH, Kromhout H, van den Brandt PA, Vermeulen R. Occupational exposure and amyotrophic lateral sclerosis in a prospective cohort. Occup Environ Med. 2017 Mar 29. pii: oemed-2016-103780. doi: 10.1136/oemed-2016-103780.

Abstract

OBJECTIVE: To prospectively study suspected occupational risk factors for amyotrophic lateral sclerosis (ALS).

METHODS: For this case-cohort analysis within the prospective Netherlands Cohort Study, 58 279 men and 62 573 women aged 55-69 years at enrollment in 1986 were followed up for 17.3 years on ALS mortality. Information on occupational history and potential confounders were collected at baseline through a self-

administered questionnaire and entered for a random subcohort (2092 men and 2074 women) and ALS deaths (76 men and 60 women). Occupational exposure to solvents, pesticides, metals, extremely low frequency magnetic fields (ELF-MFs) and electrical shocks was estimated by means of job exposure matrices (JEMs). Associations between ever/never occupationally exposed and cumulative exposure and ALS mortality were analysed by gender using Cox regression.

RESULTS: Occupational exposure to ELF-MF showed a possible association with ALS mortality among men: HR for ever holding a job with high exposure versus background 2.19 (95% (CI): 1.02 to 4.73) and HR for the highest tertile of cumulative exposure versus background 1.93 (95% CI 1.05 to 3.55).

INTERPRETATION: These results strengthen the evidence suggesting a positive association between ELF-MF exposure and ALS. We did not replicate earlier positive findings for other occupational exposures.

https://www.ncbi.nlm.nih.gov/pubmed/28356332

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Parkinson's disease and occupational exposures: a systematic literature review and meta-analyses

Gunnarsson LG, Bodin L. Parkinson's disease and occupational exposures: a systematic literature review and meta-analyses.
Scand J Work Environ Health. 2017 Apr 5. pii: 3641. doi: 10.5271/sjweh.3641.

Abstract

Objectives We conducted a systematic literature review to identify studies fulfilling good scientific epidemiological standards for use in meta-analyses of relevant risk factors for Parkinson's disease. Methods Our search identified 103 original publications on associations between work and Parkinson's disease. GRADE guidelines were used to ensure high scientific quality, and reliable guidelines were applied to classify the papers. Of the 103 articles, 47 fulfilled good scientific standards while 56 were methodologically deficient and thus excluded from our meta-analyses. Results A total of 23 publications concerned work exposure to pesticides. The weighted relative risk estimate was 1.67 (95% confidence interval 1.42-1.97). A funnel plot and bias test indicated that some publication bias concerning smaller studies might have been present. The risk estimate was not influenced by study design (case-control, cohort, or cross-sectional study) or gender. Higher estimates were found when there was a hereditary taint or onset below age 60. Studies on exposure to metals or electromagnetic fields did not show increased risk. Conclusions Using an elaborated quality protocol, there is now strong evidence that exposure to any pesticide involves a ≥50% increased risk for developing Parkinson's disease.

https://www.ncbi.nlm.nih.gov/pubmed/?term=28379585

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ELF EMF promotes astrocytic differentiation of human bone marrow stem cells by modulating SIRT1 expression

Jeong WY, Kim JB, Kim HJ, Kim CW. Extremely low-frequency electromagnetic field promotes astrocytic differentiation of human bone marrow mesenchymal stem cells by modulating SIRT1 expression. Biosci Biotechnol Biochem. 2017 Mar 29:1-7. doi: 10.1080/09168451.2017.1308243.

Abstract

It has been shown that extremely low-frequency electromagnetic fields (ELFMF) affect regulation of cell fate and differentiation. Thus, the aim of this study was to investigate the role of ELFMFs in the enhancement of

astrocytic differentiation. ELFMF exposure reduced the rate of proliferation and enhanced astrocytic differentiation. The ELFMF-treated cells showed increased levels of the astrocyte marker (GFAP), while those of the early neuronal marker (Nestin) and stemness marker (OCT3/4) were downregulated. The reactive oxygen species (ROS) level was observed to be significantly elevated after ELFMF exposure, which strengthens the modulatory role of SIRT1 and SIRT1 downstream molecules (TLE1, HES1, and MASH1) during astrocytic differentiation. After nicotinamide (5 mM) mediated inhibition of SIRT1, levels of TLE1, HES1, and MASH1 were examined; TLE1 was significantly upregulated and MASH1 was downregulated. These results suggest that ELFMFs induce astrocytic differentiation through activation of SIRT1 and SIRT1 downstream molecules.

https://www.ncbi.nlm.nih.gov/pubmed/28351214

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ELF EMF exposure enhances inflammatory response and inhibits effect of antioxidant in RAW 264.7 cells

Kim SJ, Jang YW, Hyung KE, Lee DK, Hyun KH, Jeong SH, Min KH, Kang W, Jeong JH, Park SY, Hwang KW. Extremely low-frequency electromagnetic field exposure enhances inflammatory response and inhibits effect of antioxidant in RAW 264.7 cells. Bioelectromagnetics. 2017 Mar 29. doi: 10.1002/bem.22049. [Epub ahead of print]

Abstract

In recent years there has been a dramatic increase in the number and variety of electronic devices that emit electromagnetic waves. Because people live and work in close proximity to these pieces of electrical equipment, there is growing concern surrounding the destruction of homeostasis by electromagnetic field exposure. In the present study, the effects of 60 Hz 0.8 mT extremely low-frequency electromagnetic fields (ELF-EMF) on a macrophage cell line (RAW 264.7) were examined. Under defined ELF-EMF exposure conditions, the production of nitric oxide and pro-inflammatory cytokines, TNF-α, IL-1β, and IL-6, were increased in RAW 264.7 cells and the expression of those genes was also upregulated. However, cell proliferation was not altered. Translocation of NF-κB (nuclear factor kappa B), molecules that act downstream of the pro-inflammatory cytokines, were increased to the nucleus under ELF-EMF exposure conditions. In addition, we found that ELF-EMF exposure elevated activation of nuclear factor of activated T cells (NFAT) 2, as well as positively affected the influx of calcium. Furthermore, with both the presence of a potent antioxidant (Resveratrol) and downregulation of the antioxidant-related gene Prx-1 (Peroxiredoxin-1), ELF-EMF was associated with higher inflammatory responses of macrophages. These results suggest that an ELF-EMF amplifies inflammatory responses through enhanced macrophage activation and can decrease the effectiveness of antioxidants.

https://www.ncbi.nlm.nih.gov/pubmed/28370033

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ELF EMF induces neural differentiation of hBM-MSCs through regulation of (Zn)-metallothionein-3

Aikins AR, Hong SW, Kim HJ, Yoon CH, Chung JH, Kim M, Kim CW. Extremely low-frequency electromagnetic field induces neural differentiation of hBM-MSCs through regulation of (Zn)-metallothionein-3. Bioelectromagnetics. 2017 Mar 29. doi: 10.1002/bem.22046.

Abstract

Extremely low-frequency electromagnetic field (ELFEMF) can stimulate neural differentiation in human bone marrow-derived mesenchymal cells (hBM-MSCs), and this provides an opportunity for research on

neurodegenerative diseases such as Alzheimer's disease (AD). Metallothionein-3 (MT3), an isoform of the metal-binding proteins, metallothioneins, involved in maintaining intracellular zinc (Zn) homeostasis and the deregulation of zinc homeostasis, has separately been implicated in AD. Here, we investigated the effect of ELFEMF-induced neural differentiation of hBM-MSCs on Zn-MT3 homeostatic interaction. Exposure to ELFEMF induced neural differentiation of hBM-MSCs, which was characterized by decreased proliferation and enhanced neural-like morphology. We observed expression of neuronal markers such as β-tubulin3, pleiotrophin, and neurofilament-M at the mRNA level and MAP2 at the protein level. ELFEMF-induced neural differentiation correlated with decreased expression of metal-response element-transcription factor 1 and MT3, as well as decreased intracellular Zn concentration. In addition, upregulation of dihydropyrimidinase-related protein 2 was observed, but there was no change in γ-enolase expression. These data indicate a possible regulatory mechanism for MT3 during neural differentiation. Our findings provide considerable insight into molecular mechanisms involved in neural differentiation, which is useful for developing new treatments for neurodegenerative diseases.

https://www.ncbi.nlm.nih.gov/pubmed/28370392

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Effects of 50 Hz MF exposure on DNA damage and cellular functions in various neurogenic cells

Su L, Yimaer A, Wei X, Xu Z, Chen G. The effects of 50 Hz magnetic field exposure on DNA damage and cellular functions in various neurogenic cells.J Radiat Res. 2017 Mar 21:1-13. doi: 10.1093/jrr/rrx012.

Abstract

Epidemiological studies have indicated a possible association between extremely low-frequency magnetic field (ELF-MF) exposure and the risk of nervous system diseases. However, laboratory studies have not provided consistent results for clarifying this association, despite many years of studies. In this study, we have systematically investigated the effects of 50 Hz MF exposure on DNA damage and cellular functions in both neurogenic tumor cell lines (U251, A172, SH-SY5Y) and primary cultured neurogenic cells from rats (astrocytes, microglia, cortical neurons). The results showed that exposure to a 50 Hz MF at 2.0 mT for up to 24 h did not influence γH2AX foci formation (an early marker of DNA double-strand breaks) in any of six different neurogenic cells. Exposure to a 50 Hz MF did not affect cell cycle progression, cell proliferation or cell viability in neurogenic tumor U251, A172 or SH-SY5Y cells. Furthermore, the MF exposure for 24 h did not significantly affect the secretion of cytokines (TNF-α, IL-6 or IL-1β) in astrocytes or microglia, or the phagocytic activity of microglia. In addition, MF exposure for 1 h per day did not significantly influence expression levels of microtubule-associated protein tau, microtubule-associated protein 2, postsynaptic density 95 or gephyrin in cortical neurons, indicating an absence of effects of MF exposure on the development of cortical neurons. In conclusion, our data suggest that exposure to a 50 Hz MF at 2.0 mT did not elicit DNA damage effects or abnormal cellular functions in the neurogenic cells studied.

https://www.ncbi.nlm.nih.gov/pubmed/28369556

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Electric Fields and Enzyme Catalysis

Fried SD, Boxer SG. Electric Fields and Enzyme Catalysis. Annu Rev Biochem. 2017 Mar 24. doi: 10.1146/annurev-biochem-061516-044432

Abstract

What happens inside an enzyme's active site to allow slow and difficult chemical reactions to occur so rapidly? This question has occupied biochemists' attention for a long time. Computer models of increasing

sophistication have predicted an important role for electrostatic interactions in enzymatic reactions, yet this hypothesis has proved vexingly difficult to test experimentally. Recent experiments utilizing the vibrational Stark effect make it possible to measure the electric field a substrate molecule experiences when bound inside its enzyme's active site. These experiments have provided compelling evidence supporting a major electrostatic contribution to enzymatic catalysis. Here, we review these results and develop a simple model for electrostatic catalysis that enables us to incorporate disparate concepts introduced by many investigators to describe how enzymes work into a more unified framework stressing the importance of electric fields at the active site.

https://www.ncbi.nlm.nih.gov/pubmed/28375745

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Is electromagnetism one of the causes of Colony Collapse Disorder? A work plan for testing this hypothesis

Marie-Claire Cammaerts. Is electromagnetism one of the causes of the CCD? A work plan for testing this hypothesis. Journal of Behavior. 2(1): 1006. Published Mar 28, 2017.

Abstract

The decline of domestic bees all over the world is an important problem still not well understood by scientists and beekeepers, and far from being solved. Its reasons are numerous: among others, the use of pesticides and insecticides, the decrease of plant diversity, and bee's parasites. Besides these threats, there is a potential adverse factor little considered: manmade electromagnetism. The production of electromagnetic waves by human settlements, cellphones relay and power lines largely increases nowadays. Bees are very sensitive to this electromagnetism. The present paper suggests two simple experimental protocols for bringing to the fore the potential adverse effect of electromagnetism on bees and to act consequently. The first one is the observation of bees' avoidance of a wireless apparatus; the second one is the assessment of colonies' strength and of the intensity of the electromagnetism field (EMF) surrounding them. If bees avoid a wireless apparatus, if hives in bad health are located in EMF of a rather high intensity, it can be presumed that bees are affected by manmade electromagnetism. This should enable searching for palliative measures.

https://www.jscimedcentral.com/Behavior/behavior-2-1006.php

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Zebra finches have a light-dependent magnetic compass similar to migratory birds

Pinzon-Rodriguez A, Muheim R. Zebra finches have a light-dependent magnetic compass similar to migratory birds. J Exp Biol. 2017 Apr 1;220(Pt 7):1202-1209. doi: 10.1242/jeb.148098.

Abstract

Birds have a light-dependent magnetic compass that provides information about the spatial alignment of the geomagnetic field. It is proposed to be located in the avian retina and mediated by a light-induced, radical-pair mechanism involving cryptochromes as sensory receptor molecules. To investigate how the behavioural responses of birds under different light spectra match with cryptochromes as the primary magnetoreceptor, we examined the spectral properties of the magnetic compass in zebra finches. We trained birds to relocate a food reward in a spatial orientation task using magnetic compass cues. The birds were well oriented along the trained magnetic compass axis when trained and tested under low-irradiance 521 nm green light. In the presence of a 1.4 MHz radio-frequency electromagnetic (RF)-field, the birds were disoriented, which supports the involvement of radical-pair reactions in the primary magnetoreception process. Birds trained and tested under 638 nm red light showed a weak tendency to orient ~45 deg clockwise of the trained magnetic direction.

Under low-irradiance 460 nm blue light, they tended to orient along the trained magnetic compass axis, but were disoriented under higher irradiance light. Zebra finches trained and tested under high-irradiance 430 nm indigo light were well oriented along the trained magnetic compass axis, but disoriented in the presence of a RF-field. We conclude that magnetic compass responses of zebra finches are similar to those observed in nocturnally migrating birds and agree with cryptochromes as the primary magnetoreceptor, suggesting that light-dependent, radical-pair-mediated magnetoreception is a common property for all birds, including non-migratory species.

https://www.ncbi.nlm.nih.gov/pubmed/28356366

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Evaluation of children exposure to electromagnetic fields of mobile phones using age-specific head models with age-dependent dielectric properties

Mohammed B, Jin J, Abbosh A, Bialkowski K, Manoufali M, Crozier S. Evaluation of children exposure to electromagnetic fields of mobile phones using age-specific head models with age-dependent dielectric properties. IEEE Access. PP(99). 2017

Abstract

Given the rapid introduction of mobile phones and other portable wireless devices into society, and the increased possibility of young children using or being exposed to electromagnetic (EM) fields, a study of specific absorption rate (SAR) in the head of young children is becoming increasingly relevant. To accurately evaluate the exposure of children to electromagnetic fields, realistic head models, which consider the age-specific anatomical structure and age-dependent tissues dielectric properties, are developed. During postnatal development of human tissues, the number and size of cells increase while the proportion of water content decreases. Such changes result generally in significant changes in the dielectric properties of tissues. The SAR levels for different ages are investigated using the developed child's head models when young children or their parents use a standard mobile phone.

The results show that the maximum SAR levels in brain tissues of young children (3 months) are higher by up to 61% and 78% than adults at the lowest (700 MHz) and highest (2600 MHz) investigated frequencies, respectively. The percentage absorption power in the heads of young children (3 months) is higher by up to 40.6% and 24% than the values for adults at 700 MHz and 2600 MHz, respectively.

Our investigation shows that previous studies, which used scaled head models without considering the age-dependent variations in the head anatomy and/or age-dependent tissues' dielectric properties, underestimated SAR levels in the children's heads. **The obtained results using the developed realistic head models indicate that for young children, a lower limit on radiated power might be required to meet the acceptable dosimetry levels.**

http://ieeexplore.ieee.org/document/8086149/

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An international prospective cohort study of mobile phone users and health (COSMOS): Factors affecting validity of self-reported mobile phone use

Toledano MB, Auvinen A, Tettamanti G, Cao Y, Feychting M, Ahlbom A, Fremling K, Heinävaara S, Kojo K, Knowles G, Smith RB, Schüz J, Johansen C, Poulsen AH, Deltour I, Vermeulen R, Kromhout H, Elliott P, Hillert L. An international prospective cohort study of mobile phone users and health (COSMOS): Factors

affecting validity of self-reported mobile phone use. Int J Hyg Environ Health. 2017 Sep 20. pii: S1438-4639(17)30321-8. doi: 10.1016/j.ijheh.2017.09.008.

Highlights

• Agreement for self-reported phone use was higher for call duration than frequency.
• Subjects tended to underestimate rather than overestimate mobile phone use.
• Agreement for self-reported call frequency was higher in men and older subjects.
• Subjects who reported symptoms were more likely to overestimate low call duration.

Abstract

This study investigates validity of self-reported mobile phone use in a subset of 75 993 adults from the COSMOS cohort study. Agreement between self-reported and operator-derived mobile call frequency and duration for a 3-month period was assessed using Cohen's weighted Kappa (κ). Sensitivity and specificity of both self-reported high (≥10 calls/day or ≥4h/week) and low (≤6 calls/week or <30min/week) mobile phone use were calculated, as compared to operator data. For users of one mobile phone, agreement was fair for call frequency (κ=0.35, 95% CI: 0.35, 0.36) and moderate for call duration (κ=0.50, 95% CI: 0.49, 0.50). Self-reported low call frequency and duration demonstrated high sensitivity (87% and 76% respectively), but for high call frequency and duration sensitivity was lower (38% and 56% respectively), reflecting a tendency for greater underestimation than overestimation. Validity of self-reported mobile phone use was lower in women, younger age groups and those reporting symptoms during/shortly after using a mobile phone. This study highlights the ongoing value of using self-report data to measure mobile phone use. Furthermore, compared to continuous scale estimates used by previous studies, categorical response options used in COSMOS appear to improve validity considerably, most likely by preventing unrealistically high estimates from being reported.

https://www.ncbi.nlm.nih.gov/pubmed/29056311

Excerpts

The target population for COSMOS was adult mobile phone users, aged 18–69 years, in 5 European countries: Denmark, Finland, the Netherlands, Sweden and the UK, and recently a 6th cohort has been initiated in France.

This analysis focuses on participants recruited into the study in Finland, Sweden and the UK between 2007 and 2010.

Participants were asked to report frequency and duration of mobile phone voice calls for the preceding three months via the following two questions:

“Over the last three months, how often did you talk on a mobile phone?” with the response options: <1 call per week (Finland and Sweden only; the UK web-based questionnaire filtered out these respondents in a previous question), 1–6 calls per week, 1–9 calls per day, ≥10 calls per day.

“Over the last three months, on average, how much time per week did you spend talking on a mobile phone?” with the response options: <5 min, 5–29 min, 30–59 min, 1–3 h, 4–6 h, >6 h.

Participants were asked if they experienced symptoms (“no symptoms, headache, dizziness, numbness in hands, nausea, hearing loss, tinnitus/ringing sound in ear, warming sensation on face and/or ear”) whilst using, or shortly after using, a mobile phone.

Approximately 20% of participants spent at least 4 h per week on calls and/or made at least 10 calls per day, and were thus defined as having high mobile phone use (Table 1).

We found that a considerable proportion of respondents misclassified their mobile phone use (approximately 60% and 40% for call duration and frequency, respectively) (Table 2, Supplementary Tables 1 & 2). Approximately a third of the participants underestimated their mobile phone call duration and frequency. The proportion of participants overestimating mobile phone use was much lower (23% for duration and 5% for call frequency among one- phone users) (Table 2).

Agreement between self-reported and operator call duration was significantly lower among those who reported experiencing symptoms whilst (or shortly after) using a mobile phone (κ = 0.44 (95% CI: 0.43, 0.46)) compared with those without symptoms (κ = 0.50 (95% CI: 0.49, 0.50)), primarily because those with symptoms were more likely to overestimate low call duration (sensitivity = 65% (95% CI: 62%, 67%) vs. 78% (95% CI: 77%, 79%) for those with and without symptoms respectively) (Table 4). A similar pattern was observed for call frequency, but the differences were smaller.

In this largest validation study to date, we found fair to moderate agreement between self-reported and operator-derived data on mobile phone use. The sensitivity of self-report was generally high for correctly identifying those with the smallest amount of mobile phone use, but lower for identifying heavy mobile phone use, in line with our observation that respondents in this study were more likely to underestimate than overestimate their mobile phone use.

Our findings demonstrate that those who experience symptoms when using a mobile phone are more likely to overestimate light mobile phone use, particularly call duration, compared to those without symptoms. This suggests that an individual's experience and/or perception of their health may influence the self-reporting of mobile phone use, likely affecting the validity of such exposure assessments. More specifically, it is possible that rumination bias (a form of information bias), whereby those with symptoms overestimate (consciously or subconsciously) their phone use in an effort to explain their symptoms, could be occurring in this subset of individuals. This finding has potential implications for the interpretation of previous cross-sectional studies investigating associations between mobile phone use and the symptoms reported here (Mortazavi et al., 2007; Soderqvist et al., 2008; Sandstrom et al., 2001). Overestimation of mobile phone use among those who report such symptoms would likely bias cross-sectional risk estimates away from the null, even if a true association does not exist (Armstrong, 1998), thus potentially distorting any observed associations.

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Total recall in the SCAMP cohort: Validation of self-reported mobile phone use in the smartphone era

Mireku MO, Mueller W, Fleming C, Chang I, Dumontheil I, Thomas MSC, Eeftens M, Elliott P, Röösli M, Toledano MB. Total recall in the SCAMP cohort: Validation of self-reported mobile phone use in the smartphone era. Environ Res. 2017 Oct 30;161:1-8. doi: 10.1016/j.envres.2017.10.034. [Epub ahead of print]

Abstract

Mobile phone use, predominantly smartphones, is almost ubiquitous amongst both adults and children. However adults and children have different usage patterns. A major challenge with research on mobile phone use is the reliability of self-reported phone activity for accurate exposure assessment.

We investigated the agreement between self-reported mobile phone use data and objective mobile operator traffic data in a subset of adolescents aged 11-12 years participating in the Study of Cognition, Adolescents and Mobile Phones (SCAMP) cohort. We examined self-reported mobile phone use, including call frequency, cumulative call time duration and text messages sent among adolescents from SCAMP and matched these data with records provided by mobile network operators (n = 350). The extent of agreement between self-reported mobile phone use and mobile operator traffic data use was evaluated using Cohen's weighted Kappa (κ) statistics. Sensitivity and specificity of self-reported low (< 1 call/day, ≤ 5min of call/day or ≤ 5 text messages sent/day) and high (≥ 11 calls/day, > 30min of call/day or ≥ 11 text messages sent /day) use were estimated.

Agreement between self-reported mobile phone use and mobile operator traffic data was highest for the duration spent talking on mobile phones per day on weekdays (38.9%) and weekends (29.4%) compared to frequency of calls and number of text messages sent. Adolescents overestimated their mobile phone use during weekends compared to weekdays. Analysis of agreement showed little difference overall between the sexes and socio-economic groups. Weighted kappa between self-reported and mobile operator traffic data for call frequency during weekdays was κ = 0.12, 95% CI 0.06-0.18. Of the three modes of mobile phone use measured in the questionnaire, call frequency was the most sensitive for low mobile phone users on weekdays and weekends (77.1, 95% CI: 69.3-83.7 and 72.0, 95% CI: 65.0-78.4, respectively). Specificity was moderate to high for high users with the highest for call frequency during weekdays (98.4, 95% CI: 96.4-99.5).

Despite differential agreement between adolescents' self-reported mobile phone use and mobile operator traffic data, our findings demonstrate that self-reported usage adequately distinguishes between high and low use.

The greater use of mobile smartphones over Wi-Fi networks by adolescents, as opposed to mobile phone networks, means operator data are not the gold standard for exposure assessment in this age group. This has important implications for epidemiologic research on the health effects of mobile phone use in adolescents.

https://www.ncbi.nlm.nih.gov/pubmed/29096315

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Long term variations measurement of electromagnetic field exposures in Alcalá de Henares (Spain)

Sánchez-Montero R, Alén-Corderoa C, López-Espí PL, Rigelsford JM, Aguilera-Benavente F, J.Alpuente-Hermosilla J. Long term variations measurement of electromagnetic field exposures in Alcalá de Henares (Spain). Science of the Total Environment. 598: 657-668. Nov 2017. https://doi.org/10.1016/j.scitotenv.2017.03.131.

Highlights

• The evolution of EMF exposure for Alcalá de Henares over a 2006–2015 is presented.
• Measurements take into account all the sources and their evolution in a 35 km2 area.
• A statistical and spatial analysis and their variations are also analysed.
• We have measured lower EMF levels where the population has remained unaltered.
• New areas have demanded new resources and it has led to an increase of the EMF.

Abstract

Electromagnetic radiowave exposure is a major concern in most countries due to possible adverse health effects. Over the last 10 years, many technological changes (digital television, mobile technologies, wireless networks…) have led to variations in the electromagnetic field (EMF) levels.

A large number of studies devoted to the analysis of EMF levels with personal dosimeters or computer models of the exposure of mobile stations have been conducted. However, the study of the exposure values, taking into account all the existing sources, and their evolution in a wide area, using measurements, has rarely been performed.

In this paper, we provide a comparison of the EMF exposure levels for the city of Alcalá de Henares (Spain) over a ten-year period using a broadband isotropic probe in the range from 100 kHz to 3 GHz. A statistical and spatial analysis of the measurements and their variations are also presented for the study of the global and local variations.

The measured values in the period from 2006 to 2015 were ranging from 0.02 to 2.05 V/m. Our global results show a moderate increase from 2006 to 2010 and they are almost invariant from 2010 to 2015. Although the whole dataset does not have relevant statistical difference, we have found marked local differences. In the city areas where the population density has remained unaltered, we have measured lower exposure levels. Conversely, new urban and industrial developments have demanded new resources, which have potentially contributed to the observed increase in the measured electric field levels within these areas.

Conclusions

This work considers the long term evolution of radio frequency electric field values from 2006 to 2015 for the city of Alcalá de Henares, Spain. This study has been based on 78 measurement locations across a 35 km2 area of the city, providing an average sample density of 2.2 points per square km. During the period considered, officially published statistical data shows a greater use of the radio electric spectrum for television and especially for mobile phones and wireless technologies. At the same time, significant technological changes have been introduced and widely adopted, such as the switch to digital television broadcasting and the proliferation of Wi-Fi. In 2006, the measured mean electric field value was 0.277 V/m, in 2010 this increased to 0.406 V/m and finally, in 2015 this was 0.395 V/m. The greatest increase in the exposure level of electric field strength occurred between 2006 and 2010. This general trend is largely consistent with the increase of radio resources at that time.

The statistical analysis of the measured data shows that it fits a lognormal distribution with a confidence greater than 95%. These results show a moderate increase of the global mean values from 2006 to 2010 and that they are almost invariant from 2010 to 2015. Using this statistical analysis, we can conclude that the probability of finding a value of 14 V/m (half of the prescribed public exposure limit) is less than 0.01% and the probability of finding a value of 28 V/m is negligible.

A narrowband measurement based study could help to a better understanding of the actual influence of the different sources (radio, TV, Mobile, WiFi etc.) in the observed exposure values.

http://www.sciencedirect.com/science/article/pii/S0048969717306502?via%3Dihub

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IEC/IEEE International Standard - Determining SAR in the human body from wireless communications devices, 30 MHz to 6 GHz

IEC/IEEE International Standard - Determining the peak spatial-average specific absorption rate (SAR) in the human body from wireless communications devices, 30 MHz to 6 GHz - Part 1: General requirements for using the finite difference time domain (FDTD) method for SAR calculations (IEEE Std. 62704-1-2017). No authors listed, IEEE, 2017, ISBN 9781504442596

http://ieeexplore.ieee.org/document/8088404/

IEC/IEEE International Standard - Determining the peak spatial-average specific absorption rate (SAR) in the human body from wireless communications devices, 30 MHz to 6 GHz - Part 2: Specific requirements for finite difference time domain (FDTD) modelling of exposure from vehicle mounted antennas (IEEE Std. 62704-2-2017). No authors listed, IEEE, 2017, ISBN 9781504441162

http://ieeexplore.ieee.org/document/7964816/

IEC/IEEE International Standard - Determining the peak spatial-average specific absorption rate (SAR) in the human body from wireless communications devices, 30 MHz to 6 GHz - Part 3: Specific requirements for using

the finite difference time domain (FDTD) method for SAR calculations of mobile phones (IEEE Std. 62704-3-2017) No authors listed, IEEE, 2017, ISBN 9781504442619

http://ieeexplore.ieee.org/document/8089724/

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Combined effects of varicocele and cell phones on semen and hormonal parameters

Schauer I, Mohamad Al-Ali B. Combined effects of varicocele and cell phones on semen and hormonal parameters. Wien Klin Wochenschr. 2017 Oct 13. doi: 10.1007/s00508-017-1277-9.

Abstract

BACKGROUND: The objective of this study was to evaluate if there is a combined effect of varicocele and cell phone storage in trousers pockets on semen and hormonal parameters.

METHODS: A retrospective analysis of 468 men attending an infertility clinic from 1993-2007 was performed. Varicoceles were determined by clinical examination and patients were questioned on cell phone usage and storage fashion. Semen samples were analyzed according to the World Health Organization (WHO) guidelines of 1999. Serum testosterone, luteinizing hormone (LH) and follicle stimulating hormone (FSH) were assessed.

RESULTS: There was a significant effect of cell phone storage in trousers pockets and varicocele in multivariate analysis (both $p < 0.001$). Varicocele showed an effect on sperm concentration ($p = 0.003$), LH ($p = 0.014$) and testosterone ($p = 0.003$). Compared to grade 1, grade 2 varicoceles showed a difference in sperm concentration ($p = 0.004$). Regarding testosterone differences were shown for grade 3 versus grade 1 ($p = 0.002$) and grade 3 compared to grade 2 ($p = 0.003$). Cell phone storage in trousers pockets showed an influence on the percentage of normal sperm morphology and LH (both $p < 0.001$). Varicocele and cell phone storage in trousers pockets did not show a combined effect ($p = 0.76$).

CONCLUSIONS: This analysis showed an inverse relation between sperm concentration and degree of varicocele, with lower concentrations in higher grade varicoceles. Testosterone was significantly higher in higher grade varicoceles, which could reflect a compensatory mechanism to the impaired testicular function. Cell phone storage in trousers pockets showed an effect on LH and sperm morphology. A combined effect of varicocele and cell phone storage in trousers pockets was not detected.

https://www.ncbi.nlm.nih.gov/pubmed/29030685

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Biological effects of cell-phone radiofrequency waves exposure on fertilization in mice; an in vivo and in vitro study

Fatehi D, Anjomshoa M, Mohammadi M, Seify M, Rostamzadeh A. Biological effects of cell-phone radiofrequency waves exposure on fertilization in mice; an in vivo and in vitro study. Middle East Fertility Society Journal, Available online 23 October 2017.

Abstract

Increasing use of cell-phone is one of the most important risk factors for population health. We designed an experimental study aimed at evaluating the effects of cell-phone radiofrequency (RF) waves exposure on fertilization in mice. Two hundred male and female NMRI-mice were used. One hundred males divided in five groups ($n = 20$) as control and exposed groups. Those irradiated with cell-phone RF in “Standby-mode” 1, 5 and 10 h daily named groups II, III and IV; respectively. Group V irradiated with cell-phone on “Active-mode”

one hour daily. After 30 days irradiation, 50 males and 50 females were kept 24 h to assess their embryos. Fifty males were scarified to evaluate both in vitro and in vivo parameters, and 50 females received PMSG & HCG for both quantitative and qualitative evaluation. Comparing groups III, IV and V with control-group showed significantly decreased in the number of two-cell embryos (p = .000); however, a significant increase was found in the number of dead embryos (p = .000). Furthermore, 5 h daily irradiation significantly decreased grade-A embryos (p = .015); while, it significantly increased grade-B, C and D embryos (p-values = 0.026, 0.007, 0.006; respectively). Moreover, comparing groups IV and V to control-group, significant increase was found in pregnancy duration (p = .005, p = .009; respectively). However, in the mentioned groups a significant decrease was seen in number of newborn mice (p = .001, p = .004; respectively). In conclusion our findings showed that the cell-phone radiation can affect development of embryos as well as the number of newborn and pregnancy duration in NMRI-mouse, which might be a significant cause of reproductive failure.

Conclusions

The results of this study indicate that cell-phone RF waves decreases the quantity of two cells embryos as well as embryos with grade-A quality at the developmental process; while it increases the fragmentation of IVF-derived cells as well as grade-C and D cells in the NMRI-mouse. Cell-phone RF waves also reduces the number of newborn mice, where it increases the pregnancy duration which result in fertility failure in NMRI-mouse.

http://www.sciencedirect.com/science/article/pii/S1110569017301875

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Interaction between pancreatic β cell and EMF: A systematic study toward finding the natural frequency spectrum of β cell system

Farashi S. Interaction between pancreatic β cell and electromagnetic fields: A systematic study toward finding the natural frequency spectrum of β cell system. Electromagn Biol Med. 2017 Oct 31:1-16. doi: 10.1080/15368378.2017.1389751. [Epub ahead of print]

Abstract

Interaction between biological systems and environmental electric or magnetic fields has gained attention during the past few decades. Although there are a lot of studies that have been conducted for investigating such interaction, the reported results are considerably inconsistent. Besides the complexity of biological systems, the important reason for such inconsistent results may arise due to different excitation protocols that have been applied in different experiments. In order to investigate carefully the way that external electric or magnetic fields interact with a biological system, the parameters of excitation, such as intensity or frequency, should be selected purposefully due to the influence of these parameters on the system response. In this study, pancreatic β cell, the main player of blood glucose regulating system, is considered and the study is focused on finding the natural frequency spectrum of the system using modeling approach. Natural frequencies of a system are important characteristics of the system when external excitation is applied. The result of this study can help researchers to select proper frequency parameter for electrical excitation of β cell system. The results show that there are two distinct frequency ranges for natural frequency of β cell system, which consist of extremely low (or near zero) and 100-750 kHz frequency ranges. There are experimental works on β cell exposure to electromagnetic fields that support such finding.

https://www.emf-portal.org/en/article/33742

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In vitro non-thermal oxidative stress response after 1800 MHz radiofrequency radiation

Marjanovic Cermak AM, Pavicic I, Tariba Lovakovic B, Pizent A, Trosic I. In vitro non-thermal oxidative stress response after 1800 MHz radiofrequency radiation. General Physiology and Biophysics. 36(4):407-414. Oct 2017.

Abstract
In this study possible connection between radiofrequency exposure (RF) and development of oxidative stress was investigated by measuring impairment in cellular oxidation-reduction balance immediately after RF exposure. Fibroblast cells V79 were exposed for 10, 30 and 60 minutes to 1800 MHz RF radiation. Electric field strength was 30 V/m and specific absorption rate (SAR) was calculated to be 1.6 W/kg. Electromagnetic field was generated within Gigahertz Transversal Electromagnetic Mode cell (GTEM) equipped by signal generator, amplifier and modulator. Cell viability was determined by CCK-8 colorimetric assay and level of reactive oxygen species (ROS) was detected by dihydroethidium staining. Reduced glutathione (GSH) and glutathione peroxidase (GSH-Px) were used to assess cell antioxidant activity while lipid oxidative damage was evaluated measuring concentration of malondialdehyde. Viability of V79 cells remained within normal physiological values regardless of exposure time. Increased level of superoxide radicals was detected after 60-min exposure. Significantly higher GSH level was observed immediately after 10-min exposure with higher but insignificant activity of GSH-Px. Lipid oxidative damage in exposed cell samples was not observed. Short-term RF exposure revealed transient oxidation-reduction imbalance in fibroblast cells following adaptation to applied experimental conditions.

https://www.ncbi.nlm.nih.gov/pubmed/28836500

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Involvement of the p38 MAPK signaling cascade in stress response of RAW 264.7 macrophages

Novoselova EG, Glushkova OV, Khrenov MO, Parfenyuk SB, Lunin SM, Vinogradova EV, Novoselova TV, Fesenko EE. Involvement of the p38 MAPK signaling cascade in stress response of RAW 264.7 macrophages. Dokl Biol Sci. 2017 Sep;476(1):203-205. doi: 0.1134/S0012496617050015. Epub 2017 Nov 4.

Abstract

The role of the p38 MAPK signaling cascade was studied in stress response of RAW 264.7 macrophages to extremely low-intensity centimeter microwaves. Irradiation stimulated production of a number of cytokines (IL-1, IL-6, TNF-α, INF-γ and IL-10), as well as induced activation of the signaling cascades NF- κB and p38 MAPK, and enhanced expression of Hsp72 heat shock protein. In the presence of the cascade p38 MAPK inhibitor (p38 MAP kinase inhibitor XI), the stimulating effects of electromagnetic waves were abrogated either completely (for NF-κB and Hsp72) or partially (for p38 MAPK and cytokines). The results obtained are indicative of a high sensitivity of the signaling cascade p38 MAPK to the effect of low-intensity physical fields.

https://www.ncbi.nlm.nih.gov/pubmed/29101623

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Cellular Response to ELF-MF and Heat: Evidence for a Common Involvement of Heat Shock Proteins?

Zeni O, Simkó M, Scarfi MR, Mattsson MO. Cellular Response to ELF-MF and Heat: Evidence for a Common Involvement of Heat Shock Proteins? Front Public Health. 2017 Oct 18;5:280. doi: 10.3389/fpubh.2017.00280.

Abstract

It has been shown that magnetic fields in the extremely low frequency range (ELF-MF) can act as a stressor in

various in vivo or in vitro systems, at flux density levels below those inducing excitation of nerve and muscle cells, which are setting the limits used by most generally accepted exposure guidelines, such as the ones published by the International Commission on Non-Ionizing Radiation Protection. In response to a variety of physiological and environmental factors, including heat, cells activate an ancient signaling pathway leading to the transient expression of heat shock proteins (HSPs), which exhibit sophisticated protection mechanisms. A number of studies suggest that also ELF-MF exposure can activate the cellular stress response and cause increased HSPs expression, both on the mRNA and the protein levels. In this review, we provide some of the presently available data on cellular responses, especially regarding HSP expression, due to single and combined exposure to ELF-MF and heat, with the aim to compare the induced effects and to detect possible common modes of action. Some evidence suggest that MF and heat can act as costressors inducing a kind of thermotolerance in cell cultures and in organisms. The MF exposure might produce a potentiated or synergistic biological response such as an increase in HSPs expression, in combination with a well-defined stress, and in turn exert beneficial effects during certain circumstances.

Summary

In summary, on the basis of the available data dealing with single exposure to ELF-MF showing HSP expression modulations, no (co)relation to MF-dose, specific exposure conditions, or cell type could be identified. The data regarding coexposures to MF and heat are very similar, and we cannot derive any consistent clue regarding a possible common mode of action. There is some evidence that MF and heat might act as costressors inducing thermotolerance in cell cultures and in organisms. The MF exposure might produce a potentiated biological response, such as the increase in HSPs expression in combination with a well-defined stress, and in turn exerts beneficial effects. It is also possible that ELF-MF exposure protects the cells *via* desensitization against heat stress, and so from secondary effects. Since the mode of action is not clear, we can only speculate if the applied temperature or the MF parameters or the cell type used (cell receptors and metabolic state, culture media, serum, etc.) is a relevant factor influencing the outcome, or if all together are important players in the biological response. Since systematic investigations are not available, we have to consider that beside the physical parameters used, more knowledge is needed about metabolic status and the absolute basal HSP levels of the cell models. Experiments, carried out under strictly controlled conditions from both electromagnetic and biological point of view, are needed to address specifically the underlying mechanisms involving HSPs and cellular responses to ELF-MF and heat.

Open Access Paper: https://www.frontiersin.org/articles/10.3389/fpubh.2017.00280/full

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Magnetic Fields and Reactive Oxygen Species

Wang H, Zhang X. Magnetic Fields and Reactive Oxygen Species. Int J Mol Sci. 2017 Oct 18;18(10). pii: E2175. doi: 10.3390/ijms18102175

Abstract

Reactive oxygen species (ROS) ubiquitously exist in mammalian cells to participate in various cellular signaling pathways. The intracellular ROS levels are dependent on the dynamic balance between ROS generation and elimination. In this review, we summarize reported studies about the influences of magnetic fields (MFs) on ROS levels. Although in most cases, MFs increased ROS levels in human, mouse, rat cells, and tissues, there are also studies showing that ROS levels were decreased or not affected by MFs. Multiple factors could cause these discrepancies, including but not limited to MF type/intensity/frequency, exposure time and assay time-point, as well as different biological samples examined. It will be necessary to investigate the influences of different MFs on ROS in various biological samples systematically and mechanistically, which will be helpful for people to get a more complete understanding about MF-induced biological effects. In addition, reviewing the roles of MFs in ROS modulation may open up new scenarios of MF application, which could be further and more widely adopted into clinical applications, particularly in diseases that ROS have documented

pathophysiological roles.

Open Access Paper: http://www.mdpi.com/1422-0067/18/10/2175

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Mobile phones, cordless phones and rates of brain tumors in different age groups in the Swedish National Inpatient Register and the Swedish Cancer Register during 1998-2015

Hardell L, Carlberg M. Mobile phones, cordless phones and rates of brain tumors in different age groups in the Swedish National Inpatient Register and the Swedish Cancer Register during 1998-2015. PLoS One. 12(10): e0185461. Published online Oct 4, 2017.

Abstract

We used the Swedish Inpatient Register (IPR) to analyze rates of brain tumors of unknown type (D43) during 1998–2015. Average Annual Percentage Change (AAPC) per 100,000 increased with +2.06%, 95% confidence interval (CI) +1.27, +2.86% in both genders combined. A joinpoint was found in 2007 with Annual Percentage Change (APC) 1998–2007 of +0.16%, 95% CI -0.94, +1.28%, and 2007–2015 of +4.24%, 95% CI +2.87, +5.63%. Highest AAPC was found in the age group 20–39 years. In the Swedish Cancer Register the age-standardized incidence rate per 100,000 increased for brain tumors, ICD-code 193.0, during 1998–2015 with AAPC in men +0.49%, 95% CI +0.05, +0.94%, and in women +0.33%, 95% CI -0.29, +0.45%. The cases with brain tumor of unknown type lack morphological examination. Brain tumor diagnosis was based on cytology/histopathology in 83% for men and in 87% for women in 1980. This frequency increased to 90% in men and 88% in women in 2015. During the same time period CT and MRI imaging techniques were introduced and morphology is not always necessary for diagnosis. If all brain tumors based on clinical diagnosis with CT or MRI had been reported to the Cancer Register the frequency of diagnoses based on cytology/histology would have decreased in the register. The results indicate underreporting of brain tumor cases to the Cancer Register. The real incidence would be higher. Thus, incidence trends based on the Cancer Register should be used with caution. Use of wireless phones should be considered in relation to the change of incidence rates.

http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0185461

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Recent advances in the effects of microwave radiation on brains

Wei-Jia Zhi, Li-Feng Wang, Xiang-Jun Hu. Recent advances in the effects of microwave radiation on brains. Military Medical Research. December 2017, 4:29. Published online: 21 September 2017.

Abstract

This study concerns the effects of microwave on health because they pervade diverse fields of our lives. The brain has been recognized as one of the organs that is most vulnerable to microwave radiation. Therefore, in this article, we reviewed recent studies that have explored the effects of microwave radiation on the brain, especially the hippocampus, including analyses of epidemiology, morphology, electroencephalograms, learning and memory abilities and the mechanisms underlying brain dysfunction. However, the problem with these studies is that different parameters, such as the frequency, modulation, and power density of the radiation and the irradiation time, were used to evaluate microwave radiation between studies. As a result, the existing data exhibit poor reproducibility and comparability. To determine the specific dose-effect relationship between microwave radiation and its biological effects, more intensive studies must be performed.

Open Access Review Paper: https://link.springer.com/article/10.1186/s40779-017-0139-0

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Mobile Phone Use and The Risk of Headache: A Systematic Review and Meta-analysis of Cross-sectional Studies

Wang J, Su H1, Xie W, Yu S. Mobile Phone Use and The Risk of Headache: A Systematic Review and Meta-analysis of Cross-sectional Studies. Sci Rep. 2017 Oct 3;7(1):12595. doi: 10.1038/s41598-017-12802-9.

Abstract

Headache is increasingly being reported as a detrimental effect of mobile phone (MP) use. However, studies aimed to investigate the association between MP use and headache yielded conflicting results. To assess the consistency of the data on the topic, we performed a systematic review and meta-analysis of the available cross-sectional studies. Published literature from PubMed and other databases were retrieved and screened, and 7 cross-sectional studies were finally included in this meta-analysis. The pooled odds ratio (OR) and 95% confidence interval (CI) were calculated. We found that the risk of headache was increased by 38% in MP user compared with non-MP user (OR, 1.38; 95% CI, 1.18-1.61, $p < 0.001$). Among MP users, the risk of headache was also increased in those who had longer daily call duration (2-15 min vs. <2 min: OR, 1.62; 95% CI, 1.34-1.98, $p < 0.001$; >15 min vs. <2 min: OR, 2.50; 95% CI, 1.76-3.54, $p < 0.001$) and higher daily call frequency (2-4 calls vs. <2 calls: OR, 1.37; 95% CI, 1.07-1.76, $p < 0.001$; >4 calls vs. <2 calls: OR, 2.52; 95% CI, 1.78-3.58, $p < 0.001$). Our data indicate that MP use is significantly associated with headache, further epidemiologic and experimental studies are required to affirm and understand this association.

https://www.ncbi.nlm.nih.gov/pubmed/28974725

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Effects of electromagnetic waves emitted from 3G+wi-fi modems on human semen analysis

Kamali K, Atarod M, Sarhadi S, Nikbakht J, Emami M, Maghsoudi R, Salimi H, Fallahpour B, Kamali N, Momtazan A, Ameli M. Effects of electromagnetic waves emitted from 3G+wi-fi modems on human semen analysis. Urologia. 2017 Sep 14:0. doi: 10.5301/uj.5000269.

Abstract

OBJECTIVE: The purpose of this study was to evaluate the effects of 3G+wifi modems on human sperm quality.A total of 40 semen specimens were gathered between March and September 2015, from healthy adult men.

METHODS: The sperm samples were divided into two groups - 3G+wi-fi exposed and unexposed groups. In the unexposed group, the specimens were shielded by aluminum foil in three layers and put into an incubator at a temperature of 37°C for 50 minutes. The exposed group was positioned in another room in an incubator at a temperature of 37°C for 50 minutes. A 3G+wi-fi modem was put into the same incubator and a laptop computer was connected to the modem and was downloading for the entire 50 minutes.Semen analysis was done for each specimen and comparisons between parameters of the two groups were done by using

Kolmogorov-Smirnov study and a paired t-test.

RESULTS: Mean percentage of sperm with class A and B motility were not significantly different in two groups (p = 0.22 and 0.54, respectively). In class C, it was significantly lower in the exposed group (p = 0.046), while in class D it was significantly higher (p = 0.022). Velocity curvilinear, velocity straight line, velocity average path, mean angular displacement, lateral displacement and beat cross frequency were significantly higher in the unexposed group. The limitation was the in vitro design.

CONCLUSIONS: Electromagnetic waves (EMWs) emitted from 3G+wi-fi modems cause a significant decrease in sperm motility and velocity, especially in non-progressive motile sperms. Other parameters of semen analysis did not change significantly.EMWs, which are used in communications worldwide, are a suspected cause of male infertility. Many studies evaluated the effects of cell phones and wi-fi on fertility. To our knowledge, no study has yet been done to show the effects of EMWs emitted from 3G+wi-fi modems on fertility.Our study revealed a significant decrease in the quality of human semen after exposure to EMWs emitted from 3G+wi-fi modems.

https://www.ncbi.nlm.nih.gov/pubmed/28967061

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Electromagnetic fields in neonatal incubators: the reasons for an alert

Bellieni CV, Nardi V, Buonocore G, Di Fabio S, Pinto I, Verrotti A. Electromagnetic fields in neonatal incubators: the reasons for an alert. J Matern Fetal Neonatal Med. 2017 Oct 8:1-11. doi: 10.1080/14767058.2017.1390559.

Abstract

BACKGROUND: Neonatal incubators are important tools for sick newborns in the first few days of life. Nevertheless, their electric engine, often very close to the newborn's body, emits electromagnetic fields (EMF) to which newborns are exposed. Aim of this paper is to review the available literature on EMF exposure in incubators, and the effects of such exposures on newborns that have been investigated.

METHODS: We carried out a systematic review of studies about EMF emissions produced by incubators, using Medline and Embase databases from 1993 to 2017.

RESULTS: We retrieved 15 papers that described the EMF exposure in incubators and their biological effects on babies. EMF levels in incubators appear to be between 2 and 100 mG, depending on the distance of the mattress from the electric engine. In some cases they exceed this range. These values interfere with melatonin production or with vagal tone. Even caregivers are exposed to high EMF, above 200 mG, when working at close contact with the incubators.

CONCLUSION: EMF have been described as potentially hazardous for human health, and values reported in this review are an alert to prevent babies' and caregivers' exposure when close to the incubators. A precautionary approach should be adopted in future incubator design, to prevent high exposures of newborns in incubators and of caregivers as well.

https://www.ncbi.nlm.nih.gov/pubmed/28988507

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Cellphone electromagnetic radiation damages the testicular ultrastructure of male rats

Gao XH, Hu HR, Ma X2, Chen J, Zhang GH. [Cellphone electromagnetic radiation damages the testicular ultrastructure of male rats]. [Article in Chinese]. Zhonghua Nan Ke Xue. 2016 Jun;22(6):491-495.

Abstract

OBJECTIVE: To investigate the influence of cellphone electromagnetic radiation (CER) on the testicular ultrastructure and the apoptosis of spermatogenic cells in male rats.atability, feasibility, applicability, and controllability in the construction of experimental animal models, we compared the major anatomic features of the penis of 20 adult beagle dogs with those of 10 adult men. Using microsurgical techniques, we performed cross-transplantation of the penis in the 20 (10 pairs) beagle dogs and observed the survival rate of the transplanted penises by FK506+MMF+MP immune induction. We compared the relevant indexes with those of the 10 cases of microsurgical replantation of the amputated penis.

METHODS: Thirty adult male SD rats were equally randomized into a 2 h CER, a 4 h CER, and a normal control group, the former two groups exposed to 30 days of 900 MHz CER for 2 and 4 hours a day, respectively, while the latter left untreated. Then the changes in the ultrastructure of the testis tissue were observed under the transmission electron microscope and the apoptosis of the spermatogenic cells was determined by TUNEL.

RESULTS: Compared with the normal controls, the rats of the 2 h CER group showed swollen basement membrane of seminiferous tubules, separated tight junction of Sertoli cells, increased cell intervals, apparent vacuoles and medullization in some mitochondria, and increased apoptosis of spermatogenic cells, mainly the apoptosis of primary spermatocytes ($P<0.05$). In comparison with the 2 h CER group, the animals of the 4 h CER group exhibited swollen basement membrane of seminiferous tubules, more separated tight junction of Sertoli cells, wider cell intervals, incomplete membrane of spermatogonial cells, fragments of cytoplasm, nuclear pyknosis and notch, slight dilation of perinuclear space, abnormalities of intracellular mitochondria with vacuoles, fuzzy structure, and fusion or disappearance of some cristae, and increased damage of mitochondria and apoptosis of spermatogenic cells, including the apoptosis of spermatogonial cells, primary spermatocytes, and secondary spermatocytes ($P<0.05$).

CONCLUSIONS: CER can damage the testicular ultrastructure and increase the apoptosis of spermatogenic cells of the male rat in a time-dependent manner, and the apoptosis of spermatogenic cells may be associated with the damage to mitochondria.

https://www.ncbi.nlm.nih.gov/pubmed/28963835

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Cardiovascular disease: Time to identify emerging environmental risk factors

Bandara P, Weller S. Cardiovascular disease: Time to identify emerging environmental risk factors. Eur J Prev Cardio. October 3, 2017.

No Abstract

Excerpts

In our latest review, 242 RF-EMR studies that investigated experimental endpoints related to oxidative stress (OS)16 were identified. A staggering 216 (89%) of them found significant effects related to OS, similar to a previous review.17 These are being further analysed following presentation at the recent Australasian Radiation Protection Society conference.18 Mostly in-vivo animal studies and in-vitro studies have demonstrated increased markers of endogenous OS and/or affected antioxidant levels in different tissue/cell types upon exposure to RF-EMR. Some studies have further demonstrated amelioration of RF-induced OS upon treatment with various antioxidants. Limited human studies at this stage complement these studies demonstrating OS and/or reduced antioxidant status upon acute radiofrequency exposure under experimental settings,19 in mobile phone users20 and residents near mobile phone base stations.21 Renowned physical scientists have recently presented experimental evidence and a theoretical explanation on how low-intensity RF-EMR can generate OS .22

OS is known to be implicated in CVD 23,24 and therefore RF-EMR, a new ubiquitous environmental exposure, may contribute to CVD by maintaining chronic OS, and thereby causing oxidative damage to cellular constituents and altering signal transduction pathways.

Although a few western countries have recently taken steps to reduce public exposure to RF-EMR, particularly of children, such as discouraging the use of wireless devices by children and banning/restricting WiFi in schools, 38,39 there is largely inaction at this stage. Intriguingly, a professor in public health at the University of California recently went to court and accessed the cell phone safety ‘fact sheet’ (on health risks with instructions to reduce exposure) prepared by the Californian Department of Public Health.40 It is reported that this document, originally prepared in 2009 and revised 27 times up to 2014, was abandoned due to influences from vested interests. Meanwhile in France, a physician took legal action to access data from government testing of mobile phones 41 revealing that most phones would not even pass the entirely thermally based (tissue heating) current exposure standards if held directly against the body, such as in a garment pocket.

It is clearly time to investigate the potential role of RF-EMR exposure from common wireless device use on CVD. Noting that existing research findings are influenced by the funding source, 42 fresh directives are necessary for objective high quality research to expand current primary and secondary prevention strategies. 43

http://journals.sagepub.com/doi/full/10.1177/2047487317734898

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Nonlinearity, coherence and complexity: Biophysical aspects related to health and disease

Foletti A, Brizhik L. Nonlinearity, coherence and complexity: Biophysical aspects related to health and disease. Electromagnetic Biology and Medicine. Published online 22 Sep 2017.

Abstract

Biological organisms are complex open dissipative systems whose dynamical stability is sustained due to the exchange of matter, energy and information. Dynamical stability occurs through a number of mechanisms that sustain efficient adaptive dynamics. Such properties of living matter can be the consequence of a self-consistent state of matter and electromagnetic field (EMF). Based on the soliton model of charge transport in redox processes, we describe a possible mechanism of the origin of endogenous EMF and coherence.

Solitons are formed in polypeptides due to electron–lattice interaction. Solitons experience periodical potential barrier, as a result of which their velocity oscillates in time, and, hence, they emit electromagnetic radiation (EMR). Under the effect of such radiation from all other solitons, the synchronization of their dynamics takes place, which significantly increases the intensity of the general EMF. The complex structure of biological molecules, such as helical structure, is not only important for “structure-function” relations, but also the source of the stability of biophysical processes, e.g. effectiveness of energy and charge transport on macroscopic distances. Such a complex structure also provides the framework for the spatiotemporal structure of the endogenous EMF. The highly hierarchical organization of living organisms is a manifestation of their complexity, even at the level of simple unicellular organisms. This complexity increases the dynamical stability of open systems and enhances the possibility of information storage and processing. Our findings provide a qualitative overview of a possible biophysical mechanism that supports health and disease adaptive dynamics.

https://www.ncbi.nlm.nih.gov/pubmed/28937829

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Simplified Assessment Method for Population RF Exposure Induced by a 4G Network

Huang Y, Wiart J. Simplified Assessment Method for Population RF Exposure Induced by a 4G Network. IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology. PP(99). 18 Sep 2017. DOI:10.1109/JERM.2017.2751751.

Abstract

This article presents a simplified method, based on surrogate modeling, to evaluate the day-to-day global population exposure to radio frequency (RF) electromagnetic fields (EMF) induced by a 4G network, from both uplink and downlink radio emissions in a typical urban city. The uncertainties of 4G-induced RF-EMF exposure of an entire population were characterized for the first time taking into account the variability linked to urban propagation environment, information and communication technology usage, EMF respectively from personal wireless devices and Evolved Node B (eNB), as well as uplink throughput. In addition, the study focuses on a sensitivity analysis in order to assess the influence of these parameters on RF-EMF exposure. Globally, results show that the 4G-induced RF-EMF exposure follows a Generalized Extreme Value distribution with an average value of 1.19×10 W/kg. Moreover, authors show that, contrary to what have been observed in the 3G-induced RF-EMF exposure, that is, the exposure is dominated by uplink radio emissions, results have highlighted the importance of received power density from eNB to the issue of 4G-induced RF-EMF exposure. In 4G, the uplink exposure from mobiles accounts for only 25% of global exposure, resulting from the high speed of uplink throughput.

http://ieeexplore.ieee.org/document/8039247/

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Time-averaged Realistic Maximum Power Levels for Assessment of RF Exposure for 5G Radio Base Stations

Thors B, Furuskär A, Colombi D, Törnevik C. Time-averaged Realistic Maximum Power Levels for the Assessment of Radio Frequency Exposure for 5G Radio Base Stations using Massive MIMO. IEEE Access. PP(99), 18 Sep 2017.

Abstract

In this paper a model for time-averaged realistic maximum power levels for the assessment of radio frequency (RF) electromagnetic field (EMF) exposure for the fifth generation (5G) radio base stations (RBS) employing massive MIMO is presented. The model is based on a statistical approach and developed to provide a realistic conservative RF exposure assessment for a significant proportion of all possible downlink exposure scenarios (95th percentile) in-line with requirements in a recently developed International Electrotechnical Commission (IEC) standard for RF EMF exposure assessments of radio base stations (RBS). Factors such as RBS utilization, time-division duplex (TDD), scheduling time, and spatial distribution of users within a cell are considered. The model is presented in terms of a closed-form equation. For an example scenario corresponding to an expected 5G RBS product, the largest realistic maximum power level was found to be less than 15% of the corresponding theoretical maximum. For far-field exposure scenarios, this corresponds to a reduction in RF EMF limit compliance distance with a factor of about 2.6. Results are given for antenna arrays of different sizes and for scenarios with beamforming in both azimuth and elevation.

http://ieeexplore.ieee.org/document/8039290/

Excerpt

In this paper, a theoretical model was presented to estimate the time-averaged realistic maximum power levels for the assessment of RF EMF exposure for 5G Radio Base Stations using Massive MIMO. The model was based on realistic conservative assumptions of a 5G mobile communication system and made use of a statistical approach to distribute the transmitted energy within the cell to obtain results that may be used in context with the ‘actual maximum exposure conditions’ in the international RF EMF exposure assessment standard for radio base stations IEC 62232:2017.

A key parameter of the model is how the users are assumed to be distributed within the cell. For all UDS considered, the time-averaged realistic maximum power levels was found to be significantly below the theoretical maximum. Even for very large degrees of system utilization, the time-averaged realistic maximum was found to take values between 7% - 22% of the theoretical maximum. This translates to reduced compliance distances and may be used to facilitate installation of 5G RBS products. The obtained results provide valuable input to standardization of RF EMF exposure assessments in the vicinity of RBS.

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Magnetic field exposure to wireless charging stations for mobile phones

Fröhlich, J., Zahner, M. and Dürrenberger, G. (2017), Magnetic field exposure to wireless charging stations for mobile phones. Bioelectromagnetics. doi:10.1002/bem.22087

No Abstract

Excerpts

This brief communication presents measurement and simulation data about magnetic field levels of, and human exposure to, wireless charging devices for smart phones, respectively. Most transmitters for inductive charging operate within a frequency window from 110 up to 205 kHz. The highest instantaneous field levels can be measured in stand-by mode. Peak and rms values amount to a few 100 μT, which is above the reference level. However, simulation results showed that the basic restrictions (defined in terms of electric field levels, V/m, in tissue and power absorption, specific absorption rate [SAR]), were met. From a regulatory point

of view, inductive charging systems for small electronic devices like cell phones comply with safety standards, but worst-case induced electrical fields may come close to basic restrictions. Therefore, maximum currents for all specific implementations have to be restricted.

Currently, inductive charging is the only commercialized wireless charging technology. In the near future, devices for resonant power transfer will be available, too. Two standards for inductive charging exist: Qi and AirFuel. Qi is dominating the market. Some key technical characteristics of the Qi inductive charging standard are given in Table 1.

Conclusion

The dosimetric characterization showed that inductive charging stations comply with basic restrictions recommended by ICNIRP and IEEE, albeit the incident magnetic flux densities exceed the reference values by factors of tens, roughly. For internal electric fields, the margin was below a factor of 10. For SAR, in contrast, the margin amounted to three orders of magnitude. The study (i) affirmed that checking basic restrictions in case of local exposures that exceed reference values is necessary; (ii) showed that **exposure levels of current smartphone wireless charging systems may exploit ICNIRP basic restrictions on induced electric fields up to 30%, roughly, and are far from recommended maximum SAR levels**; and (iii) indicated that increasing the allowed maximum power for charging systems (as already outlined in the standard) has to be carefully evaluated regarding instantaneous values of induced electric fields.

http://onlinelibrary.wiley.com/doi/10.1002/bem.22087/full

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Evaluation of the mobile phone electromagnetic radiation on serum iron parameters in rats

Çetkin M, Demirel C, Kızılkan N, Aksoy N, Erbağcı H. Evaluation of the mobile phone electromagnetic radiation on serum iron parameters in rats.
Afr Health Sci. 2017 Mar;17(1):186-190. doi: 10.4314/ahs.v17i1.23.

Abstract

BACKGROUND: Electromagnetic fields (EMF) created by mobile phones during communication have harmful effects on different organs.

OBJECTIVES: It was aimed to investigate the effects of an EMF created by a mobile phone on serum iron level, ferritin, unsaturated iron binding capacity and total iron binding capacity within a rat experiment model.

METHODS: A total of 32 male Wistar albino rats were randomly divided into the control, sham, mobile phone speech (2h/day) and stand by (12 h/day) groups. The speech and stand by groups were subjected to the EMF for a total of 10 weeks.

RESULTS: No statistically significant difference was observed between the serum iron and ferritin values of the rats in the speech and stand by groups than the control and sham groups ($p>0.05$). The unsaturated iron binding capacity and total iron capacity values of the rats in the speech and stand by groups were significantly lower in comparison to the control group ($p<0.01$).

CONCLUSION:It was found that exposure to EMF created by mobile phones affected unsaturated iron binding capacity and total iron binding capacity negatively.

Open Access Paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5636244/

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Electromagnetic fields with frequencies of 5, 60 and 120 Hz affect the cell cycle and viability of human fibroblast BJ in vitro

Koziorowska A, Romerowicz-Misielak M Filipek A, Koziorowski M. Electromagnetic fields with frequencies of 5, 60 and 120 Hz affect the cell cycle and viability of human fibroblast BJ in vitro. J Biol Regul Homeost Agents. 2017 Jul-Sep;31(3):725-730.

Abstract

The impact of electromagnetic field (EMF) on humans has been described in numerous studies, but many questions are still unanswered. The aim of the experiment described in this study was to evaluate the effect of EMF on the viability of human fibroblast BJ in vitro and the percentage of cells in different phases of the cell cycle (G1/G0, S, G2/M) after 2 hours of exposure to sinusoidal continuous and pulsed EMFs with frequency of 5 Hz, 60 Hz and 120 Hz at a magnetic induction of 2,5 mT. The viability of BJ cells exposed to an EMF was estimated immediately after completion of exposure and after 24 hours. Metabolic activity of cells was assessed by MTT assay and compared to a control culture not exposed to EMFs. Cell cycle analysis was performed by BrdU incorporation. The analysis of the viability demonstrated significant differences in field efficiency, depending on its nature. Exposure of cells to pulse EMFs resulted in a decrease in their viability for each of the analyzed frequencies. Reduced viability was maintained for a further 24 hours after the end of exposure of cells to pulsed EMF. In the case of continuous field, reduced BJ cell viability was observed only at the highest applied frequency - 120Hz, and this effect maintained for the next 24 hours. Although there was no significant effect on cell viability (metabolic activity) of cells immediately after exposure to continuous EMF with a frequency of 5Hz, a significant increase was observed after 24 hours of incubation.

https://www.ncbi.nlm.nih.gov/pubmed/28956424

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Activation of Signaling Cascades by Weak Extremely Low Frequency Electromagnetic Fields

Kapri-Pardes E, Hanoch T, Maik-Rachline G, Murbach M, Bounds PL, Kuster N, Seger R. Activation of Signaling Cascades by Weak Extremely Low Frequency Electromagnetic Fields. Cell Physiol Biochem. 2017 Oct 16;43(4):1. doi: 10.1159/000481977.

Abstract

BACKGROUND/AIMS: Results from recent studies suggest that extremely low frequency magnetic fields (ELF-MF) interfere with intracellular signaling pathways related to proliferative control. The mitogen-activated protein kinases (MAPKs), central signaling components that regulate essentially all stimulated cellular processes,

include the extracellular signal-regulated kinases 1/2 (ERK1/2) that are extremely sensitive to extracellular cues. Anti-phospho-ERK antibodies serve as a readout for ERK1/2 activation and are able to detect minute changes in ERK stimulation. The objective of this study was to explore whether activation of ERK1/2 and other signaling cascades can be used as a readout for responses of a variety of cell types, both transformed and non-transformed, to ELF-MF.

METHODS: We applied ELF-MF at various field strengths and time periods to eight different cell types with an exposure system housed in a tissue culture incubator and followed the phosphorylation of MAPKs and Akt by western blotting.

RESULTS: We found that the phosphorylation of ERK1/2 is increased in response to ELF-MF. However, the phosphorylation of ERK1/2 is likely too low to induce ELF-MF-dependent proliferation or oncogenic transformation. The p38 MAPK was very slightly phosphorylated, but JNK or Akt were not. The effect on ERK1/2 was detected for exposures to ELF-MF strengths as low as 0.15 μT and was maximal at ~10 μT. We also show that ERK1/2 phosphorylation is blocked by the flavoprotein inhibitor diphenyleneiodonium, indicating that the response to ELF-MF may be exerted via NADP oxidase similar to the phosphorylation of ERK1/2 in response to microwave radiation.

CONCLUSIONS: Our results further indicate that cells are responsive to ELF-MF at field strengths much lower than previously suspected and that the effect may be mediated by NADP oxidase. However, the small increase in ERK1/2 phosphorylation is probably insufficient to affect proliferation and oncogenic transformation. Therefore, the results cannot be regarded as proof of the involvement of ELF-MF in cancer in general or childhood leukemia in particular.

https://www.ncbi.nlm.nih.gov/pubmed/29035881

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Geomagnetic storm under laboratory conditions: randomized experiment

Gurfinkel YI, Vasin AL, Pishchalnikov RY, Sarimov RM, Sasonko ML, Matveeva TA. Geomagnetic storm under laboratory conditions: randomized experiment. Int J Biometeorol. 2017 Oct 13. doi: 10.1007/s00484-017-1460-8.

Abstract

The influence of the previously recorded geomagnetic storm (GS) on human cardiovascular system and microcirculation has been studied under laboratory conditions. Healthy volunteers in lying position were exposed under two artificially created conditions: quiet (Q) and storm (S). The Q regime playbacks a noise-free magnetic field (MF) which is closed to the natural geomagnetic conditions on Moscow's latitude. The S regime playbacks the initially recorded 6-h geomagnetic storm which is repeated four times sequentially. The cardiovascular response to the GS impact was assessed by measuring capillary blood velocity (CBV) and blood pressure (BP) and by the analysis of the 24-h ECG recording. A storm-to-quiet ratio for the cardio intervals (CI) and the heart rate variability (HRV) was introduced in order to reveal the average over group significant differences of HRV. An individual sensitivity to the GS was estimated using the autocorrelation function analysis of the high-frequency (HF) part of the CI spectrum. The autocorrelation analysis allowed for detection a group of subjects of study which autocorrelation functions (ACF) react differently in the Q and S

regimes of exposure.

https://www.ncbi.nlm.nih.gov/pubmed/29030697

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NTP Cell Phone Radiation Study

Evaluation of Genotoxicity of Cell Phone Radiation in Male & Female Rats & Mice Following Subchronic Exposure

Smith-Roe SL, Wyde, ME, Stout MD, Winters JW, Hobbs CA, Shepard KG, Green AS, Kissing GA, Tice RR, Bucher JR, Witt KL. Evaluation of the Genotoxicity of Cell Phone Radiofrequency Radiation in Male and Female Rats and Mice Following Subchronic Exposure. Presentation at at annual meeting of Environmental Mutagenesis and Genomics Society held in Raleigh, North Carolina from September 9-13, 2017.

I don't know if a paper or slides are available. The abstract for this presentation is available at http://bitly.com/NTPsaferemr

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Dosimetric Assessment for Mice & Rats Exposed in Reverberation Chambers for the Two-Year NTP Cancer Bioassay Study on Cell Phone Radiation

Gong, YJ, Capstick, MH; Kuehn, S ; Wilson, PF; Ladbury, JM ; Koepke, G; McCormick, DL ; Melnick, RL Kuster, N.Life-Time Dosimetric Assessment for Mice and Rats Exposed in Reverberation Chambers for the Two-Year NTP Cancer Bioassay Study on Cell Phone Radiation. IEEE Transactions on Electromagnetic Compatibility. 59(6):1798-1808. DOI: 10.1109/TEMC.2017.2665039. Dec 2017.

Abstract

In this paper, we present the detailed life-time dosimetry analysis for rodents exposed in the reverberation exposure system designed for the two-year cancer bioassay study conducted by the National Toxicology Program of the National Institute of Environmental Health Sciences. The study required the well-controlled and characterized exposure of individually housed, unrestrained mice at 1900 MHz and rats at 900 MHz, frequencies chosen to give best uniformity exposure of organs and tissues. The wbSAR, the peak spatial SAR, and the organ specific SAR as well as the uncertainty and variation due to the exposure environment, differences in the growth rates, and animal posture were assessed. Compared to the wbSAR, the average exposure of the high-water-content tissues (blood, heart, lung) were higher by similar to 4 dB, while the low-loss tissues (bone and fat) were less by similar to 9 dB. The maximum uncertainty over the exposure period for the SAR was estimated to be <49% (k = 2) for the rodents whereas the relative uncertainty between the exposure groups was < 14% (k = 1). The instantaneous variation (averaged over 1 min) was < 13% (k = 1), which is small compared to other long term exposure research projects. These detailed dosimetric results empowers comparison with other studies and provides a reference for studies of long-term biological effects of exposure.

http://ieeexplore.ieee.org/abstract/document/7880616/

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A History of the International Commission on Non-Ionizing Radiation Protection

Repacholi MH. A History of the International Commission on Non-Ionizing Radiation Protection. Health Phys. 2017 Oct;113(4):282-300. doi: 10.1097/HP.0000000000000699.

Abstract

Concern about health risks from exposure to non-ionizing radiation (NIR) commenced in the 1950s after tracking radars were first introduced during the Second World War. Soon after, research on possible biological effects of microwave radiation in the former Soviet Union and the U.S. led to public and worker exposure limits being much lower in Eastern European than in Western countries, mainly because of different protection philosophies. As public concern increased, national authorities began introducing legislation to limit NIR exposures from domestic microwave ovens and workplace devices such as visual display units. The International Radiation Protection Association (IRPA) was formed in 1966 to represent national radiation protection societies. To address NIR protection issues, IRPA established a Working Group in 1974, then a Study Group in 1975, and finally the International NIR Committee (INIRC) in 1977. INIRC's publications quickly became accepted worldwide, and it was logical that it should become an independent commission. IRPA finally established the International Commission on Non-Ionizing Radiation Protection (ICNIRP), chartering its remit in 1992, and defining NIR as electromagnetic radiation (ultraviolet, visible, infrared), electromagnetic waves and fields, and infra- and ultrasound. ICNIRP's guidelines have been incorporated into legislation or adopted as standards in many countries. While ICNIRP has been subjected to criticism and close scrutiny by the public, media, and activists, it has continued to issue well-received, independent, science-based protection advice. This paper summarizes events leading to the formation of ICNIRP, its key activities up to 2017, ICNIRP's 25th anniversary year, and its future challenges.

https://www.ncbi.nlm.nih.gov/pubmed/28846587

Excerpts

"At the Budapest meeting, Repacholi advised that since he had established the International EMF Project at WHO, and as ICNIRP was now working closely with this project, it was a conflict of interest for him to remain as Chairman or as a member of ICNIRP. As such, he resigned."

"While the independence of ICNIRP members is clearly required in its Charter and Statutes, it had become an issue of public and political interest in some countries. At its meeting in Bordeaux (September 2003), it was decided that a conflict of interest declaration by all current and new members should not only be kept on file but also posted on ICNIRP's website. A "Declaration of Personal Interest" completed by all Commission and Scientific Expert Group members is now posted on the ICNIRP website as a demonstration of the independence of its members, openness and transparency. These declarations of personal interest were made more stringent following discussions at the annual meeting in Thessaloniki (Greece, June 2013) and more detailed information was required from Commission and Scientific Expert Group members."

"Recommendations on exposure limits have been and continue to be based purely on the science and only minor changes or fine-tuning to these limits have been necessary over the years. Many national authorities have adopted ICNIRP guidelines into their own guidance or legislation. The stability of the limits over many years, because there has not been any research providing evidence of harm from exposures below the guideline limits, provides reassurance to national authorities about the adequacy of the protection the limits provide."

"ICNIRP members have taken a leading role in assisting WHO's International EMF Project with its first systematic review of the scientific literature to determine whether there are any health consequences from exposure to radiofrequency fields. The results and conclusions of this Environmental Health Criteria monograph will form a basis for the updated ICNIRP guidelines on high frequency EMF. An important aspect of this WHO review is that, not only WHO Task Group members, but all members of any working groups

contributing to each chapter, including ICNIRP members, must complete a form detailing any conflict of interest for review and approval by the WHO Legal Department.Given the huge amount of work this systematic review involves, it is anticipated that this monograph should now be published in 2018. Much of ICNIRP's future work will be done in collaboration with WHO's EMF Project."

"ICNIRP published its general philosophy of NIR protection 15 y ago (ICNIRP 2002), but this needs updating and more detail added. ICNIRP is currently working on this update since it views the protection principles as fundamental to the development of all its guidelines and statements. In addition, such principles provide consistency in protection for future publications."

"Possible health effects of EMF have been of concern for a long time and so ICNIRP has been subjected to significant public and political scrutiny. To its credit, by
steadfastly remaining a purely scientific Commission and not entering the politics of NIR issues, ICNIRP has successfully weathered all storms to become the most recognized agency for producing independent authoritative advice on NIR protection issues."

"The authors declare no conflicts of interest."

My note: In recent years, many professional journals require authors to disclose conflicts of interest (COIs). However, it is extremely rare that anyone discloses their COIs. Thus, this requirement which relies on self reporting COIs has been largely a sham.

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Increasing levels of saliva alpha amylase in electrohypersensitive (EHS) patients

Andrianome S, Hugueville L, de Seze R, Selmaoui B.Increasing levels of saliva alpha amylase in electrohypersensitive (EHS) patients.Int J Radiat Biol. 2017 Aug;93(8):841-848. doi: 10.1080/09553002.2017.1325971. Epub 2017 May 17.

Abstract

PURPOSE: To assess the level of various salivary and urinary markers of patients with electromagnetic hypersensitivity (EHS) and to compare them with those of a healthy control group.

MATERIALS AND METHODS: We analyzed samples from 30 EHS individuals and a matched control group of 25 individuals (non-EHS) aged between 22 and 66. We quantified cortisol both in saliva and urine, alpha amylase (sAA), immunoglobulin A and C Reactive Protein levels in saliva and neopterin in urine (uNeopterin).

RESULTS: sAA was found to be significantly higher ($p < 0.005$) in the EHS group. uNeopterin and sAA analysis showed a significant difference based on the duration of EHS.

CONCLUSION: Higher levels of sAA in EHS participants may suggest that the sympathetic adrenal medullar system is activated. However, most of the analyzed markers of the immune system, sympathetic activity and circadian rhythm did not vary significantly in the EHS group. There is a trend to the higher levels of some variables in subgroups according to the EHS duration.

https://www.ncbi.nlm.nih.gov/pubmed/28466664

Excerpts

sAA activity was significantly different ($p < 0.0001$) between the control and EHS group. The EHS group showed a significantly higher level of sAA (Figure 2(a)).

Figure 2. Salivary concentration of α-amylase (a) and IgA (b) in the control (black line) and EHS group (grey line) during experimentation (from bedtime to 16:30 h). Data expressed as mean ± SEM. Significant difference between groups for α-amylase ($p < 0.0001$); significant effect of time for α-amylase ($p = 0.0001$) and IgA ($p < 0.0001$).

The mean of sIgA showed a tendency to be positively correlated with EHS duration ($r = 0.141$, $p = 0.010$); sAA was also slightly but positively correlated with EHS duration ($r = 0.254$, $p < 0.001$).

Besides, the salivary enzyme α-amylase has been proposed as a marker for the stress-induced activity of the sympathetic nervous system (SNS), or more precisely of the sympathetic adrenomedullary (SAM) system, which is also involved in the secretion of adrenaline and noradrenaline (Chatterton et al. 1996 Chatterton RT Jr, Vogelsong KM, Lu YC, Ellman AB, Hudgens GA. 1996. Salivary alpha-amylase as a measure of endogenous adrenergic activity. Clin Physiol. 16:433–448.[Crossref], [PubMed], [Google Scholar]; Rohleder & Nater 2009 Rohleder N, Nater UM. 2009. Determinants of salivary alpha-amylase in humans and methodological considerations. Psychoneuroendocrinology. 34:469–485.[Crossref], [PubMed], [Web of Science ®], [Google Scholar]). Unlike cortisol, saliva alpha amylase levels were found to be significantly higher in the EHS group, in comparison to the control group. The question that arises here is whether this change in α-amylase activity was a result of outside exposure to EMF or simply a consequence of chronic stress.

.. in the present study, sAA levels were shown to be constantly elevated in EHS individuals, even during their stay (from 09:00 to 16:30 h) in the EMF-shielded room in our laboratory. The role of EMF on the increase of AA is still to be proven. However, our results indicated that the EHS population seems to have higher levels of sAA than the control group. And the cause of this increase is to be yet determined.

Moreover, a significant and positive correlation was shown between sAA levels and the duration of EHS. Indeed, the longer the duration of EHS, the higher the level of sAA. This may suggest that the longer they are EHS, the more they react. One may speculate that this could be due to a degraded system in patients presenting EHS for a long time.

Besides, a study has shown that exposure to radiofrequency electromagnetic fields (RF-EMF) emitted by mobile phone base stations affected salivary α-amylase in healthy participants (Augner et al. 2010 Augner C, Hacker GW, Oberfeld G, Florian M, Hitzl W, Hutter J, Pauser G. 2010. Effects of exposure to GSM mobile phone base station signals on salivary cortisol, alpha-amylase, and immunoglobulin A. Biomed Environ Sci BES. 23:199–207.[Crossref], [PubMed], [Web of Science ®], [Google Scholar]). In addition, a study of people living next to phone base stations, self-declaring base-station neighbors (distance to base station ≤100 m), had higher levels of α-amylase accompanied by a higher general strain (Augner & Hacker 2009 Augner C, Hacker GW. 2009. Are people living next to mobile phone base stations more strained? Relationship of health concerns, self-estimated distance to base station, and psychological parameters. Indian J Occup Environ Med. 13:141–145.[Crossref], [PubMed], [Google Scholar]; Augner et al. 2010 Augner C, Hacker GW, Oberfeld G, Florian M, Hitzl W, Hutter J, Pauser G. 2010. Effects of exposure to GSM mobile phone base station signals on salivary cortisol, alpha-amylase, and immunoglobulin A. Biomed Environ Sci BES. 23:199–207.[Crossref], [PubMed], [Web of Science ®], [Google Scholar]). This may suggest that people self-reporting EHS could share similarities with this population, but whether this is due to actual exposure to EMF or to other underlying factors is not clear. In our study, unfortunately, recordings of exposure field density before entering the study (outside the experimental lab) were not available.

In summary, an exploration of selected and measurable markers of EHS was conducted in our study to understand this condition. Our finding indicates that markers of the circadian rhythm and immune system were not affected in EHS compared to non-EHS individuals. Our results suggest different profiles of EHS according to the duration of the syndrome. Furthermore, the mechanism underlying the higher expression of α-amylase should be focused on. These findings could be new elements in the understanding, explanation and comprehension of the physiopathology of EHS.

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Maternal cell phone use in early pregnancy & child's language, communication & motor skills at 3 & 5 years: Norwegian mother child cohort study

Papadopoulou E, Haugen M, Schjølberg S, Magnus P, Brunborg G, Vrijheid M, Alexander J. Maternal cell phone use in early pregnancy and child's language, communication and motor skills at 3 and 5 years: the Norwegian mother and child cohort study (MoBa). BMC Public Health. 2017 Sep 5;17(1):685. doi: 10.1186/s12889-017-4672-2.

Abstract

BACKGROUND: Cell phone use during pregnancy is a public health concern. We investigated the association between maternal cell phone use in pregnancy and child's language, communication and motor skills at 3 and 5 years.

METHODS: This prospective study includes 45,389 mother-child pairs, participants of the MoBa, recruited at mid-pregnancy from 1999 to 2008. Maternal frequency of cell phone use in early pregnancy and child language, communication and motor skills at 3 and 5 years, were assessed by questionnaires. Logistic regression was used to estimate the associations.

RESULTS: No cell phone use in early pregnancy was reported by 9.8% of women, while 39%, 46.9% and 4.3% of the women were categorized as low, medium and high cell phone users. Children of cell phone user mothers had 17% (OR = 0.83, 95% CI: 0.77, 0.89) lower adjusted risk of having low sentence complexity at 3 years, compared to children of non-users. The risk was 13%, 22% and 29% lower by low, medium and high maternal cell phone use. Additionally, children of cell phone users had lower risk of low motor skills score at 3 years, compared to children of non-users, but this association was not found at 5 years. We found no association between maternal cell phone use and low communication skills.

CONCLUSIONS: We reported a decreased risk of low language and motor skills at three years in relation to prenatal cell phone use, which might be explained by enhanced maternal-child interaction among cell phone users. No evidence of adverse neurodevelopmental effects of prenatal cell phone use was reported.

https://www.ncbi.nlm.nih.gov/pubmed/28870201

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Use of non-ionizing electromagnetic fields for the treatment of cancer

Jimenez H, Blackman C, Lesser G, Debinski W, Chan M, Sharma S, Watabe K, Lo HW, Thomas A, Godwin D, Blackstock W, Mudry A, Posey J, O'Connor R, Brezovich I, Bonin K, Kim-Shapiro D, Barbault A, Pasche B. Use of non-ionizing electromagnetic fields for the treatment of cancer. Front Biosci (Landmark Ed). 2018 Jan 1;23:284-297.

Abstract

Cancer treatment and treatment options are quite limited in circumstances such as when the tumor is inoperable, in brain cancers when the drugs cannot penetrate the blood-brain-barrier, or when there is no tumor-specific target for generation of effective therapeutic antibodies. Despite the fact that electromagnetic fields (EMF) in medicine have been used for therapeutic or diagnostic purposes, the use of non-ionizing EMF for cancer treatment is a new emerging concept. Here we summarize the history of EMF from the 1890's to the novel and new innovative methods that target and treat cancer by non-ionizing radiation.

https://www.ncbi.nlm.nih.gov/pubmed/28930547

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Efficacy and Safety of Treating Glioblastoma With Tumor-Treating Fields Therapy

Saria MG, Kesari S. Efficacy and Safety of Treating Glioblastoma With Tumor-Treating Fields Therapy. Clin J Oncol Nurs. 2016 Oct 1;20(5):S9-S13. doi: 10.1188/16.CJON.S1.9-13.

Abstract

BACKGROUND: Glioblastoma (GBM) is a highly aggressive astrocytoma with a dismal prognosis. Since 1976, only three chemotherapeutic agents have been approved for the treatment of GBM. Tumor-treating fields (TTFields) therapy, delivered via a noninvasive device, is a new therapy approved for use in patients with recurrent GBM and in combination with temozolomide for the treatment of newly diagnosed GBM.

OBJECTIVES: This article reviews the mechanism of action and findings from preclinical and clinical studies supporting the use of TTFields for patients with newly diagnosed and recurrent GBM.

METHODS: This article provides an overview of published literature on the efficacy and safety of treating GBM with TTFields.

FINDINGS: For the first time in more than a decade, patients with GBM have a noninvasive treatment option that has been shown to increase progression-free survival and overall survival with minimal adverse events.

https://www.ncbi.nlm.nih.gov/pubmed/27668388

Excerpts

Compared with historic cancer treatment modalities, TTFields have an innovative mechanism of action. Nonbiochemical and nonablative, TTFields use frequency-specific, low-intensity, alternating electric fields to disrupt structures within the cancer cell during mitosis, leading to apoptosis. Specifically, TTFields technology takes advantage of the special characteristics, geometric shape, and the rate of dividing cancer cells, which make them susceptible to the effects of TTFields. TTFields alter tumor cell polarity at an intermediate frequency (100–300 kHz). The frequency used for TTFields is specific to the target cell type (e.g., 200 kHz for gliomas). TTFields have been shown to disrupt the normal assembly of the microtubule spindle by exerting directional forces on polar intracellular elements, such as macromolecules and organelles. These processes lead to physical disruption of the cell membrane and to programmed cell death (Giladi et al., 2015) (see Figure 1).

The pivotal, randomized phase III study leading to the FDA approval of Optune for recurrent GBM and the subsequent prospective, multicenter, open-label, randomized, controlled trial leading to the approval of Optune for patients with newly diagnosed GBM demonstrate that the addition of TTFields to maintenance TMZ chemotherapy significantly improves survival without increasing toxicities in patients with glioblastoma. The introduction of the second-generation device, which weighs about 50% less than the original device, is expected to improve GBM patient compliance. Trials are evaluating the safety and efficacy of TTFields in low-grade gliomas, solid tumor brain metastases, non-small cell lung cancer, pancreatic cancer, and other solid malignancies.

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Evaluation of Electromagnetic Exposure During 85 kHz Wireless Power Transfer for Electric Vehicles

SangWook Park. Evaluation of Electromagnetic Exposure During 85 kHz Wireless Power Transfer for Electric Vehicles. IEEE Transactions on Magnetics. Volume: PP, Issue: 99. Sep 1, 2017.
10.1109/TMAG.2017.2748498

Abstract

The external fields in the proximity of electric vehicle (EV) wireless power transfer (WPT) systems requiring high power may exceed the limits of international safety guidelines. This study presents dosimetric results of an 85 kHz WPT system for electric vehicles. A WPT system for charging EVs is designed and dosimetry for the system is evaluated for various exposure scenarios: a human body in front of the WPT system without shielding, with shielding, with alignment and misalignment between transmitter and receiver, and with a metal plate on the system for vehicle mimic floor pan. The minimum accessible distances in compliance are investigated for various transmitting powers. The maximum allowable transmitting power are also investigated with the limits of international safety guidelines and the dosimetric results.

http://ieeexplore.ieee.org/document/8024022/

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Effect of 2G and 3G Cell Phone Radiation on Developing Liver of Chick Embryo - Comparative Study

D'Silva MH, Swer RT, Anbalagan J, Rajesh B. Effect of Radiofrequency Radiation Emitted from 2G and 3G Cell Phone on Developing Liver of Chick Embryo - A Comparative Study. J Clin Diagn Res. 2017 Jul;11(7):AC05-AC09. doi: 10.7860/JCDR/2017/26360.10275. Epub 2017 Jul 1.

Abstract

INTRODUCTION: The increasing scientific evidence of various health hazards on exposure of Radiofrequency Radiation (RFR) emitted from both the cell phones and base stations have caused significant media attention and public discussion in recent years. The mechanism of interaction of RF fields with developing tissues of children and fetuses may be different from that of adults due to their smaller physical size and variation in tissue electromagnetic properties. The present study may provide an insight into the basic mechanisms by which RF fields interact with developing tissues in an embryo.

AIM: To evaluate the possible tissue and DNA damage in developing liver of chick embryo following chronic exposure to Ultra-High Frequency/Radiofrequency Radiation (UHF/RFR) emitted from 2G and 3G cell phone.

MATERIALS AND METHODS: Fertilized chick embryos were incubated in four groups. Group A-experimental group exposed to 2G radiation (60 eggs), Group B- experimental group exposed to 3G radiation (60 eggs), Group C- sham exposed control group (60 eggs) and Group D- control group (48 eggs). On completion of scheduled duration, the embryos were collected and processed for routine histological studies to check structural changes in liver. The nuclear diameter and karyorrhexis changes of hepatocytes were analysed using oculometer and square reticule respectively. The liver procured from one batch of eggs from all the four groups was subjected to alkaline comet assay technique to assess DNA damage. The results were compared using one-way ANOVA test.

RESULTS: In our study, the exposure of developing chick embryos to 2G and 3G cell phone radiations caused structural changes in liver in the form of dilated sinusoidal spaces with haemorrhage, increased vacuolations in cytoplasm, increased nuclear diameter and karyorrhexis and significantly increased DNA damage.

CONCLUSION: The chronic exposure of chick embryo liver to RFR emitted from 2G and 3G cell phone resulted in various structural changes and DNA damage. The changes were more pronounced in 3G experimental group. Based on these findings it is necessary to create awareness among public about the possible ill effects of RFR exposure from cell phone.

Open Access: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5583901/

Excerpts

The first four batches (48 eggs) were grouped as control (Group–D) and they were incubated without any external factors interfering with their developmental process. Next five batches (60 eggs) were treated as sham exposed group (Group-C). They were incubated along with a popular brand cell phone with the SAR of 0.310 watts/kilogram hung from above with 5 cm distance separating the egg and kept in null status (switched off)....

The experimental group, Group–A (exposed to 2G cell phone radiation) and Group–B (exposed to 3G cell phone radiation), were also incubated (60+60 eggs) in a similar manner with the cell phone kept in silent operative mode with head phone plugged in (switched on). This arrangement ensured that the cell phone got activated automatically each time it received a call and the intensity of radio frequency waves were measured using radiofrequency meter (RF meter, Less EMF Inc, USA) [Table/Fig-1].

A popular brand cell phone hand set and a service provider were used for network connection for both 2G and 3G exposure. For exposure activation, the cell phone was rung from another cell phone for duration of three minutes each, every half an hour, with the first exposure given at 12th hour of incubation (4.30 am-4.30 pm). The total exposure for a 12 hour period was 75 minutes followed by 12 hour of exposure-free period. This was repeated daily up to 12th day of incubation.

From our experimental outcome, we conclude that the chronic exposure of chick embryo liver to RFR emitted from 2G and 3G cell phone resulted in various structural changes and DNA damage. The changes were more pronounced in 3G experimental group. Many researchers now opine that cell phones may turn out to be the cigarettes of 21st century as their effects or interactions with biological tissues on long term exposure are yet to be explored especially in foetuses and children. Hence, children and pregnant women should use the cell phone with caution. Introduction of new generation phones, 4G and 5G, open a vast potential for future research and whether these changes observed due to RFR exposure are reversible or not on withdrawing the exposure is another arena which warrants further research.

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Effects of Combined Exposure to Microwave and Heat on Gene Expression and Sperm Parameters in Mice

Gohari FA, Saranjam B, Asgari M, Omidi L, Ekrami H, Moussavi-Najarkola SA.An Experimental Study of the Effects of Combined Exposure to Microwave and Heat on Gene Expression and Sperm Parameters in Mice. J Hum Reprod Sci. 2017 Apr-Jun;10(2):128-134. doi: 10.4103/jhrs.JHRS_136_16.

Abstract

OBJECTIVES: Separate exposure to microwaves (MWs) or heat had effects on expression levels of Bax and Bcl-2 and sperm parameters in studied group.

AIMS: The objectives of this research were to determine the effects of separate and combined exposure to 900-MHz MW (as representative of cell phone radiation) and heat on gene expression and spermogram of male mice.

SETTINGS AND DESIGN: This experimental animal study was conducted in the school of public health.

MATERIALS AND METHODS: The study was done on 12 male mice randomly divided into four groups (21-23 g): control, test group 1 with separate exposure to 900-MHz MW, test group 2 with separate exposure to hot and sultry climate, and test group 3 with simultaneous whole body exposures to 900-MHz MW and hot and

sultry climate. In all studied groups, gene expression and sperm parameters were measured.

RESULTS: Tissue samples in all test groups showed integrity of the seminiferous tubule followed by all types of germ line cells. Significant increases in the number of dead sperms in mice with separate exposure to heat were observed in comparison with the other studied groups ($P < 0.05$). The ratio of Bax expression was elevated to 0.015 ± 0.006 in mice after combined exposures to 900-MHz MW and heat.

CONCLUSION: Separate and combined exposure to 900-MHz MW and heat may induce adverse effects on sperm parameters and gene expression of studied male mice.

https://www.ncbi.nlm.nih.gov/pubmed/28904503

Note: limited statistical power -- 12 mice randomly divided into 4 groups

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Residential magnetic fields exposure and childhood leukemia: a population-based case-control study in California

Kheifets L, Crespi CM, Hooper C, Cockburn M, Amoon AT, Vergara XP. Residential magnetic fields exposure and childhood leukemia: a population-based case-control study in California. Cancer Causes Control. 2017 Sep 12. doi: 10.1007/s10552-017-0951-6. [Epub ahead of print]

Abstract

PURPOSE: Studies have reported an increased risk of childhood leukemia associated with exposure to magnetic fields. We conducted a large records-based case-control study of childhood leukemia risk and exposure to magnetic fields from power lines in California.

METHODS: The study included 5,788 childhood leukemia cases (born in and diagnosed in California 1986-2008) matched to population-based controls on age and sex. We calculated magnetic fields at birth addresses using geographic information systems, aerial imagery, historical information on load and phasing, and site visits.

RESULTS: Based on unconditional logistic regression controlling for age, sex, race/ethnicity, and socioeconomic status using subjects geocoded to a basic standard of accuracy, we report a slight risk deficit in two intermediate exposure groups and a small excess risk in the highest exposure group (odds ratio of 1.50 (95% confidence interval [0.70, 3.23])). Subgroup and sensitivity analyses as well as matched analyses gave similar results. All estimates had wide confidence intervals.

CONCLUSION: Our large, statewide, record-based case-control study of childhood leukemia in California does not in itself provide clear evidence of risk associated with greater exposure to magnetic fields from power lines, but could be viewed as consistent with previous findings of increased risk.

https://www.ncbi.nlm.nih.gov/pubmed/28900736

Excerpts

Over 35 epidemiologic studies have investigated the association of childhood leukemia with residential low-frequency magnetic fields or physical surrogates of magnetic fields [1]. Three pooled analyses have found an increased risk of childhood leukemia for relatively high estimated residential magnetic field exposure [2, 3, 4]. The consistent association found between childhood leukemia and average magnetic field exposure above 0.3–0.4 μT could be due to chance, selection bias, misclassification, other factors which confound the association, or true causal relationship. As explanation for both individual results and pooled efforts is lacking,

selection bias seems as the most likely explanation, but uncertainty remains and other explanations outlined above are possible. This study aims to address this uncertainty by minimizing bias, misclassification, and chance.

The California Power Line Study is funded by the Electric Power Research Institute.

The authors declare no conflicts of interest.

[The estimates of leukemia risk for 0.4 or greater microTesla exposure ranged from 1.48 - 1.55 (all p-values > .25). There were only 17 cases and 11 controls in this subgroup so the study has limited statistical power.]

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Power frequency magnetic field promotes a more malignant phenotype in neuroblastoma cells via redox-related mechanisms

Falone S, Santini S Jr, Cordone V, Cesare P, Bonfigli A, Grannonico M, Di Emidio G, Tatone C, Cacchio M, Amicarelli F. Power frequency magnetic field promotes a more malignant phenotype in neuroblastoma cells via redox-related mechanisms.Sci Rep. 2017 Sep 13;7(1):11470. doi: 10.1038/s41598-017-11869-8.

Abstract

In accordance with the classification of the International Agency for Research on Cancer, extremely low frequency magnetic fields (ELF-MF) are suspected to promote malignant progression by providing survival advantage to cancer cells through the activation of critical cytoprotective pathways. Among these, the major antioxidative and detoxification defence systems might be targeted by ELF-MF by conferring cells significant resistance against clinically-relevant cytotoxic agents. We investigated whether the hyperproliferation that is induced in SH-SY5Y human neuroblastoma cells by a 50 Hz, 1 mT ELF magnetic field was supported by improved defence towards reactive oxygen species (ROS) and xenobiotics, as well as by reduced vulnerability against both H2O2 and anti-tumor ROS-generating drug doxorubicin. ELF-MF induced a proliferative and survival advantage by activating key redox-responsive antioxidative and detoxification cytoprotective pathways that are associated with a more aggressive behavior of neuroblastoma cells. This was coupled with the upregulation of the major sirtuins, as well as with increased signaling activity of the erythroid 2-related nuclear transcription factor 2 (NRF2). Interestingly, we also showed that the exposure to 50 Hz MF as low as 100 μT may still be able to alter behavior and responses of cancer cells to clinically-relevant drugs.

https://www.ncbi.nlm.nih.gov/pubmed/28904402

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Modified health effects of non-ionizing EMR combined with other agents reported in the biomedical literature

Kostoff RN, Lau CGY. Modified health effects of non-ionizing electromagnetic radiation combined with other agents reported in the biomedical literature. In C.D. Geddes (ed.), Microwave Effects on DNA and Proteins. Switzerland: Springer, pp. 97-158.DOI 10.1007/978-3-319-50289-2. 2017.

Abstract

Ionizing and non-ionizing electromagnetic field (EMF) radiation, either stand-alone or in combination with other agents, exert health effects on biological systems. The present chapter examines the scope of non-ionizing EMF radiation combined effects; i.e., identifies effects on biological systems from combined exposure to non-ionizing electromagnetic fields/radiation and at least one other agent. Only articles in which the presence of non-ionizing EMF radiation had some effect (beneficial or adverse) on the biological system were selected. A comprehensive and novel query was developed using an iterative hybrid approach, whereby articles related by common text and by citation linkages were retrieved. This retrieved literature was: (1) clustered algorithmically into 32 biomedical sub-themes (assigned by the authors); (2) grouped through factor analysis into 32 factors; and (3) subsequently grouped manually (by the authors) into an effects-based taxonomy. The common principles within each thematic cluster/group that accounted for the combined effects were identified. Non-ionizing EMF radiation plays a supportive role in a wide range of beneficial and adverse effects. Major beneficial effects include (1) accelerated healing of wounds and injuries in concert with other agents and (2) treatment of cancer by combining chemotherapy with radiation. Major adverse effects, on the other hand, include (1) enhanced carcinogenesis, (2) enhanced cellular or genetic mutations, and (3) teratogenicity. It should be noted that community consensus (unanimity among papers published in peer-reviewed journals) does not exist on these potential effects, either beneficial or adverse, although there is substantial credible scientific evidence supporting the above effects (as described in this chapter).

Open access chapter: http://stip.gatech.edu/wp-content/uploads/2017/03/371048_1_En_4_Chapter_OnlinePDF.pdf

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Multiple sclerosis and environmental risk factors: a case-control study in Iran

Abbasi M, Nabavi SM, Fereshtehnejad SM, Jou NZ, Ansari I, Shayegannejad V, Mohammadianinejad SE, Farhoudi M, Noorian A, Razazian N, Abedini M, Faraji F. Multiple sclerosis and environmental risk factors: a case-control study in Iran. Neurol Sci. 2017 Aug 10. doi: 10.1007/s10072-017-3080-9.

Abstract

Studies have shown an increase in the incidence of MS in Iran. The aim of our study was to evaluate the relationship between environmental exposure and MS in Iran. This case-control study was conducted on 660 MS patients and 421 controls. Many environmental factors are compared between the two groups. Our findings demonstrated that prematurity ([OR = 4.99 (95% CI 1.34-18.68), P = 0.017]), history of measles and mumps ([OR = 1.60 (95% CI 1.05-2.45), P = 0.029; OR = 1.85 (95% CI 1.22-2.78), P = 0.003, respectively]), breast feeding [OR = 2.90 (95% CI 1.49-5.65), P = 0.002], head trauma in childhood ([OR = 8.21 (95% CI 1.56-43.06), P = 0.013]), vaccination in adulthood ([OR = 4.57 (95% CI 1.14-18.41), P = 0.032, respectively]), migraine ([OR = 3.50 (95% CI 1.61-7.59), P = 0.002]), family history of MS, IBD, migraine, and collagen vascular diseases ([OR = 2.73 (95% CI 1.56-4.78), P < 0.001], [OR = 3.14 (95% CI 1.460-6.78), P = 0.004; OR = 3.18 (95% CI 1.83-5.53), P < 0.001; OR = 1.81 (95% CI 1.03-3.20), P = 0.040, respectively]), stressful events ([OR = 32.57 (95% CI 17.21-61.64), P < 0.001]), and **microwave exposure ([OR = 3.55 (95% CI 2.24-5.63)**, P ≤0.001]) were more in the MS group. Sun exposure ([OR = 0.09 (95% CI 0.02-0.38), P = 0.001]), dairy and calcium consumption ([OR = 0.44 (95% CI 0.27-0.71), P = 0.001]), diabetes mellitus ([OR = 0.11 (95% CI 0.01-00.99), P = 0.049], and complete vaccination during childhood appeared to decreased MS risk. Our results investigated many risk factors and protective factors in Iran.

https://www.ncbi.nlm.nih.gov/pubmed/28799006

Excerpts

[44.3% of the MS cases used a microwave oven more than 3 times a week compared to 19.9% of the controls (adjusted OR = 3.55, 95% CI= 2.24 - 5.63)].

Conclusions
It seems that the increase in MS prevalence is due to environmental factors. As a result of disability and high cost, prevention of environmental risk factors is important. The result demonstrated that the most modifiable risk factors in Iranian population were stressful event and microwave exposure. Also, the most protective modifiable factors were sun exposure and calcium supplement consumption. However, more studies are required to evaluate the potential risk factors in a geographical area such as Iran with increasing prevalence in MS.

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Human exposure to pulsed fields in the frequency range from 6 to 100 GHz

Laakso I, Morimoto R, Heinonen J, Jokela K, Hirata A. Human exposure to pulsed fields in the frequency range from 6 to 100 GHz. Phys Med Biol. 2017 Aug 9;62(17):6980-6992. doi: 10.1088/1361-6560/aa81fe.

Abstract

Restrictions on human exposure to electromagnetic waves at frequencies higher than 3-10 GHz are defined in terms of the incident power density to prevent excessive temperature rise in superficial tissue. However, international standards and guidelines differ in their definitions of how the power density is interpreted for brief exposures. This study investigated how the temperature rise was affected by exposure duration at frequencies higher than 6 GHz. Far-field exposure of the human face to pulses shorter than 10 s at frequencies from 6 to 100 GHz was modelled using the finite-difference time-domain method. The bioheat transfer equation was used for thermal modelling. We investigated the effects of frequency, polarization, exposure duration, and depth below the skin surface on the temperature rise. The results indicated limitations in the current human exposure guidelines and showed that radiant exposure, i.e. energy absorption per unit area, can be used to limit temperature rise for pulsed exposure. The data are useful for the development of human exposure guidelines at frequencies higher than 6 GHz.

https://www.ncbi.nlm.nih.gov/pubmed/28791963

Excerpts

Figure 2 shows that the hotspot locations depend on the frequency and polarization and often appear in and around fine structures such as the eyelids. However, they can also appear in other locations, most notably in the eyes and cheeks. Future studies should investigate the differences in the absorption pattern and temperature rise in multiple anatomically different individuals. The investigation should also take into account the extent of opening between the eyelids,

.. our results showed that relatively long exposure averaging times used in current ICNIRP guidelines may not provide adequate protection in the case of brief, intense pulsed exposure (figure 4). An additional limit defined for the maximum radiant exposure could provide protection from short pulse exposure. It is important to note that the effect of exposure duration diminishes as the frequency decreases (figure 5). Therefore, separate consideration for pulsed exposure is relevant only at frequencies higher than 10 GHz.

In conclusion, this study addressed the issue of pulsed exposure, which is currently treated differently in different international guidelines and standards. The results showed the effects of non-uniform energy absorption, exposure duration, and frequency on the temperature rise, and are useful for the development of human exposure guidelines at frequencies higher than 6 GHz.

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Assessment of fetal exposure to 4G LTE tablet in realistic scenarios: Effect of position, gestational age and frequency

Chiaramello E, Parazzini M, Fiocchi S, Ravazzani P, Wiart J. Assessment of fetal exposure to 4G LTE tablet in realistic scenarios: Effect of position, gestational age and frequency. IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology. PP:90. 2017.

Abstract

The continuous development of Radio-Frequency (RF) devices used in every-day life highlights the need of conducting appropriate health risk assessment due to Radio- Frequency Electromagnetic Fields (RF-EMF) exposure, especially for the fetal exposure in realistic scenarios. In this study, we used stochastic dosimetry, an approach that combines electromagnetic computational techniques and statistics, to assess the fetal exposure to a 4G LTE tablet in realistic scenarios, assessing the influence of the position of the tablet, the gestational age of the fetus and the frequency of the emitting antenna. Results showed that the exposure in terms of Specific Absorption Rate (SAR) was within the limits of the ICNIRP 1998 general public Guidelines in all the considered scenarios. The position of the tablet was very influential for the induced SAR in the fetus, resulting in Quartile Coefficient of Dispersion always higher than 40%. The level of exposure for the later pregnancy was found to be higher than those for the early pregnancy. As to the effect of the emitting frequency of the tablet, we found that the higher the frequency, the lower the induced SAR in the fetus.

http://ieeexplore.ieee.org/document/8000304/

Excerpt

Fig.2 shows, as example, some preliminary results referred to the exposure of the 9-months GA fetus to the 4G LTE tablet in a generic position among those described in Fig.1. All the reported SAR values have been normalized to a radiated power equal to 1 W. In this specific position, among all fetal tissues, adrenal gland, gallbladder and kidney showed SARWT values slightly higher than 5 mW/kg. Considering the pSAR1gT values, among all tissues skin, small intestine, muscle and kidney showed values higher than 10 mW/kg (with maximum of 22 mW/kg in the skin tissue).

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Nature relatedness is connected with modern health worries and electromagnetic hypersensitivity

Dömötör Z, Szemerszky R, Köteles F. Nature relatedness is connected with modern health worries and electromagnetic hypersensitivity. J Health Psychol. 2017 Mar 1:1359105317699681. doi: 10.1177/1359105317699681.

Abstract

Although nature relatedness is considered a positive characteristic, its relationship to constructs involving worries about the negative effects of artificial environmental factors is also feasible. A questionnaire assessing modern health worries, electrosensitivity, somatosensory amplification, spirituality, and nature relatedness was completed by 510 individuals. Nature relatedness was related to electrosensitivity, modern health worries, and spirituality. In a binary logistic regression analysis, somatosensory amplification, modern health worries, and nature relatedness were associated with electrosensitivity, and nature relatedness moderated the connection between modern health worries and electrosensitivity. In naive representations, "natural" might be associated with health, whereas "modern" and "artificial" evoke negative associations.

https://www.ncbi.nlm.nih.gov/pubmed/28810440

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Thermal mapping on male genital and skin tissues of laptop thermal sources and electromagnetic interaction

Safari M, Mosleminiya N, Abdolali A. Thermal mapping on male genital and skin tissues of laptop thermal sources and electromagnetic interaction. Bioelectromagnetics. 2017 Aug 11. doi: 10.1002/bem.22068.
Abstract

Since the development of communication devices and expansion of their applications, there have been concerns about their harmful health effects. The main aim of this study was to investigate laptop thermal effects caused by exposure to electromagnetic fields and thermal sources simultaneously; propose a nondestructive, replicable process that is less expensive than clinical measurements; and to study the effects of positioning any new device near the human body in steady state conditions to ensure safety by U.S. and European standard thresholds. A computer simulation was designed to obtain laptop heat flux from SolidWorks flow simulation. Increase in body temperature due to heat flux was calculated, and antenna radiation was calculated using Computer Simulation Technology (CST) Microwave Studio software. Steady state temperature and specific absorption rate (SAR) distribution in user's body, and heat flux beneath the laptop, were obtained from simulations. The laptop in its high performance mode caused 420 (W/m2) peak two-dimensional heat flux beneath it. The cumulative effect of laptop in high performance mode and 1 W antenna radiation resulted in temperatures of 42.9, 38.1, and 37.2 °C in lap skin, scrotum, and testis, that is, 5.6, 2.1, and 1.4 °C increase in temperature, respectively. Also, 1 W antenna radiation caused 0.37 × 10-3 and 0.13 × 10-1**.**

https://www.ncbi.nlm.nih.gov/pubmed/28799651

Excerpts

Findlay and Dimbylow [2010] carried out one such study on SAR in the body of a sitting 10-year-old at 2.4 and 5 GHz. They found maximum peak localized three-dimensional (3D) SAR of 3.99 × 10−3 (W/kg) in the torso area.

It should be specified that this study only considered thermal effects on men; however, laptop antenna could have non-thermal effects on the user's body or pregnant women, including DNA fraction [Nagaoka et al., 2007; Zoppetti et al., 2011; Avendano et al., 2012], but such non-thermal effects are not considered in the present paper.

Since maximum allowed power consumption for an array of antennas designed for this purpose is 1 W and there were two antennas, each one consumed up to 0.5 W of power. However, in normal conditions, Wireless Local Area Network (WLAN) antennas can radiate using only 10 mW [Guterman et al., 2009].

It should be noted that the given values of SAR were normalized to 1 W peak antenna power output, while typically a WLAN antenna radiates about 10 mW; therefore, for a real world operating system, maximum SAR of 0.37×10^{-3} and 0.18×10^{-3} (W/kg) is expected for 2 and 1 active antennas, respectively, which are 10^4 times lower than the European safety limit (2 W/kg) [IEEE Standard for Safety Levels with Respect to Humans, 2005].

Also, maximum SAR of 0.13×10^{-3} (W/kg) is expected for a WLAN antenna radiation power of about 10 mW operating at 5 GHz, which is still lower than safety limits.

... maximum temperature on surface of scrotum skin of the laptop user in the studied position was 38.1 °C, which was 2.1 °C higher than normal temperature in absence of the laptop in the simulation.

It can be inferred from the aforementioned works that increase in scrotal temperature can result in reduction of sperm motility, which consequently enhances the probability of infertility, lessens sperm production, decreases

sperm concentration by 56% [Hjollund et al., 2002], increases ROS, and negatively affects sperm morphology, increasing the number of sperm with physical dimensions different from those of normal sperm.

A method of simulating thermal mapping of positioning laptop on laps of an adult man was developed. To tackle this problem, we exploited computer simulation and, to make the simulation close to the actual problem, we created 3D models of an actual laptop (Sony FW 590 Gab), antennas, and human phantom with inhomogeneous body, large number of tissues, and dispersion properties. We employed a commercial laptop Wi-Fi antenna at 2.4 GHz and a dipole antenna at 5 GHz, thermal sources with radiation powers, and human body voxel consisting of 97 tissues which were described previously. In the simulation, maximum SAR in human body was calculated 0.37×10^{-3} and 0.13×10^{-1} (W/kg) at 2.4 and 5 GHz, respectively, which was negligible according to IEEE standards; thus, the major calculated temperature elevation was due to laptop thermal sources. The temperature in glans penis, lap skin, lap muscles, and testes increased up to 37.8, 42.9, 38.8, and 37.2 °C, respectively, which was in line with clinical studies of thermal effect. Hence, the proposed method can be replicated for other scenarios. It is worth noting that the presented result cannot be easily generalized to other devices or human models. However, the whole method is replicable for similar phenomena. The recommended subject for future works can be used with the presented method for determining the effect of laptop and other devices on adult pregnant women and similar cases.

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Comparative analysis of downlink signal levels emitted by GSM 900, GSM 1800, UMTS, and LTE base stations

Ibrani M, Hamiti E, Ahma L, Halili R, Dragusha B. Comparative analysis of downlink signal levels emitted by GSM 900, GSM 1800, UMTS, and LTE base stations. Ad Hoc Networking Workshop (Med-Hoc-Net), 2017 16th Annual Mediterranean.28-30 June 2017.

Abstract

Determination of exposure levels is considered as one of the parameters of planning and optimization of green cellular networks. While moving towards 5G technology and standardization, the results of comparative exposure levels induced by 2G, 3G and 4G networks are of interest. We present the results of in-situ determination of downlink signal levels [jn Kosovo] emitted by GSM 900, GSM 1800, UMTS, and LTE networks in urban areas. The measurements are conducted with calibrated spectrum analyzer NARDA SRM 3006 at outdoor and indoor spots, including LOS and NLOS positions. The highest measured value is 2.82 V/m registered in outdoor LOS position for GSM 900. The results of comparative research highlight GSM 900 as the biggest contributor to the overall cellular systems downlink signal level, followed with UMTS, GSM 1800 and LTE. Obtained results are compared with the ICNIRP reference levels as well as with downlink signal levels emitted by cellular systems in other countries.

http://ieeexplore.ieee.org/document/8001655/

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Cancer occurrences in laboratory rats from exposure to RF and microwave radiation

Lin JC. Cancer Occurrences in Laboratory Rats from Exposure to RF and Microwave Radiation. IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology. Aug 2, 2017. PP:99.

Health effects of radio frequency (RF) and microwave radiation have been a subject of scientific inquiry and public interest of late because of widespread global usage of mobile communication devices by billions of people everywhere. A minute increase in health risks such as cancer from RF radiation might lead to significant consequences for health of the general public. A recent U.S. government announcement of discovery of rare cancers in rats exposed to RF radiation is an important occurrence. Note that any new or

single report should not be viewed in isolation. The U.S. government project was organized to confront the weaknesses of prior laboratory rodent studies on the potential of RF exposure to impact human health such as cancer in controlled environments. Indeed, several published reports on animal cancer investigations involving prolonged exposures to RF radiation are contentious and perplexing. The discrepancies have presented ambiguity in assessing public health threats from RF exposure. It is the objective of this review to provide a critical and analytical synopsis and assessment on current progress in cancers in rats exposed, lifelong, to RF and microwave radiation. Its focus is on laboratory studies involving cancer production and promotion, and survival of experimental rats. Of special interest is carcinogenesis in the head—cancer development in the head. The question of whether RF exposure from wireless and mobile devices and systems poses a health risk would likely remain equivocal and controversial for some time to come.

http://ieeexplore.ieee.org/document/8000308/

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Mobile phone (1800MHz) radiation impairs female reproduction in mice through stress induced inhibition of ovarian & uterine activity

Shahin S, Singh SP, Chaturvedi CM. Mobile Phone (1800MHz) Radiation Impairs Female Reproduction in Mice, Mus musculus, through Stress Induced Inhibition of Ovarian and Uterine Activity. Reprod Toxicol. 2017 Aug 2. pii: S0890-6238(17)30167-3. doi: 10.1016/j.reprotox.2017.08.001. [Epub ahead of print]

Highlights

• Mice exposed to mobile phone radiation (MPR) in different operative modes.
• Ovarian & uterine histopathology, steroidogenesis & stress parameters were checked.
• Degenerative changes & reduced follicle count were observed in MPR exposed ovary.
• MPR resulted significant decrease in ovarian steroidogenic proteins & sex steroids.
• MPR induced oxidative & nitrosative stress impairs reproductive functions in mice.

Abstract

Present study investigated the long-term effects of mobile phone (1800MHz) radiation in stand-by, dialing and receiving modes on the female reproductive function (ovarian and uterine histo-architecture, and steroidogenesis) and stress responses (oxidative and nitrosative stress). We observed that mobile phone radiation induces significant elevation in ROS, NO, lipid peroxidation, total carbonyl content and serum corticosterone coupled with significant decrease in antioxidant enzymes in hypothalamus, ovary and uterus of mice. Compared to control group, exposed mice exhibited reduced number of developing and mature follicles as well as corpus lutea. Significantly decreased serum levels of pituitary gonadotrophins (LH, FSH), sex steroids (E2 and P4) and expression of SF-1, StAR, P-450scc, 3β-HSD, 17β-HSD, cytochrome P-450 aromatase, ER-α and ER-β were observed in all the exposed groups of mice, compared to control. These findings suggest that mobile phone radiation induces oxidative and nitrosative stress, which affects the reproductive performance of female mice.

https://www.ncbi.nlm.nih.gov/pubmed/28780396

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The effects of electromagnetic radiation (2450 MHz wireless devices) on the heart and blood tissue: role of melatonin

Gumral N, Saygin M, Asci H, Uguz AC, Celik O, Doguc DK, Savas HB, Comlekci S.The effects of electromagnetic radiation (2450 MHz wireless devices) on the heart and blood tissue: role of melatonin. Bratisl

Lek Listy. 2016;117(11):665-671. doi: 10.4149/BLL_2016_128.

Abstract

OBJECTIVE: This study was designed to investigate the effects of 2450 MHz EMR on the heart and blood in rat and possible ameliorating effects of melatonin.

MATERIAL AND METHOD: Thirty-two female Wistar Albino rats were randomly grouped (by eight in each group) as follows: Group I: cage-control group (dimethysulfoxide (DMSO), 10mg/kg/day i.p. without stress and EMR. Group II: sham-control rats stayed in restrainer without EMR and DMSO (10mg/kg/day i.p.). Group III: rats exposed to 2450 MHz EMR. Group IV: treated group rats exposed to 2450 MHz EMR+melatonin (MLT) (10mg/kg/day i.p.).

RESULTS: In the blood tissue, there was no significant difference between the groups in respect of erythrocytes GSH, GSH-Px activity, plasma LP level and vitamin A concentration ($p > 0.05$). However, in the Group IV, erythrocytes' LP levels ($p < 0.05$) were observed to be significantly decreased while plasma vitamin C, and vitamin E concentrations ($p < 0.05$) were found to be increased when compared to Group III. In the heart tissues, MDA and NO levels significantly increased in group III compared with groups I and II ($p < 0.05$). Contrary to these oxidant levels, CAT and SOD enzyme activities decreased significantly in group III compared with groups I and II (p 0.05). Besides, MLT treatment lowered the MDA and NO levels compared with group III.

DISCUSSION: In conclusion, these results demonstrated that contrary to its effect on the heart, the wireless (2450 MHz) devices cause slight oxidative-antioxidative changes in the blood of rats, and a moderate melatonin supplementation may play an important role in the antioxidant system (plasma vitamin C and vitamin E). However, further investigations are required to clarify the mechanism of action of the applied 2450 MHz EMR exposure (Tab. 3, Fig. 1, Ref. 49).

https://www.ncbi.nlm.nih.gov/pubmed/28125893

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Effect of 2G and 3G cell phone radiation on developing liver of chick embryo – A comparative study

Mary Hydrina D'Silva MH, Swer RT, Anbalagan J, Rajesh B. Effect of Radiofrequency Radiation Emitted from 2G and 3G Cell Phone on Developing Liver of Chick Embryo – A Comparative Study. J Clinical Diagnostic Research. 11(7):AC05-AC09. Jul 2017

Introduction: The increasing scientific evidence of various health hazards on exposure of Radiofrequency Radiation (RFR) emitted from both the cell phones and base stations have caused significant media attention and public discussion in recent years. The mechanism of interaction of RF fields with developing tissues of children and fetuses may be different from that of adults due to their smaller physical size and variation in tissue electromagnetic properties. The present study may provide an insight into the basic mechanisms by which RF fields interact with developing tissues in an embryo.

Aim: To evaluate the possible tissue and DNA damage in developing liver of chick embryo following chronic exposure to ultra-high frequency/radiofrequency radiation (UHF/RFR) emitted from 2G and 3G cell phone.

Materials and Methods: Fertilized chick embryos were incubated in four groups. Group A-experimental group exposed to 2G radiation (60 eggs), Group B- experimental group exposed to 3G radiation (60 eggs), Group C-sham exposed control group (60 eggs) and Group D– control group (48 eggs). On completion of scheduled duration, the embryos were collected and processed for routine histological studies to check structural changes in liver. The nuclear diameter and karyorrhexic changes of hepatocytes were analysed using oculometer and square reticule respectively. The liver procured from one batch of eggs from all the four groups was subjected to alkaline comet assay technique to assess DNA damage. The results were compared using one-way ANOVA

test.

Results: In our study, the exposure of developing chick embryos to 2G and 3G cell phone radiations caused structural changes in liver in the form of dilated sinusoidal spaces with haemorrhage, increased vacuolations in cytoplasm, increased nuclear diameter and karyorrhexis and significantly increased DNA damage.

Conclusion: The chronic exposure of chick embryo liver to RFR emitted from 2G and 3G cell phone resulted in various structural changes and DNA damage. The changes were more pronounced in 3G experimental group. Based on these findings it is necessary to create awareness among public about the possible ill effects of RFR exposure from cell phone.

http://www.jcdr.net/article_abstract.asp?issn=0973-709x&year=2017&month=July&volume=11&issue=7&page=AC05-AC09&id=10275

Excerpts

The experimental group, Group–A (exposed to 2G cell phone radiation) and Group–B (exposed to 3G cell phone radiation), were also incubated (60+60 eggs) in a similar manner with the cell phone kept in silent operative mode with head phone plugged in (switched on). This arrangement ensured that the cell phone got activated automatically each time it received a call ...

A popular brand cell phone hand set and a service provider were used for network connection for both 2G and 3G exposure. For exposure activation, the cell phone was rung from another cell phone for duration of three minutes each, every half an hour, with the first exposure given at 12th hour of incubation (4.30 am-4.30 pm). The total exposure for a 12 hour period was 75 minutes followed by 12 hour of exposure-free period. This was repeated daily up to 12th day of incubation.

From our experimental outcome, we conclude that the chronic exposure of chick embryo liver to RFR emitted from 2G and 3G cell phone resulted in various structural changes and DNA damage. The changes were more pronounced in 3G experimental group. Many researchers now opine that cell phones may turn out to be the cigarettes of 21st century as their effects or interactions with biological tissues on long term exposure are yet to be explored especially in foetuses and children. Hence children and pregnant women should use the cell phone with caution. Introduction of new generation phones, 4G and 5G, open a vast potential for future research and whether these changes observed due to RFR exposure are reversible or not on withdrawing the exposure is another arena which warrants further research.

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Disturbing honeybees' behavior with EMF: a methodology

Danial Favre. Disturbing honeybees' behavior with electromagnetic waves: A methodology.J Behav 2(2): 1010 (2017).

Abstract

Mobile phone companies and policy makers point to studies with contradictory results and usually claim that there is a lack of scientific proof of adverse effects of electromagnetic fields on animals. The present perspective article describes an experiment on bees, which clearly shows the adverse effects of electromagnetic fields on these insects' behavior. The experiment should be reproduced by other researchers so that the danger of man-made electromagnetism (for bees, nature and thus humans) ultimately appears evident to anyone.

https://www.jscimedcentral.com/Behavior/behavior-2-1010.php

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Effect of DECT cordless phone radiation on exposed, laboratory cultivated maize plants

Stefia AL, Margaritis LH, Christodoulakis NS. The effect of the non-ionizing radiation on exposed, laboratory cultivated maize (Zea mays L.) plants. Flora. 223: 23-20. Aug 2017. https://doi.org/10.1016/j.flora.2017.05.008

Highlights

• Young corn plants exposed to long term radiation from a DECT base-unit.
• No biomass reduction was observed for the exposed plants, after two weeks.
• Photosynthetic pigment content seems unaltered.
• After two weeks, mesophyll chloroplast structure seems not to be affected.
• Bundle sheath chloroplasts severely affected, apprehending repression of a major advantage.

Abstract

A series of experiments was carried out to investigate possible structural or biochemical effects on young *Zea mays* plants after a long-term exposure to non-ionizing, continuous radiation emitted from the base unit of a cordless DECT system. Exposed plants, compared to their normal counterparts, do not seem to be affected concerning their sprouting potential, biomass production for both the above ground part and the root, leaf structure, photosynthetic pigment content and their absorbance. The structural profile of the exposed plants seems almost identical to those of the control ones. Biomass production, photosynthetic pigments, leaf structure and chloroplast arrangement do not differ in exposed plants. What seems to be affected is the structure of the chloroplasts accommodated in the bundle sheath cells of the exposed leaves. They suffer a slight swelling of their thylakoids and an undulation of some of the thylakoid membranes. Scarcely a disruption of chloroplast envelope can be observed.

http://www.sciencedirect.com/science/article/pii/S0367253017332176

Excerpts

In the middle of one of the two cages, the base unit of a DECT telephone apparatus (General, Model 123) was appropriately positioned (Fig. 2). The DECT base was in a 24 h a day, 7 days a week, pulsed transmission mode, at 1882 MHz, as described elsewhere (Margaritis et al., 2014) while the light/dark programme of the chamber was adjusted to a 16/8 cycle (Stefi et al., 2016, 2017).

Radiation was measured in the two cages, while the DECT device was transmitting within one of them, with a NARDA SRM3000 (Germany) spectrum analyzer. The corresponding electrical field intensity (average and peak), in each experimental setup, was measured for a 6-min period according to ICNIRP (1998) guidelines as in Table 1. Supplementary, low precision measurements were made in the control cage with a broadband field meter (TES-92, 50 MHz–3.5 GHz, Electromagnetic radiation detector – TES Electrical Electronic Corp. Taipei, Taiwan, R.O.C.) at the value of 490.1 mV/m. In the nearby cage (exposed), radiation reached the value of 27.46 V/m (27.460 mV/m, at 1882 MHz) (55 fold higher).

Concluding, we could say that non-ionizing radiation emitted from devices of everyday use such as mobile phones, DECT phones, tablets, Wi-Fi routers etc, can by no means be considered as “innocent”. Our current results, recent papers for the effects on Arabidopsis thaliana and Gossypium hirsutum (Stefi et al., 2016, 2017), numerous reports from epidemiological researches correlating exposure and clinical disorders such as sleep disorders on children that use mobile phone before sleep (Van den Bulck 2007), promotion of lymphomas and leukemias in adults and children (Hardell et al., 2014) are serious reasons for further consideration.

Moreover, the effects of non-ionizing electromagnetic radiation on behavior (Divan et al., 2012), cardiovascular system (Celik and Hascalik 2004), reproduction and development (Margaritis et al., 2014), oxidative stress induction (Esmekaya et al., 2011; Manta et al., 2014), memory deficits (Fragopoulou et al., 2010, Ntzouni et al., 2011) and cancer provocation (Hardell and Carlberg 2009), strongly support the aspect that the problem is far more than serious and public anxiety seems justified.

Taking in to account that:

• The function of the C_4 chloroplasts is uniquely associated with the function of stomata (Ghannoum, 2008).
• Stomata of *Z. mays* are of the dumbbell – shape type. This type of stomata appears only in Graminae and is unique in structure and function.
• The total yield in our experiments was almost similar for both control and exposed plants.
• The photosynthetic pigment content, as measured with the UV/Vis Specol photometer, was more or less similar in both control and exposed plants.
• Taking into consideration that maize plants are fully mature and pistillate female flowers appear after about two months while corns are harvested three months after sprouting,
We may conclude that the differences between control and exposed plants are negligible in spite of the significant structural deformations of the agranal BSC chloroplasts. Moreover, stomatal function seems not to be affected and photosynthesis (even the C_4) not to be disturbed by radiation, until this stage of the plant's life. Finally, we may point out that the deformations observed in the chloroplasts may affect the mature plant by suspending the great advantage of the C_4 photosynthesis.

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Effect of DECT cordless phone radiation on exposed, laboratory cultivated upland cotton plants

Stefi AL, Margaritis LH, Christodoulakis NS. The effect of the non ionizing radiation on exposed, laboratory cultivated upland cotton (Gossypium hirsutum L.) plants. Flora: Morphology, Distribution, Functional Ecology of Plants [Internet]. 2017;226:55 - 64.

Abstract

A series of experiments was carried out to investigate possible structural or biochemical alterations in Gossypium hirsutum plants after a long term (21 days) exposure to non ionizing radiation (1882 MHz) emitted from the base unit of a cordless DECT system. Exposed plants, compared to the negative (matched) controls, seem to be seriously affected. Notably lower biomass production for the above ground part and the root was recorded. Reduction of the photosynthetic pigments and severe damage of the chloroplast structure were also observed. It seems that non ionizing radiation can be noxious for plant life functions.

https://www.scopus.com/record/display.uri?eid=2-s2.0-84997817372&doi=10.1016%2fj.flora.2016.11.009&origin=inward&txGid=2a0c5f11e55ffcd3b656cd415c1041ac

Excerpt

[same exposure setup as the maize study]

The effect of the non-ionizing radiation at the microwave band, on the Gossypium hirsutum young plants, after a long termexposure, can be considered as significant. The disastrous effect on chloroplast structure, the reduction of the photosynthetic pigments and the suppression of the photosynthetic potential, are the main causes for the significant reduction of the primary productivity. Moreover, a serious effect on the underground part of the plant was recorded but this cannot be evaluated yet.

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The aftermath of long-term exposure to non-ionizing radiation on laboratory cultivated pine plants

Stefi AL, Margaritis LH, Christodoulakis NS. The aftermath of long-term exposure to non-ionizing radiation on laboratory cultivated pine plants (Pinus halepensis M.). Flora. 234: 173-186. September 2017. https://doi.org/10.1016/j.flora.2017.07.016

Highlights

• Young pine plants exposed to long term radiation from a DECT base-unit.
• Significant biomass reduction was observed for the exposed plants, after seven weeks.
• Photosynthetic pigment content decreased in the exposed leaves.
• Cotyledon, leaf, stem and root structure seem unaffected.
• Many mesophyll cells severely affected with extensive damages to their chloroplasts.

Abstract

Sprouts of Pinus halepensis were incubated and cultured in the laboratory under controlled conditions to investigate their response to a long-term exposure to continuous, non-ionizing radiation emitted from the base unit of a cordless DECT system. Exposed plants, compared to their control counterparts, seem to be affected since they exhibit lower sprouting potential, minor fresh weight and biomass for both the above ground part and the root, reduction of their photosynthetic pigments and significantly increased ROS levels. Cotyledon, juvenile leaf, primary shoot and root structure seem similar in both control and exposed plants. What seems to be affected is the structure of chloroplasts in the exposed leaves. Many cells of the exposed leaves possess severely deformed chloroplasts with dilated or destructed thylakoid membranes although disruption of chloroplast envelopes was not observed.

http://www.sciencedirect.com/science/article/pii/S0367253017332760

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Impact of RFR on DNA damage & antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations

Zothansiama, Zosangzuali M, Lalramdinpuii M, Jagetia GC. Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations. Electromagn Biol Med. 2017 Aug 4:1-11. doi: 10.1080/15368378.2017.1350584.

Abstract

Radiofrequency radiations (RFRs) emitted by mobile phone base stations have raised concerns on its adverse impact on humans residing in the vicinity of mobile phone base stations. Therefore, the present study was envisaged to evaluate the effect of RFR on the DNA damage and antioxidant status in cultured human peripheral blood lymphocytes (HPBLs) of individuals residing in the vicinity of mobile phone base stations and comparing it with healthy controls.

The study groups matched for various demographic data including age, gender, dietary pattern, smoking habit, alcohol consumption, duration of mobile phone use and average daily mobile phone use.

The RF power density of the exposed individuals was significantly higher ($p < 0.0001$) when compared to the control group. The HPBLs were cultured and the DNA damage was assessed by cytokinesis blocked

micronucleus (MN) assay in the binucleate lymphocytes. The analyses of data from the exposed group (n = 40), residing within a perimeter of 80 meters of mobile base stations, showed significantly ($p < 0.0001$) higher frequency of micronuclei (MN) when compared to the control group, residing 300 meters away from the mobile base station/s.

The analysis of various antioxidants in the plasma of exposed individuals revealed a significant attrition in glutathione (GSH) concentration ($p < 0.01$), activities of catalase (CAT) ($p < 0.001$) and superoxide dismutase (SOD) ($p < 0.001$) and rise in lipid peroxidation (LOO) when compared to controls. Multiple linear regression analyses revealed a significant association among reduced GSH concentration ($p < 0.05$), CAT ($p < 0.001$) and SOD ($p < 0.001$) activities and elevated MN frequency ($p < 0.001$) and LOO ($p < 0.001$) with increasing RF power density.

https://www.ncbi.nlm.nih.gov/pubmed/28777669

My note: All of the recorded RFR power density values in this study were well below the Federal Communication Commission's maximum permissible exposure limits in the U.S. for the general population. These limits are are 6,000 mW/m^2 [milliwatts per square meter] for 900 MHz and 10,000 mW/m^2 for 1800 MHz radiofrequency radiation. In contrast, the highest recorded value in this study was 7.52 mW/m^2 of RFR. The "exposed individuals" who resided within 80 meters of a cell antenna received an average of 5.00 mW/m^2 of RFR in their bedrooms.

To see excerpts from this study and related research: **Cell Tower Health Effects** or **http://bit.ly/saferemrcelltower**

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Mobile phone RF exposure has no effect on DNA double strand breaks in human lymphocytes

Danese E, Lippi G, Buonocore R, Benati M, Bovo C, Bonaguri C, Salvagno GL, Brocco G, Roggenbuck D, Montagnana M. Mobile phone radiofrequency exposure has no effect on DNA double strand breaks (DSB) in human lymphocytes. Ann Transl Med. 2017 Jul;5(13):272. doi: 10.21037/atm.2017.04.35.

Abstract

BACKGROUND: The use of mobile phones has been associated with an increased risk of developing certain type of cancer, especially in long term users. Therefore, this study was aimed to investigate the potential genotoxic effect of mobile phone radiofrequency exposure on human peripheral blood mononuclear cells in vitro.

METHODS: The study population consisted in 14 healthy volunteers. After collection of two whole blood samples, the former was placed in a plastic rack, 1 cm from the chassis of a commercial mobile phone (900 MHz carrier frequency), which was activated by a 30-min call. The second blood sample was instead maintained far from mobile phones or other RF sources. The influence of mobile phone RF on DNA integrity was assessed by analyzing γ-H2AX foci in lymphocytes using immunofluorescence staining kit on AKLIDES.

RESULTS: No measure of γ-H2AX foci was significantly influenced by mobile phone RF exposure, nor mobile phone exposure was associated with significant risk of genetic damages in vitro (odds ratio comprised between 0.27 and 1.00).

CONCLUSIONS: The results of this experimental study demonstrate that exposure of human lymphocytes to a conventional 900 MHz RF emitted by a commercial mobile phone for 30 min does not significantly impact DNA integrity.

https://www.ncbi.nlm.nih.gov/pubmed/28758098

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Effects of Long-Term Exposure to 60 GHz Millimeter-Wavelength Radiation on Genotoxicity & Heat Shock Protein Expression of Cells Derived from Human Eye

Koyama S, Narita E, Shimizu Y, Suzuki Y, Shiina T, Taki M, Shinohara N, Miyakoshi J.Effects of Long-Term Exposure to 60 GHz Millimeter-Wavelength Radiation on the Genotoxicity and Heat Shock Protein (Hsp) Expression of Cells Derived from Human Eye. Int J Environ Res Public Health. 2016 Aug 8;13(8). pii: E802. doi: 10.3390/ijerph13080802.

Abstract

Human corneal epithelial (HCE-T) and human lens epithelial (SRA01/04) cells derived from the human eye were exposed to 60 gigahertz (GHz) millimeter-wavelength radiation for 24 h. There was no statistically significant increase in the micronucleus (MN) frequency in cells exposed to 60 GHz millimeter-wavelength radiation at 1 mW/cm² compared with sham-exposed controls and incubator controls. The MN frequency of cells treated with bleomycin for 1 h provided positive controls. The comet assay, used to detect DNA strand breaks, and heat shock protein (Hsp) expression also showed no statistically significant effects of exposure. These results indicate that exposure to millimeter-wavelength radiation has no effect on genotoxicity in human eye cells.

https://www.ncbi.nlm.nih.gov/pubmed/27509516

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RF EMF exposure in everyday microenvironments in Europe: A systematic literature review

Sagar S, Dongus S, Schoeni A, Roser K, Eeftens M, Struchen B, Foerster M, Meier N, Adem S, Röösli M. Radiofrequency electromagnetic field exposure in everyday microenvironments in Europe: A systematic literature review. J Expo Sci Environ Epidemiol. 2017 Aug 2. doi: 10.1038/jes.2017.13.

Abstract

The impact of the introduction and advancement in communication technology in recent years on exposure level of the population is largely unknown. The main aim of this study is to systematically review literature on the distribution of radiofrequency electromagnetic field (RF-EMF) exposure in the everyday environment in Europe and summarize key characteristics of various types of RF-EMF studies conducted in the European countries.

We systematically searched the ISI Web of Science for relevant literature published between 1 January 2000 and 30 April 2015, which assessed RF-EMF exposure levels by any of the methods: spot measurements, personal measurement with trained researchers and personal measurement with volunteers.

Twenty-one published studies met our eligibility criteria of which 10 were spot measurements studies, 5 were personal measurement studies with trained researchers (microenvironmental), 5 were personal measurement studies with volunteers and 1 was a mixed methods study combining data collected by volunteers and trained researchers. RF-EMF data included in the studies were collected between 2005 and 2013. The mean total RF-EMF exposure for spot measurements in European "Homes" and "Outdoor" microenvironments was 0.29 and 0.54 V/m, respectively. In the personal measurements studies with trained researchers, the mean total RF-EMF exposure was 0.24 V/m in "Home" and 0.76 V/m in "Outdoor". In the personal measurement studies with volunteers, the population weighted mean total RF-EMF exposure was 0.16 V/m in "Homes" and 0.20 V/m in

"Outdoor". Among all European microenvironments in "Transportation", the highest mean total RF-EMF 1.96 V/m was found in trains of Belgium during 2007 where more than 95% of exposure was contributed by uplink.

Typical RF-EMF exposure levels are substantially below regulatory limits. We found considerable differences between studies according to the type of measurements procedures, which precludes cross-country comparison or evaluating temporal trends. A comparable RF-EMF monitoring concept is needed to accurately identify typical RF-EMF exposure levels in the everyday environment.

https://www.ncbi.nlm.nih.gov/pubmed/28766560

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Measurement of the environmental broadband electromagnetic waves in a mid-size European city

Fernández-García R, Gil I. Measurement of the environmental broadband electromagnetic waves in a mid-size European city. Environ Res. 2017 Jul 26;158:768-772. doi: 10.1016/j.envres.2017.07.040.

Abstract

In this paper, the level of exposure to broadband radiofrequency electromagnetic field in a mid-size European city was evaluated in accordance with the International Commission on Non-ionizing Radiation Protection guidelines from 1998. With the aim to analyse all the potential electromagnetic waves present in the city up to 18GHz, a total of 271 locations distributed along Terrassa (Spain) have been measured. To show the results in an easy-to-interpret way by the citizen, the results have been represented in a set of raster maps. The measurement results obtained showed that the electromagnetic wave measured in all broadband frequency range along the city is much lower than the safety level according to the international regulations for both public and occupational sectors.

https://www.ncbi.nlm.nih.gov/pubmed/28755561

Excerpts

... according to the World Health Organization, due to the ubiquitous source of RF radiation the percentage of all people being exposed to RF electromagnetic radiation is rapidly approaching the percentage exposed to polluted air (Lin, 2016) and therefore, more research must be devoted to this crucial issue. In addition, it is necessary to extend the RF-EMF exposure assessment to broadband frequency measurements including fields beyond 6 GHz. This fact will be mandatory in the future because of the deployment of new wireless standards such as the fifth-generation mobile communication systems (5G) (Colombi et al., 2015; Zhao et al., 2015).

The electric field measurements have been carried out by means of the electromagnetic field meter *Wavecontrol SMP2* and a *WPF18* broadband isotropic probe to assess the radioelectric environment and all the potential hand-made radiofrequency sources. The probe has a broadband frequency range from 300 kHz to 18 GHz with a measurement range from 0.5 V/m to 250 V/m. The electromagnetic sensor is based on a diode technology and it presents a sensitivity of 0.5 V/m with a resolution lower than 5%, a dynamic range of 54 dB and a linearity of ± 0.5 dB. The measurement equipment has been calibrated according to the ISO 17025 standard. The equipment is able to cover all the potential non-ionizing electromagnetic emissions in the environment from 300 kHz to 18 GHz....

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Are electromagnetic fields in incubators a risk factor for autism?

Bellieni CV, Buonocore G. Acta Paediatr. Are electromagnetic fields in incubators a risk factor for autism? 2017 Jul 22. doi: 10.1111/apa.14001.

Abstract

Hugo Lagercrantz recently argued (1) that a possible cause of infantile autism was the unnatural isolation that babies experienced in neonatal incubators. Atypical brain connectivity has been detected in children with autism and it is possible that this may be also due to environmental factors, including the lack of physiological stimuli that is typically found in the incubator environment. We suggest that also another factor may expose babies in incubators to the risk of developing autistic traits and that is the high electromagnetic fields (EMF) produced by the incubator's electric engine.

https://www.ncbi.nlm.nih.gov/pubmed/28734102

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Report from the BioEM2017: Annual meeting of BEMS & EBEA

Dariusz Leszczynski. Report from the BioEM2017: Annual meeting of BEMS & EBEA, Hangzhou, China, June 5-9, 2017.

https://betweenrockandhardplace.files.wordpress.com/2017/07/report-from-bioem2017.pdf

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Effects of short and long term EMF exposure on the human hippocampus

Omur Gulsum Deniz, Suleyman Kaplan, Mustafa Bekir Selçuk, Murat Terzi, Gamze Altun, Kıymet Kübra Yurt, Kerim Aslan, Devra Davis. Effects of short and long term electromagnetic fields exposure on the human hippocampus. Journal of Microscopy and Ultrastructure, In Press, Corrected Proof, Available online 13 July 2017.

Highlights

• This pilot investigation of female medical students finds that electromagnetic fields exposure does not alter the volume of the human hippocampus.
• Widespread use of mobile phones among medical students results in a low level of concentration in the present study.
• Prolonged use of mobile phones can lead to a decline in the ability to suppress stimuli.

Abstract

The increasing use of mobile phones may have a number of physiological and psychological effects on human health. Many animal and human studies have reported various effects on the central nervous system and cognitive performance from of exposure to electromagnetic fields (EMF) emitted by mobile phones. The aim of the present study was to evaluate the effects of mobile phones on the morphology of the human brain and on cognitive performance using stereological and spectroscopic methods and neurocognitive tests.

Sixty healthy female medical school students aged 18–25 years were divided into a low exposure group (30 subjects, <30 min daily use by the head) and high exposure group (30 subjects, >90 min daily use by the head). Magnetic resonance images (MRI) of the brain analysed on OsiriX 3.2.1 workstation. Neuropsychological tests were performed for each subject. In addition, three dominant specific metabolites were analysed, choline at 3.21 ppm, creatine at 3.04 ppm and N-acetyl aspartate at 2.02 ppm. Analysis of the spectroscopic results revealed no significant difference in specific metabolites between the groups ($p > 0.05$).

There was also no significant difference in terms of hippocampal volume between the groups ($p > 0.05$). In contrast, the results of the stroop and digit span (backward) neurocognitive tests of high exposure group for evaluating attention were significantly poorer from low exposure group ($p < 0.05$). Based on these results, we conclude that a lack of attention and concentration may occur in subjects who talk on mobile phones for longer times, compared to those who use phones relatively less.

http://www.sciencedirect.com/science/article/pii/S2213879X17300524

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Monte Carlo simulations of skin exposure to electromagnetic field from 10 GHz to 1 THz

Sasaki K, Mizuno M, Wake K, Watanabe S. Monte Carlo simulations of skin exposure to electromagnetic field from 10 GHz to 1 THz.
Phys Med Biol. 2017 Jul 25. doi: 10.1088/1361-6560/aa81fc.

Abstract

In this study, we present an assessment of human-body exposure to an electromagnetic eld at frequencies ranging from 10 GHz to 1 THz. The energy absorption and temperature elevation were assessed by solving boundary value problems of the one-dimensional Maxwell equations and a bioheat equation for a multilayer plane model. Dielectric properties were measured in vitro at frequencies of up to 1 THz at body temperature. A Monte Carlo simulation was conducted to assess variations of the transmittance into a skin surface and temperature elevation inside a body by considering the variation of the tissue thickness due to individual differences among human bodies. Furthermore, the impact of the dielectric properties of adipose tissue on temperature elevation, for which large discrepancies between our present measurement results and those in past works were observed, was also examined. We found that the dielectric properties of adipose tissue do not impact on temperature elevation at frequencies over 30 GHz. The potential risk of skin burn was discussed on the basis of the temperature elevation in millimeter-wave and terahertz-wave exposure. Furthermore, the consistency of the basic restrictions in the international guidelines set by ICNIRP was discussed.

https://www.ncbi.nlm.nih.gov/pubmed/28742056

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Electromagnetic fields may act via calcineurin inhibition to suppress immunity, thereby increasing risk for opportunistic infection: Conceivable mechanisms of action

Doyon, PR, Johansson O. Electromagnetic fields may act via calcineurin inhibition to suppress immunity, thereby increasing risk for opportunistic infection: Conceivable mechanisms of action. Med Hypotheses. 106:71-87. Sep 2017. https://doi.org/10.1016/j.mehy.2017.06.028Get rights and content

Abstract

While a good number of studies have demonstrated that modern, man-made ambient electromagnetic fields can have both stimulatory and inhibitory effect on immune system function, the precise mechanisms have yet to be completely elucidated. It is hypothesized here that, depending on the parameters, one of the means by which long-term electromagnetic field exposure has the potential to eventually lead to immunosuppression is via downstream inhibition of the enzyme calcineurin — a protein phosphatase, which activates the T-cells of the immune system and can be blocked by pharmaceutical agents.

Calcineurin is the target of a class of pharmaceuticals called calcineurin inhibitors (e.g., cyclosporine, pimecrolimus and tacrolimus). When organ transplant recipients take such pharmaceuticals to prevent or suppress organ transplant rejection, one of the major side effects is immunosuppression leading to increased

risk of opportunistic infection: e.g., fungal, viral (Epstein-Barr virus, cytomegalovirus), atypical bacterial (Nocardia, Listeria, mycobacterial, mycoplasma), and parasitic (e.g., toxoplasmosis) infections.

Frequent anecdotal reports, as well as a number of scientific studies, have shown that electromagnetic field exposures may indeed produce the same effect: a weakened immune system leading to an increase in the same or similar opportunistic infections: i.e., fungal, viral, atypical bacterial, and parasitic infections.

Furthermore, numerous research studies have shown that man-made electromagnetic fields have the potential to open voltage-gated calcium channels, which can in turn produce a pathological increase of intracellular calcium, leading downstream to the pathological production of a series of reactive oxygen species. Finally, there are a number of research studies demonstrating the inhibition of calcineurin by a pathological production of reactive oxygen species.

Hence, it is hypothesized here that exposures to electromagnetic fields have the potential to inhibit immune system response by means of an eventual pathological increase in the influx of calcium into the cytoplasm of the cell, which induces a pathological production of reactive oxygen species, which in turn can have an inhibitory effect on calcineurin. Calcineurin inhibition leads to immunosuppression, which in turn leads to a weakened immune system and an increase in opportunistic infection.

http://www.sciencedirect.com/science/article/pii/S0306987717301718

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Biochemical & pathological changes in male rat kidney & bladder following exposure to continuous 900-MHz EMF on postnatal days 22-59

Türedi S, Kerimoğlu G, Mercantepe T, Odacı E. Biochemical and pathological changes in the male rat kidney and bladder following exposure to continuous 900-MHz electromagnetic field on postnatal days 22-59. Int J Radiat Biol. 2017 Jul 27:1-10. doi: 10.1080/09553002.2017.1350768.

Abstract

PURPOSE: To investigate the effect on male rat kidney and bladder tissues of exposure to 900-megahertz (MHz) electromagnetic field (EMF) applied on postnatal days 22-59, inclusive.

MATERIALS AND METHODS: Twenty-four male Sprague Dawley rats, aged 21 days, were used. These were divided equally into one of three groups, control (CG), sham (SG) or EMF (EMFG). CG was not exposed to any procedure. SG rats were kept inside a cage, without being exposed to the effect of EMF, for 1 h a day on postnatal days 22-59, inclusive. EMFG rats were exposed to continuous 900-MHz EMF for 1 h a day under the same conditions as those for the SG rats. Rats were sacrificed on postnatal day 60, and the kidney and bladder tissues were removed. Tissues were stained with hematoxylin and eosin (H&E) and Masson trichrome for histomorphological evaluation. The TUNEL method was used to assess apoptosis. Transmission electron microscopy (TEM) was also used for the kidney tissue. Oxidant/antioxidant parameters were studied in terms of biochemical values.

RESULTS: The findings showed that tissue malondialdehyde increased in EMFG compared to CG and SG in both kidney ($p = 0.004$ and $p = 0.004$, respectively) and bladder tissue ($p = 0.004$, $p = 0.006$, respectively), while catalase and glutathione levels decreased compared to CG ($p = 0.004$; $p = 0.004$, respectively) and SG ($p = 0.004$; $p = 0.004$, respectively). In the EMF group, pathologies such as dilatation and vacuolization in the distal and proximal tubules, degeneration in glomeruli and an increase in cells tending to apoptosis were observed in kidney tissue. In bladder tissue, degeneration in the transitional epithelium and stromal irregularity and an increase in cells tending to apoptosis were observed in EMFG. Additionally, EMFG samples exhibited glomerular capillary degeneration with capillary basement membranes under TEM.

CONCLUSIONS: We conclude that continuous exposure to the effect of 900-MHz EMF for 1 h a day on postnatal days 22-59, inclusive, causes an increase in oxidative stress and various pathological changes in male rat kidney and bladder tissues.

https://www.ncbi.nlm.nih.gov/pubmed/28747141

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Anxiety-like behavioural effects of ELF EMF in rats

Djordjevic NZ, Paunović MG, Peulić AS.Anxiety-like behavioural effects of extremely low-frequency electromagnetic field in rats. Environ Sci Pollut Res Int. 2017 Jul 29. doi: 10.1007/s11356-017-9710-1.

Abstract

In recent years, extremely low-frequency electromagnetic field (ELF-EMF) has received considerable attention for its potential biological effects. Numerous studies have shown the role of ELF-EMF in behaviour modulation. The aim of this study was to investigate the effect of short-term ELF-EMF (50 Hz) in the development of anxiety-like behaviour in rats through change hypothalamic oxidative stress and NO. Ten adult male rats (Wistar albino) were divided in two groups: control group-without exposure to ELF-EMF and experimental group-exposed to ELF-EMF during 7 days. After the exposure, time open field test and elevated plus maze were used to evaluate the anxiety-like behaviour of rats. Upon completion of the behavioural tests, concentrations of superoxide anion (O2·-), nitrite (NO2-, as an indicator of NO) and peroxynitrite (ONOO-) were determined in the hypothalamus of the animals. Obtained results show that ELF-EMF both induces anxiety-like behaviour and increases concentrations of O2·- and NO, whereas it did not effect on ONOO- concentration in hypothalamus of rats. In conclusion, the development of anxiety-like behaviour is mediated by oxidative stress and increased NO concentration in hypothalamus of rats exposed to ELF-EMF during 7 days.

https://www.ncbi.nlm.nih.gov/pubmed/28756602

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Influence of electromagnetic pulse on the offspring sex ratio of male BALB/c mice

Li JH, Jiang DP, Wang YF, Yan JJ, Guo QY, Miao X, Lang HY, Xu SL, Liu JY, Guo GZ.Influence of electromagnetic pulse on the offspring sex ratio of male BALB/c mice. Environ Toxicol Pharmacol. 2017 Jun 21;54:155-161. doi: 10.1016/j.etap.2017.06.015. [Epub ahead of print]

Abstract

Public concern is growing about the exposure to electromagnetic fields (EMF) and its effect on male reproductive health. Detrimental effect of EMF exposure on sex hormones, reproductive performance and sex-ratio was reported. The present study was designed to clarify whether paternal exposure to electromagnetic pulse (EMP) affects offspring sex ratio in mice. 50 male BALB/c mice aged 5-6 weeks were exposed to EMP daily for 2 weeks before mated with non-exposed females at 0d, 7d, 14d, 21d and 28d after exposure. Sex hormones including total testosterone, LH, FSH, and GnRH were detected using radioimmunoassay. The sex ratio was examined by PCR and agarose gel electrophoresis. The results of D0, D21 and D28 showed significant increases compared with sham-exposed groups. The serum testosterone increased significantly in D0, D14, D21, and D28 compared with sham-exposed groups ($p<0.05$). Overall, this study suggested that EMP exposure may lead to the disturbance of reproductive hormone levels and affect the offspring sex ratio.

https://www.ncbi.nlm.nih.gov/pubmed/28735146

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Hore PJ, Mouritsen H. The Radical-Pair Mechanism of Magnetoreception.Annu Rev Biophys. 2016 Jul 5;45:299-344. doi: 10.1146/annurev-biophys-032116-094545.

Abstract

Although it has been known for almost half a century that migratory birds can detect the direction of the Earth's magnetic field, the primary sensory mechanism behind this remarkable feat is still unclear. The leading hypothesis centers on radical pairs-magnetically sensitive chemical intermediates formed by photoexcitation of cryptochrome proteins in the retina. Our primary aim here is to explain the chemical and physical aspects of the radical-pair mechanism to biologists and the biological and chemical aspects to physicists. In doing so, we review the current state of knowledge on magnetoreception mechanisms. We dare to hope that this tutorial will stimulate new interdisciplinary experimental and theoretical work that will shed much-needed additional light on this fascinating problem in sensory biology.

https://www.ncbi.nlm.nih.gov/pubmed/27216936

Bolte P et al. Localisation of the Putative Magnetoreceptive Protein Cryptochrome 1b in the Retinae of Migratory Birds and Homing Pigeons. PLoS One. 2016 Mar 8;11(3):e0147819. doi: 10.1371/journal.pone.0147819.

Abstract

Cryptochromes are ubiquitously expressed in various animal tissues including the retina. Some cryptochromes are involved in regulating circadian activity. Cryptochrome proteins have also been suggested to mediate the primary mechanism in light-dependent magnetic compass orientation in birds. Cryptochrome 1b (Cry1b) exhibits a unique carboxy terminus exclusively found in birds so far, which might be indicative for a specialised function. Cryptochrome 1a (Cry1a) is so far the only cryptochrome protein that has been localised to specific cell types within the retina of migratory birds. Here we show that Cry1b, an alternative splice variant of Cry1a, is also expressed in the retina of migratory birds, but it is primarily located in other cell types than Cry1a. This could suggest different functions for the two splice products. Using diagnostic bird-specific antibodies (that allow for a precise discrimination between both proteins), we show that Cry1b protein is found in the retinae of migratory European robins (Erithacus rubecula), migratory Northern Wheatears (Oenanthe oenanthe) and pigeons (Columba livia). In all three species, retinal Cry1b is localised in cell types which have been discussed as potentially well suited locations for magnetoreception: Cry1b is observed in the cytosol of ganglion cells, displaced ganglion cells, and in photoreceptor inner segments. The cytosolic rather than nucleic location of Cry1b in the retina reported here speaks against a circadian clock regulatory function of Cry1b and it allows for the possible involvement of Cry1b in a radical-pair-based magnetoreception mechanism.

https://www.ncbi.nlm.nih.gov/pubmed/26953791

Bazalova O et al. Cryptochrome 2 mediates directional magnetoreception in cockroaches.Proc Natl Acad Sci U S A. 2016 Feb 9;113(6):1660-5. doi: 10.1073/pnas.1518622113.

Abstract

The ability to perceive geomagnetic fields (GMFs) represents a fascinating biological phenomenon. Studies on transgenic flies have provided evidence that photosensitive Cryptochromes (Cry) are involved in the response to magnetic fields (MFs). However, none of the studies tackled the problem of whether the Cry-dependent magnetosensitivity is coupled to the sole MF presence or to the direction of MF vector. In this study, we used gene silencing and a directional MF to show that mammalian-like Cry2 is necessary for a genuine directional response to periodic rotations of the GMF vector in two insect species. Longer wavelengths of light required higher photon fluxes for a detectable behavioral response, and a sharp detection border was present in the

cyan/green spectral region. Both observations are consistent with involvement of the FADox, FAD(•-) and FADH(-) redox forms of flavin. The response was lost upon covering the eyes, demonstrating that the signal is perceived in the eye region. Immunohistochemical staining detected Cry2 in the hemispherical layer of laminal glia cells underneath the retina. Together, these findings identified the eye-localized Cry2 as an indispensable component and a likely photoreceptor of the directional GMF response. Our study is thus a clear step forward in deciphering the in vivo effects of GMF and supports the interaction of underlying mechanism with the visual system.

https://www.ncbi.nlm.nih.gov/pubmed/26811445

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World Health Organization, radiofrequency radiation and health - a hard nut to crack (Review)

Hardell L. World Health Organization, radiofrequency radiation and health - a hard nut to crack (Review). International Journal of Oncology. Published online on: June 21, 2017. https://doi.org/10.3892/ijo.2017.4046

Abstract

In May 2011 the International Agency for Research on Cancer (IARC) evaluated cancer risks from radiofrequency (RF) radiation. Human epidemiological studies gave evidence of increased risk for glioma and acoustic neuroma. RF radiation was classified as Group 2B, a possible human carcinogen. Further epidemiological, animal and mechanistic studies have strengthened the association. In spite of this, in most countries little or nothing has been done to reduce exposure and educate people on health hazards from RF radiation. On the contrary ambient levels have increased. In 2014 the WHO launched a draft of a Monograph on RF fields and health for public comments. It turned out that five of the six members of the Core Group in charge of the draft are affiliated with International Commission on Non-Ionizing Radiation Protection (ICNIRP), an industry loyal NGO, and thus have a serious conflict of interest. Just as by ICNIRP, evaluation of non-thermal biological effects from RF radiation are dismissed as scientific evidence of adverse health effects in the Monograph. This has provoked many comments sent to the WHO. However, at a meeting on March 3, 2017 at the WHO Geneva office it was stated that the WHO has no intention to change the Core Group.

Open Access Paper: https://www.spandidos-publications.com/10.3892/ijo.2017.4046

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Use of cell phones and brain tumors: a true association?

Mortazavi, S.A.R., Mortazavi, G. & Mortazavi, S.M.J. Letter to the Editor: Use of cell phones and brain tumors: a true association? Neurol Sci (2017). doi:10.1007/s10072-017-3055-x.

Dear Editor:

With great interest, we have read the editorial by Beghi entitled “Use of cell phones and brain tumors: a true association?” that is published in the journal of Neurol Sci 2017 doi: 10.1007/s10072-017-2992-8 [1]. In this article, the author confirms the lack of robust evidence of association between use of cell phones and brain tumors. However, Beghi mentions that absence of evidence does not necessarily mean that there is no any association. The editorial authored by Beghi addresses a very challenging issue. However, this editorial cannot be considered as a good contribution in the field of radiofrequency exposure and cancer. Over the past several years, our team has conducted several studies on the possible association of exposure to radiofrequency electromagnetic fields (RF-EMFs) and adverse health effects. Beghi claims that the findings of case–control studies have not been confirmed by cohort studies “First of all, the positive results of some case–control

studies have not been confirmed by cohort studies. Case–control studies, even when methodologically robust, cannot replace cohort studies in confirming or disproving an association between a given exposure and a disease. ….In this context, none of the cohort studies found an increased risk of brain tumors in people exposed to cell phones." Although what he claims about the advantages of cohort studies seems to be right, his conclusion is problematic. Beghi does not mention that the number of cohort studies conducted on this topic so far is drastically low and all of these studies had some basic limitations. Therefore, the absence of cohort-proven findings does not necessarily mean that there is no detrimental effect. In this light, as free radical formation after exposure to RF-EMF is confirmed in many studies, even without firm conclusions from cohort studies, these exposures should be limited.

Furthermore, Beghi claims that "Second, the increased risk of brain tumors in case–control studies, if proven, is at best modest and, as brain tumors are rare diseases, the total number of tumors appears only slightly increased." It is worth mentioning that a systematic review and meta-analysis recently published by Yang et al. could not find a link between mobile phone use of any duration and the odds of high-grade glioma. However, there was a 2.22 times greater odds of the occurrence of low-grade glioma for long-term mobile phone use (OR = 2.22, 95% CI = 1.69–2.92) [2]. Beghi also claims that a clear dose–response effect has never been confirmed. Over the past several years, our team has conducted several studies on the possible association of RF-EMFs and adverse health effects. Mortazavi et al. have also recently addressed the shortcoming of some of the papers claiming lack of association between exposure to RF-EMF and cancer. They have provided evidence showing that exposure to RF-EMFs, at least at high levels and long durations, can increase the risk of cancer [3]. Substantial evidence now indicates that the current controversy regarding the carcinogenesis of RF-EMFs might be caused by the lack of accurate information regarding the magnitude of exposure to RF-EMFs which possibly plays a basic role in RF-induced carcinogenesis [4]. We have also provided evidence which shows that, in a similar pattern with ionizing radiation, the carcinogenesis of non-ionizing RF-EMF may have a nonlinear J-shaped dose–response relationship [4].

https://www.ncbi.nlm.nih.gov/pubmed/28689225

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Use of mobile and cordless phones and change in cognitive function: a prospective cohort analysis of Australian primary school children

Bhatt CR, Benke G, Smith CL, Redmayne M, Dimitriadis C, Dalecki A, Macleod S, Sim MR, Croft RJ, Wolfe R, Kaufman J, Abramson MJ Use of mobile and cordless phones and change in cognitive function: a prospective cohort analysis of Australian primary school children. Environ Health. 2017 Jun 19;16(1):62. doi: 10.1186/s12940-017-0250-4.

Abstract

BACKGROUND: Some previous studies have suggested an association between children's use of mobile phones (MPs)/cordless phones (CPs) and development of cognitive function. We evaluated possible longitudinal associations between the use of MPs and CPs in a cohort of primary school children and effects on their cognitive function.

METHODS: Data on children's socio-demographics, use of MPs and CPs, and cognitive function were collected at baseline (2010-2012) and follow-up (2012-2013). Cognitive outcomes were evaluated with the CogHealth™ test battery and Stroop Color-Word test. The change in the number of MP/CP voice calls weekly from baseline to follow-up was dichotomized: "an increase in calls" or a "decrease/no change in calls". Multiple linear regression analyses, adjusting for confounders and clustering by school, were performed to evaluate the associations between the change in cognitive outcomes and change in MP and CP exposures.

RESULTS: Of 412 children, a larger proportion of them used a CP (76% at baseline and follow-up), compared to a MP (31% at baseline and 43% at follow-up). Of 26 comparisons of changes in cognitive outcomes, four

demonstrated significant associations. The increase in MP usage was associated with larger reduction in response time for response inhibition, smaller reduction in the number of total errors for spatial problem solving and larger increase in response time for a Stroop interference task. Except for the smaller reduction in detection task accuracy, the increase in CP usage had no effect on the changes in cognitive outcomes.

CONCLUSION: Our study shows that a larger proportion of children used CPs compared to MPs. We found limited evidence that change in the use of MPs or CPs in primary school children was associated with change in cognitive function.

https://www.ncbi.nlm.nih.gov/pubmed/28629417

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Patterns of cellular phone use among young people in 12 countries: Implications for RF exposure

Langer CE, de Llobet P, Dalmau A, Wiart J, Goedhart G, Hours M, et al. (32 authors). Patterns of cellular phone use among young people in 12 countries: Implications for RF exposure. Environ Int. 2017 Jun 29;107:65-74. doi: 10.1016/j.envint.2017.06.002.

Highlights

• Number and duration of calls varied by sex, age range, and socioeconomic status
• Laterality and hands-free use were less influenced by user characteristics
• Country of origin explained most of the variance in number and duration of calls, as well as SMS and data/Wi-Fi

Abstract

Characterizing exposure to radiofrequency (RF) fields from wireless telecommunications technologies during childhood and adolescence is a research priority in investigating the health effects of RF. The Mobi-Expo study aimed to describe characteristics and determinants of cellular phone use in 534 young people (10-24years) in 12 countries. The study used a specifically designed software application installed on smartphones to collect data on the use of wireless telecommunications devices within this age group. The role of gender, age, maternal education, calendar period, and country was evaluated through multivariate models mutually adjusting for all variables. Call number and duration were higher among females compared to males (geometric mean (GM) ratio 1.17 and 1.42, respectively), among 20-24year olds compared to 10-14year olds (GM ratio 2.09 and 4.40, respectively), and among lowest compared to highest social classes (GM ratio 1.52 and 1.58, respectively). The number of SMS was higher in females (GM ratio 1.46) and the middle age group (15-19year olds: GM ratio 2.21 compared to 10-14year olds) and decreased over time. Data use was highest in the oldest age group, whereas Wi-Fi use was highest in the middle age group. Both data and Wi-Fi use increased over time. Large differences in the number and duration of calls, SMS, and data/Wi-Fi use were seen by country, with country and age accounting for up to 50% of the variance. Hands-free and laterality of use did not show significant differences by sex, age, education, study period, or country. Although limited by a convenience sample, these results provide valuable insights to the design, analysis, and interpretation of future epidemiological studies concerning the health effects of exposure resulting from cellular phone use in young people. In addition, the information provided by this research may be used to design strategies to minimize RF exposure.

https://www.ncbi.nlm.nih.gov/pubmed/28668725

Excerpts

Participants made on average 30.6 calls per week (median 20.9) and spent 60.8 min per week making or receiving calls (median 34.3; Table 2).

A total of 248 (46.4%) subjects had usable data for laterality. For these participants, 18.8% of total call time was “hands-free” on average (median 10.6%), i.e. using the speaker phone, a hands-free kit, or holding the phone away from the head (Table 2). Out of the total call time near the head (not “hands-free”), participants used the phone on the right side of the head in 63.8% of the time on average (median 70.8% - Table 2). With respect to gender, there was no statistically significant difference between males and females for hands-free usage, although females tended to speak somewhat less on their right-hand side (68% in males versus 61% in females, adj OR 0.75; 95% CI 0.54, 1.03).

Overall, UMTS (3G) was the most commonly used communication protocol with 37% of voice calls occurring using UMTS. HSDPA (3G transitional) was the next most common, with 32% of voice calls. UMTS was the most common communication protocol in Canada, France, Greece, Italy, and The Netherlands (80%, 30%, 36%, 41%, and 55%, respectively) (Fig. 2). In contrast, HSDPA was the most common network in Australia, Germany, Israel, Japan, New Zealand, and Spain (69%, 36%, 68%, 51%, 46%, and 33%, respectively). The most common network in Korea was “other” (43%). GPRS and EDGE (both 2G transitional) were not commonly used in any of the countries during our study period; use ranged from 0% (Japan and Korea) to 32% (The Netherlands) GPRS and 22% (France and Germany) EDGE, respectively.

In comparison with our findings, CEFALO, a study among 7–19 year old children and adolescents investigating possible associations between cellular phone use and brain tumors, had a much lower level of phone use among controls during a period from early 2004 through mid-2008 (Aydin et al., 2011). The top quartile of controls had a cumulative lifetime use of 2638 calls and 144 h spent on voice calls. Using the mean number and duration of calls, it would take the participants in our study less than three years to reach the lifetime use of the highest quartile of CEFALO controls.

First, the handset is not near the head for the full call duration, but rather for about 83% of the time. In addition to intentional hands-free device or speaker phone usage, this is explained by other hands-free use such as answering and ending a call. Furthermore, the time spent with the phone on one side of the head was not as high as the 90% assigned to the self-reported predominant side within the RF dose algorithm used in the INTERPHONE study (Cardis et al., 2011a), but that was a study of older adults.

A major limitation of this study is that it is a convenience sample, limiting the generalizability of the results. Given that most of the volunteers were found through friends and/or colleagues of the research team, the education level and in turn socioeconomic status is likely higher than that of the general population.

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Functional brain MRI in patients complaining of EHS after long term exposure to EMF

Heuser G, Heuser SA. Functional brain MRI in patients complaining of electrohypersensitivity after long term exposure to electromagnetic fields. Rev Environ Health. 2017 Jul 5.

Abstract

INTRODUCTION: Ten adult patients with electromagnetic hypersensitivity underwent functional magnetic resonance imaging (fMRI) brain scans. All scans were abnormal with abnormalities which were consistent and similar. It is proposed that fMRI brain scans be used as a diagnostic aid for determining whether or not a patient has electromagnetic hypersensitivity. Over the years we have seen an increasing number of patients who had developed multi system complaints after long term repeated exposure to electromagnetic fields (EMFs). These complaints included headaches, intermittent cognitive and memory problems, intermittent disorientation, and also sensitivity to EMF exposure. Regular laboratory tests were within normal limits in these patients. The patients refused to be exposed to radioactivity. This of course ruled out positron emission tomography (PET) and single-photon emission computed tomography (SPECT) brain scanning. This is why we ordered fMRI brain scans on these patients. We hoped that we could document objective abnormalities in

these patients who had often been labeled as psychiatric cases.

MATERIALS AND METHODS: Ten patients first underwent a regular magnetic resonance imaging (MRI) brain scan, using a 3 Tesla Siemens Verio MRI open system. A functional MRI study was then performed in the resting state using the following sequences: A three-dimensional, T1-weighted, gradient-echo (MPRAGE) Resting state network. The echo-planar imaging (EPI) sequences for this resting state blood oxygenation level dependent (BOLD) scan were then post processed on a 3D workstation and the independent component analysis was performed separating out the various networks. Arterial spin labeling. Tractography and fractional anisotropy.

RESULTS: All ten patients had abnormal functional MRI brain scans. The abnormality was often described as hyper connectivity of the anterior component of the default mode in the medial orbitofrontal area. Other abnormalities were usually found. Regular MRI studies of the brain were mostly unremarkable in these patients.

CONCLUSION: We propose that functional MRI studies should become a diagnostic aid when evaluating a patient who claims electrohypersensitivity (EHS) and has otherwise normal studies. Interestingly, the differential diagnosis for the abnormalities seen on the fMRI includes head injury. It turns out that many of our patients indeed had a history of head injury which was then followed sometime later by the development of EHS. Many of our patients also had a history of exposure to potentially neurotoxic chemicals, especially mold. Head injury and neurotoxic chemical exposure may make a patient more vulnerable to develop EHS.

https://www.ncbi.nlm.nih.gov/pubmed/28678737

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An off-the-shelf meter for measuring body amperage: A new gold standard for epidemiologic studies?

Milham S. An off-the-shelf meter for measuring body amperage: A new gold standard for epidemiologic studies? Electromagn Biol Med. 2017 Jun 26:1. doi: 10.1080/15368378.2017.1336101.

No Abstract (letter)

https://www.ncbi.nlm.nih.gov/pubmed/28650676

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Effects of folic acid on rat kidney exposed to 900 MHz EMR

Ömür Gülsüm Deniz, Elfide Gizem Kıvrak, Arife Ahsen Kaplan, Berrin Zuhal Altunkaynak. Effects of folic acid on rat kidney exposed to 900 MHz electromagnetic radiation. Journal of Microscopy and Ultrastructure. Available online 17 June 2017.

Highlights

• The kidneys of adult male rats were investigated after exposure to 900-MHz electromagnetic radiation.
• Folic acid exhibited protective effects in the kidney against the side-effects of electromagnetic radiation exposure.
• Changes in volume and numbers of glomeruli in the kidney were analyzed using unbiased stereological methods.

Abstract

Because of increased use of cell phones, the purpose of this study was to investigation of the oxidative damage caused by electromagnetic radiation (EMR) emitted by cell phones and histological and morphometrical determination of the possible protective role of folic acid (FA) in preventing the detrimental effects of EMR on the kidney. Twenty-four adult male Wistar albino rats were divided into control (Cont), EMR, EMR + FA and FA groups, each containing six rats. The EMR and EMR + FA groups were exposed to EMR for 60 min a day over a period of 21 days, while no EMR exposure was applied to the Cont and FA groups. The source of the EMR was an EMR device which emits a digital signal producing 900-MHz frequency radiation. The generator connected to a one-monopole antenna was used in this study and the rats were placed in the plexiglass restrainer at an equal distance from the monopole antenna. Following the experimental period, and after tissue processing, a physical disector-Cavalieri method combination was applied to the sections. The mean volume of the cortex, medulla, proximal and distal tubules increased significantly in the EMR groups compared to the Cont group ($p < 0.01$). Contrarily, the total number of glomeruli in the EMR group decreased compared to the Cont group ($p < 0.01$). The protective effects of FA was observed in the kidney ($p < 0.05$).

In conclusion, the 900-MHz EMR leads to kidney damage. FA may exhibit a protective effect against the adverse effects of EMR exposure in terms of the total number of glomeruli.

http://www.sciencedirect.com/science/article/pii/S2213879X17300500

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Changes in locomotor activity in mice due to low-intensity microwaves amplitude modulated in the EEG spectral domain

Eeghem VV, Arfani AE, Anthoula A, Walrave L, Pourkazemi A, Bentea E, Demuyser T, Smolders I, Stiens J. Selective changes in locomotor activity in mice due to low-intensity microwaves amplitude modulated in the EEG spectral domain. Neuroscience. 2017 Jul 4. pii: S0306-4522(17)30461-X. doi: 10.1016/j.neuroscience.2017.06.056.

Abstract

Despite the numerous benefits of microwave applications in our daily life, microwaves were associated with diverse neurological complaints such as headaches and impaired sleep patterns, and changes in the electroencephalogram (EEG). To which extent microwaves influence the brain function remains unclear. This exploratory study assessed the behavior and neurochemistry in mice immediately or 4 weeks after a 6-day exposure to low-intensity 10 GHz microwaves with an amplitude modulation (AM) of 2 or 8 Hz. These modulation frequencies of 2 and 8 Hz are situated within the delta and theta-alpha frequency bands in the EEG spectrum and are associated with sleep and active behavior, respectively. During these experiments, the specific absorbance rate was 0.3 W/kg increasing the brain temperature with 0.23°C. For the first time, exposing mice to 8 Hz AM significantly reduced locomotor activity in an open field immediately after exposure which normalized after 4 weeks. This in contrast to 2 Hz AM which didn't induce significant changes in locomotor activity immediately and 4 weeks after exposure. Despite this difference in motor behavior, no significant changes in striatal dopamine and DOPAC levels and DOPAC/dopamine turnover nor in cortical glutamate concentrations were detected. In all cases, no effects on motor coordination on a rotarod, spatial working memory, anxiety nor depressive-like behavior were observed. The outcome of this study indicates that exposing mice to low-intensity 8 Hz AM microwaves can alter the locomotor activity in contrast to 2 Hz AM which did not affect the tested behaviors.

https://www.ncbi.nlm.nih.gov/pubmed/28687311

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Influence of RF EMF from 3rd-generation cellular phones on fertilization and embryo development in mice (W-CDMA study)

Suzuki S, Okutsu M, Suganuma R, Komiya H, Nakatani-Enomoto S, Kobayashi S, Ugawa Y, Tateno H, Fujimori K.Influence of radiofrequency-electromagnetic waves from 3rd-generation cellular phones on fertilization and embryo development in mice. Bioelectromagnetics. 2017 Jun 19. doi: 10.1002/bem.22063.

Abstract

The purpose of this study was to evaluate the effects of 3rd-generation (3G) cellular phone radiofrequency-electromagnetic wave (RF-EMW) exposure on fertilization and embryogenesis in mice. Oocytes and spermatozoa were exposed to 3G cellular phone RF-EMWs, 1.95 GHz wideband code division multiple access, at a specific absorption rate of 2 mW/g for 60 min, or to sham exposure. After RF-EMW exposure, in vitro fertilization and intracytoplasmic sperm injection were performed. Rates of fertilization, embryogenesis (8-cell embryo, blastocyst), and chromosome aberration were compared between the combined spermatozoa and oocyte groups: both exposed, both non-exposed, one exposed, and the other non-exposed. Rates of fertilization, embryogenesis, and blastocyst formation did not change significantly across the four groups. Considering that the degree of exposure in the present study was ≥100 times greater than daily exposure of human spermatozoa and even greater than daily exposure of oocytes, the present results indicate safety of RF-EMW exposure in humans.

https://www.ncbi.nlm.nih.gov/pubmed/28628221

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The Effects of Exposure to Low Frequency EMF on Male Fertility

Darbandi M, Darbandi S, Agarwal A, Henkle R, Sadeghi MR. The Effects of Exposure to Low Frequency Electromagnetic Fields on Male Fertility. Altern Ther Health Med. 2017 Jun 23. pii: AT5423.

Abstract

Context • People are increasingly exposed to low frequency (LF) electromagnetic fields (EMFs), mainly from electricity distribution networks and electronic devices. Critics of this widespread exposure believe that it can have detrimental effects on the human body. On the other hand, many in vivo and in vitro studies have claimed that low frequency electromagnetic therapy can function as a form of alternative medicine and that therapists can treat disease by applying electromagnetic radiation or pulsed EMFs to the body or cells. It is not yet entirely clear, however, whether LF-EMF is beneficial or harmful.
Objectives • This study aimed to examine the effects of LF-EMFs on men's reproductive functions, according to the types of waveform and the frequency and duration of exposure.
Design • The study reviewed all available research, both human and animal, on the effects of LF-EMFs on male reproductive functions, covering the literature from January 1978 to June 2016. The documents were obtained from PubMed, Science Direct, and Google Scholar, and any article that was irrelevant or a duplicate was excluded. A total of 61 articles were found, and 27 articles were reviewed.
Setting • This project was performed at the Avicenna Research Center (Tehran, Iran).
Participants • Literature included human and animal studies conducted on rabbits, mice, rats, and boars.
Intervention • Among these studies, any article that was irrelevant, a duplicate, or published with duplicate data was excluded. At the end, 27 articles were checked.
Outcome Measures • Outcome measures included testing related to reproductive organ weights, reproductive endocrinal hormones, fetal development, and spermatogenesis as well as sperm motility, morphology, and vitality.
Results • The reviewed studies provided contradictory results that were highly dependent on the exposure parameters, such as the shape and frequency of wave, intensity, duration, and timing of the exposure.
Conclusions • LF-EMF at 15 Hz with a peak intensity of 8 Gauss, with a square waveform of 50 Hz frequency and a duration of a few hours or less can have a positive effect on sperm quality, motility, and fertility. Exposures at other frequencies either had no effects on the sperm's performance and quality or held biological

hazard for cells. It appears that there is still little understanding of how EMF affects cellular functions. Therefore, more standardized and controlled studies should be carried out to understand the effects of EMF on the body.

https://www.ncbi.nlm.nih.gov/pubmed/28646801

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Proteomic Analysis of the Effect of ELF-EMF With Different Intensities in SH-SY5Y Neuroblastoma Cell Line

Rezaie-Tavirani M, Hasanzadeh H, Seyyedi S, Zali H.Proteomic Analysis of the Effect of Extremely Low-Frequency Electromagnetic Fields (ELF-EMF) With Different Intensities in SH-SY5Y Neuroblastoma Cell Line.J Lasers Med Sci. 2017 Spring;8(2):79-83. doi: 10.15171/jlms.2017.14.

Abstract

Introduction: During the last 3 decades, human is exposed to extremely low frequency electromagnetic fields (ELF-EMF) emitted by power lines and electronic devices. It is now well accepted that ELF-EMF are able to produce a variety of biological effects, although the molecular mechanism is unclear and controversial. Investigation of different intensities effects of 50 Hz ELF-EMF on cell morphology and protein expression is the aim of this study.
Methods: SH-SY5Y human neuroblastoma cell line was exposed to 0.5 and 1 mT 50 Hz (ELF-EMF) for 3 hours. Proteomics techniques were used to determine the effects of these fields on protein expression. Bioinformatic and statistical analysis of proteomes were performed using Progensis SameSpots software.
Results: Our results showed that exposure to ELF-EMF changes cell morphology and induces a dose-dependent decrease in the proliferation rate of the cells. The proteomic studies and bioinformatic analysis indicate that exposure to 50 Hz ELF-EMF leads to alteration of cell protein expression in both dose-dependent and intensity dependent manner, but the later is more pronounced.
Conclusion: Our data suggests that increased intensity of ELF-EMF may be associated with more alteration in cell protein expression, as well as effect on cell morphology and proliferation

https://www.ncbi.nlm.nih.gov/pubmed/28652900

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The bee, the flower, and the electric field: electric ecology and aerial electroreception

Clarke D, Morley E, Robert D. The bee, the flower, and the electric field: electric ecology and aerial electroreception. J Comp Physiol A Neuroethol Sens Neural Behav Physiol. 2017 Jun 24. doi: 10.1007/s00359-017-1176-6.

Abstract

Bees and flowering plants have a long-standing and remarkable co-evolutionary history. Flowers and bees evolved traits that enable pollination, a process that is as important to plants as it is for pollinating insects. From the sensory ecological viewpoint, bee-flower interactions rely on senses such as vision, olfaction, humidity sensing, and touch. Recently, another sensory modality has been unveiled; the detection of the weak electrostatic field that arises between a flower and a bee. Here, we present our latest understanding of how these electric interactions arise and how they contribute to pollination and electroreception. Finite-element modelling and experimental evidence offer new insights into how these interactions are organised and how they can be further studied. Focusing on pollen transfer, we deconstruct some of the salient features of the three ingredients that enable electrostatic interactions, namely the atmospheric electric field, the capacity of bees to accumulate positive charge, and the propensity of plants to be relatively negatively charged. This

article also aims at highlighting areas in need of further investigation, where more research is required to better understand the mechanisms of electrostatic interactions and aerial electroreception.

https://www.ncbi.nlm.nih.gov/pubmed/28647753

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Biological effects related to geomagnetic activity and possible mechanisms

Krylov VV. Biological effects related to geomagnetic activity and possible mechanisms. Bioelectromagnetics. 2017 Jun 21. doi: 10.1002/bem.22062. [Epub ahead of print]

Abstract

This review presents contemporary data on the biological effects of geomagnetic activity. Correlations between geomagnetic indices and biological parameters and experimental studies that used simulated geomagnetic storms to detect possible responses of organisms to these events in nature are discussed. Possible mechanisms by which geomagnetic activity influences organisms are also considered. Special attention is paid to the idea that geomagnetic activity is perceived by organisms as a disruption of diurnal geomagnetic variation. This variation, in turn, is viewed by way of a secondary zeitgeber for biological circadian rhythms. Additionally, we discuss the utility of cryptochrome as a biological detector of geomagnetic storms. The possible involvement of melatonin and protein coding by the CG8198 gene in the biological effects of geomagnetic activity are discussed. Perspectives for studying mechanisms by which geomagnetic storms affect organisms are suggested.

https://www.ncbi.nlm.nih.gov/pubmed/28636777

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Mobile phone use and risk for intracranial tumors and salivary gland tumors - A meta-analysis

Bortkiewicz A, Gadzicka E, Szymczak W. Mobile phone use and risk for intracranial tumors and salivary gland tumors - A meta-analysis. Int J Occup Med Environ Health. 2017 Feb 21;30(1):27-43. doi: 10.13075/ijomeh.1896.00802. Epub 2017 Feb 13.

Abstract

Results of epidemiological studies on the association between use of mobile phone and brain cancer are ambiguous, as well as the results of 5 meta-analysis studies published to date. Since the last meta-analysis (2009), new case-control studies have been published, which theoretically could affect the conclusions on this relationship. Therefore, we decided to perform a new meta-analysis. We conducted a systematic review of multiple electronic data bases for relevant publications. The inclusion criteria were: original papers, case-control studies, published till the end of March 2014, measures of association (point estimates as odds ratio and confidence interval of the effect measured), data on individual exposure. Twenty four studies (26 846 cases, 50 013 controls) were included into the meta-analysis. A significantly higher risk of an intracranial tumor (all types) was noted for the period of mobile phone use over 10 years (odds ratio (OR) = 1.324, 95% confidence interval (CI): 1.028-1.704), and for the ipsilateral location (OR = 1.249, 95% CI: 1.022-1.526). The results support the hypothesis that long-term use of mobile phone increases risk of intracranial tumors, especially in the case of ipsilateral exposure. Further studies are needed to confirm this relationship.

Excerpts

The results obtained in the random effects model indicated that there was a significant relationship between mobile phone use for longer than 10 years and the risk of intracranial tumors (OR = 1.46, 95% CI: 1.07–1.98).

Because OR is significantly greater than 1 (OR = 1.25, 95% CI: 1.04–1.52), we can conclude that there is a significant relationship between the time from the first regular use of mobile phone of 10 years or more and the risk of intracranial tumors.

Since OR is greater than 1 (OR = 1.29, 95% CI: 1.06–1.57), there is a significant relationship between ipsilateral use of mobile phone and the risk of intracranial tumor.

We found a significant relationship between:
— all intracranial tumors and all phone types; ipsilateral exposure;
— all intracranial tumors and all phone types, when the time of mobile phone use was not shorter than 10 years;
— all intracranial tumors and all phone types when the time from the first regular use of mobile phone was 10 years or more.

We are not able to compare our results with reference to different kinds of intracranial tumors (glioma, meningioma, acoustic neuroma) in relation to time of using mobile phones. A reliable analysis was not feasible because, in our opinion, the number of original works is too small.

Conclusions
Our results support the hypothesis that long-term (over 10 years) use of mobile phones increases the risk of intracranial tumors, especially in the case of ipsilateral exposure. The same conclusions are valid for the work by Davis et al. (2013) [45], who reviewed papers on the association between the use of wireless (mobile and cordless) phones and intracranial tumors. Those authors stress that the risk of tumors in people who have used the phone for periods longer than 10 years is significantly elevated. In people who had started using the phone on a regular basis before they were 20 years old, the risk of ipsilateral glioma was found to be fourfold higher. Hardell et al. (2013) [46] stress the significance of the “lifetime exposure dose.” For an exposure of ≥ 1640 h, the risk of ipsilateral acoustic neuroma is 2.55 (95% CI: 1.5–4.4).

These results are in concordance with the conclusion of the expert panel for the International Agency for Research on Cancer (IARC), that cell phones are possibly carcinogenic (Group 2B) [47]. More research is needed to confirm that electromagnetic fields emitted by mobile phones are carcinogenic to humans.

Open Access Paper: http://bit.ly/2m8Amwt

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Mobile phone use and risk of brain tumours: a systematic review of association between study quality, source of funding, and research outcomes

Prasad M, Kathuria P, Nair P, Kumar A, Prasad K. Mobile phone use and risk of brain tumours: a systematic review of association between study quality, source of funding, and research outcomes. Neurol Sci. 2017 Feb 17. doi: 10.1007/s10072-017-2850-8. [Epub ahead of print]

Abstract

Mobile phones emit electromagnetic radiations that are classified as possibly carcinogenic to humans. Evidence for increased risk for brain tumours accumulated in parallel by epidemiologic investigations remains controversial. This paper aims to investigate whether methodological quality of studies and source of funding can explain the variation in results. PubMed and Cochrane CENTRAL searches were conducted from 1966 to December 2016, which was supplemented with relevant articles identified in the references. Twenty-two case control studies were included for systematic review. Meta-analysis of 14 case-control studies showed

practically no increase in risk of brain tumour [OR 1.03 (95% CI 0.92-1.14)]. However, for mobile phone use of 10 years or longer (or >1640 h), the overall result of the meta-analysis showed a significant 1.33 times increase in risk. The summary estimate of government funded as well as phone industry funded studies showed 1.07 times increase in odds which was not significant, while mixed funded studies did not show any increase in risk of brain tumour. Metaregression analysis indicated that the association was significantly associated with methodological study quality ($p < 0.019$, 95% CI 0.009-0.09). Relationship between source of funding and log OR for each study was not statistically significant ($p < 0.32$, 95% CI 0.036-0.010). We found evidence linking mobile phone use and risk of brain tumours especially in long-term users (≥10 years). Studies with higher quality showed a trend towards high risk of brain tumour, while lower quality showed a trend towards lower risk/protection.

https://www.ncbi.nlm.nih.gov/pubmed/28213724

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Non-ionizing radiation (NIR): Evaluating safety

Martin Blank. Non-ionizing radiation (NIR): Evaluating safety. Environmental Pollution. 222:153. March 2017. http://dx.doi.org/10.1016/j.envpol.2016.12.063.

No Abstract.

Excerpt

... the divisions of the EM spectrum were created by engineers and physicists who set frequency boundaries that did not take biological factors into account. It is clear that stress protein synthesis is stimulated across the ranges of the spectrum. If the public is to be protected, safety standards should be based on measurable properties that relate to protective biological mechanisms, rather than the less sensitive thermal criterion.

http://www.sciencedirect.com/science/article/pii/S0269749116328159

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Mobile phone types and SAR characteristics of the human brain

Lee AK, Hong SE, Kwon JH, Choi HD, Cardis E. Mobile phone types and SAR characteristics of the human brain.Phys Med Biol. 2017 Mar 7;62(7):2741-2761. doi: 10.1088/1361-6560/aa5c2d. [Epub ahead of print]

Abstract

Mobile phones differ in terms of their operating frequency, outer shape, and form and location of the antennae, all of which affect the spatial distributions of their electromagnetic field and the level of electromagnetic absorption in the human head or brain. For this paper, the specific absorption rate (SAR) was calculated for four anatomical head models at different ages using 11 numerical phone models of different shapes and antenna configurations. The 11 models represent phone types accounting for around 86% of the approximately 1400 commercial phone models released into the Korean market since 2002. Seven of the phone models selected have an internal dual-band antenna, and the remaining four possess an external antenna. Each model was intended to generate an average absorption level equivalent to that of the same type of commercial phone model operating at the maximum available output power. The 1 g peak spatial SAR and ipsilateral and contralateral brain-averaged SARs were reported for all 11 phone models. The effects of the phone type, phone position, operating frequency, and age of head models on the brain SAR were comprehensively determined.

https://www.ncbi.nlm.nih.gov/pubmed/28267685

Excerpts

Both the psSAR in the brain and the brain hemisphere-averaged SAR were analyzed for the four anatomical head models and 11 representative phone models. The head models used are Eartha and Billie (8 and 11 year-old females), and Louis and Duke (14 and 34 year-old males) from IT'IS. The 11 phone models include bar, slider, and flip types operating at 835 and 1850
MHz (1765 MHz for some of the flip-type models) ....

• Phone positions and SAR. The gap in the psSAR between the cheek and tilt positions is small in the brain compared to that in the SAM phantom. Flip-type phone models with an external antenna (M8h, M8w, M9h, and M9w) generated higher SAR levels at the left position than at the right position for both frequencies.
• Frequency and SAR. Both the psSAR and the brain hemisphere-averaged SAR are higher at low frequency (835 MHz) than at high frequency (1850 or 1765 MHz). This seems to be because the electromagnetic energy penetrates deeper and is deposited in a larger 'hot spot' area at lower frequency.
• Phone types and SAR. ...The closer the antenna is located to the receiver of the phone, the higher the SAR that seems to appear in the brain. The variability in the psSAR in the brain is much higher between the different phone types than between the different head models. It suggests that it is crucial for study subjects to report exact information on the phone models used for proper exposure assessments in epidemiological studies.
• Laterality of brain hemisphere-averaged SAR. The contralateral brain-averaged SAR level of some models such as M7 and M8 at low frequency is comparable to their ipsilateral brain-averaged SAR at high frequency.
• Age-related changes in SAR. Both the psSAR (tables 2 and 3) and the brain hemisphere-averaged SAR (figures 11 and 12) seem to be strongly influenced by the distance between the head (or auricle) surface and the surface of the temporal lobe of the brain; the temporal lobe of Eartha is the farthest away from the phone body out of all of head models, and Eartha showed the lowest 1 g psSAR and lowest ipsilateral brain-averaged SAR for most of the cases considered. Overall, the variability in the brain SAR of the four head models in this study did not form a consistent pattern with age.

It is impossible to obtain the proper amount of global information regarding the outer shape, antenna location, operating frequency, and detailed SAR values because the SAR-compliance process for mobile phones varies by country. The phone models used in this paper cover the phone types of around 86% of all commercial models released onto the Korean market
since 2002. The closer the antenna is located to the receiver of the phone, the higher the SAR is generally produced in the human brain. The maximum difference in psSAR in the brain between the numerical phone models amounted to around 12 dB. The results suggest that it is very important for all subjects to report exact information on the phone models they use if
accurate exposure levels are to be obtained in epidemiological studies ....

The issue of whether children are more sensitive to EMF emitted from mobile phones has been a hot topic among many researchers over the past two decades. In this study, a maximum psSAR variability of 5.6 dB was shown between the four head models, but was not dependent on age. To generate representative head models, the anatomical morphology of the human head at different ages and for both genders is being statistically investigated using MR images of hundreds of Koreans from early childhood to adult. The resultant statistical figures will become the foundation for detecting age-related influences on the SAR.
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On the averaging area for incident power density for human exposure limits at frequencies over 6 GHz

Hashimoto Y, Hirata A, Morimoto R, Aonuma S, Laakso I, Jokela K, Foster K. On the averaging area for incident power density for human exposure limits at frequencies over 6 GHz. Phys Med Biol. 2017 Feb 8. doi: 10.1088/1361-6560/aa5f21.

Abstract

Incident power density is used as the dosimetric quantity to specify the restrictions on human exposure to

electromagnetic fields at frequencies above 3 or 10 GHz in order to prevent excessive temperature elevation at the body surface. However, international standards and guidelines have different definitions for the size of the area over which the power density should be averaged. This study reports computational evaluation of the relationship between the size of the area over which incident power density is averaged and the local peak temperature elevation in a multi-layer model simulating a human body. Three wave sources are considered in the frequency range from 3 to 300 GHz: an ideal beam, a half-wave dipole antenna, and an antenna array. One-dimensional analysis shows that averaging area of 20 mm × 20 mm is a good measure to correlate with the local peak temperature elevation when the field distribution is nearly uniform in that area. The averaging area is different from recommendations in the current international standards/guidelines, and not dependent on the frequency. For a non-uniform field distribution, such as a beam with small diameter, the incident power density should be compensated by multiplying a factor that can be derived from the ratio of the effective beam area to the averaging area. The findings in the present study suggest that the relationship obtained using the one-dimensional approximation is applicable for deriving the relationship between the incident power density and the local temperature elevation.

https://www.ncbi.nlm.nih.gov/pubmed/28176675

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A Technical Approach to the Evaluation of Radiofrequency Radiation Emissions from Mobile Telephony Base Stations

Buckus R, Strukčinskienė B, Raistenskis J, Stukas R, Šidlauskienė A, Čerkauskienė R, Isopescu DN, Stabryla J, Cretescu I. A Technical Approach to the Evaluation of Radiofrequency Radiation Emissions from Mobile Telephony Base Stations. Int J Environ Res Public Health. 2017 Mar 1;14(3). pii: E244. doi: 10.3390/ijerph14030244.

Abstract

During the last two decades, the number of macrocell mobile telephony base station antennas emitting radiofrequency (RF) electromagnetic radiation (EMR) in residential areas has increased significantly, and therefore much more attention is being paid to RF EMR and its effects on human health. Scientific field measurements of public exposure to RF EMR (specifically to radio frequency radiation) from macrocell mobile telephony base station antennas and RF electromagnetic field (EMF) intensity parameters in the environment are discussed in this article. The research methodology is applied according to the requirements of safety norms and Lithuanian Standards in English (LST EN). The article presents and analyses RF EMFs generated by mobile telephony base station antennas in areas accessible to the general public. Measurements of the RF electric field strength and RF EMF power density were conducted in the near- and far-fields of the mobile telephony base station antenna. Broadband and frequency-selective measurements were performed outside (on the roof and on the ground) and in a residential area. The tests performed on the roof in front of the mobile telephony base station antennas in the near-field revealed the presence of a dynamic energy interaction within the antenna electric field, which changes rapidly with distance. The RF EMF power density values on the ground at distances of 50, 100, 200, 300, 400, and 500 m from the base station are very low and are scattered within intervals of 0.002 to 0.05 μW/cm². The results were compared with international exposure guidelines (ICNIRP).

https://www.ncbi.nlm.nih.gov/pubmed/28257069

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Effect of Base Transceiver Station waves on some immunological and hematological factors in exposed persons

Taheri M, Roshanaei G, Ghaffari J, Rahimnejad S, Khosroshahi BN, Aliabadi M, Eftekharian MM. The effect of

Base Transceiver Station waves on some immunological and hematological factors in exposed persons. Hum Antibodies. 2017;25(1-2):31-37. doi: 10.3233/HAB-160303.

Abstract

BACKGROUND: Since the number of mobile subscribers has significantly increased in recent years, the installation and deployment of Base Transceiver Station (BTS) antennas sending and receiving signals has become common and inevitable in different regions.

OBJECTIVE: In this study, we have tried to evaluate the effect of the waves on some immunological and hematological parameters in exposed individuals. In this study, the exposed and non-exposed individuals were used as the test and control groups, respectively.

METHODS: The test group was healthy people who resided in the vicinity of the Base Transceiver Station (BTS) antenna and received the maximum of radiation. The control group was selected from the healthy individuals that were matched with the exposed group by age. They resided in a distance of Base Transceiver Station (BTS) antenna and received the minimum of radiation. After stating complete explanations and obtaining the consent, the venous blood samples were taken from them. Then, CBC and the level of cytokines including IL-4, IL-10 and interferon γ were performed on the samples and the results were analyzed by SPSS software.

RESULTS: In the test group, the whole number of white blood cells, the level of hematocrit, percent of monocytes, eosinophils and basophils were significantly lower than the control group. The number of red blood cells, their average volume and the mean concentration of hemoglobin were notably higher than the controls. There was not observed a significant difference between the two groups in hemoglobin, its mean concentration, platelet count, percent of lymphocytes and neutrophils as well as serum levels of cytokines IL-4, IL-10 and interferon γ .

CONCLUSIONS: It seems that radiation of mobile phone antennas influenced the blood and immune systems, but further study should be done to exactly determine the targets.

https://www.ncbi.nlm.nih.gov/pubmed/27911288

Also see: http://bit.ly/1cXH1B4

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A study on the effect of prolonged mobile phone use on pure tone audiometry thresholds of medical students of Sikkim

Das S, Chakraborty S, Mahanta B. A study on the effect of prolonged mobile phone use on pure tone audiometry thresholds of medical students of Sikkim. J Postgrad Med. 2017 Mar 3. doi: 10.4103/0022-3859.201419. [Epub ahead of print]

Abstract

INTRODUCTION: Mobile phones have become indispensable for daily activities, and people are exposed to them from an early age. There is, however, concern about the harmful effect of the electromagnetic radiation emitted from the mobile phones.

OBJECTIVE: The objective of the study was to study the effect of mobile phone on average pure tone audiometry (PTA) threshold of the person and to study the changes in the pure tone threshold at high frequencies such as 2 kHz, 4 kHz, and 8 kHz among the students with prolonged exposure to mobile phones.

METHODOLOGY: A cross-sectional study was conducted among the medical students who have been using mobile phones for the past 5 years. The effect of mobile phones on the PTA threshold in the exposed ear and the nonexposed ear was assessed.

RESULTS: The study shows that there is a significant difference in average air conduction (AC) and bone conduction (BC) hearing threshold among the exposed and the nonexposed ears ($P < 0.05$). A significant rise of both AC and BC threshold at individual frequencies between the exposed and the nonexposed ear is also noted in this study.

CONCLUSION: The study conducted shows changes in the hearing threshold of the exposed ear when compared with the nonexposed ear. There are however lot of unanswered questions which provide an interesting avenue for further research. Till concrete evidence is available the only feasible way to control its exposure is to limit the duration of usage of mobile phones.

https://www.ncbi.nlm.nih.gov/pubmed/28272071

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RF EMR from cell phone causes defective testicular function in male Wistar rats

Oyewopo AO, Olaniyi SK, Oyewopo CI, Jimoh AT. Radiofrequency electromagnetic radiation from cell phone causes defective testicular function in male Wistar rats. Andrologia. 2017 Mar 6. doi: 10.1111/and.12772. [Epub ahead of print]

Abstract

Cell phones have become an integral part of everyday life. As cell phone usage has become more widespread, concerns have increased regarding the harmful effects of radiofrequency electromagnetic radiation from these devices. The current study was undertaken to investigate the effects of the emitted radiation by cell phones on testicular histomorphometry and biochemical analyses. Adult male Wistar rats weighing 180-200 g were randomly allotted to control, group A (switched off mode exposure), group B (1-hr exposure), group C (2-hr exposure) and group D (3-hr exposure). The animals were exposed to radiofrequency electromagnetic radiation of cell phone for a period of 28 days. Histomorphometry, biochemical and histological investigations were carried out. The histomorphometric parameters showed no significant change ($p < .05$) in the levels of germinal epithelial diameter in all the experimental groups compared with the control group. There was no significant change ($p < .05$) in cross-sectional diameter of all the experimental groups compared with the control group. Group D rats showed a significant decrease ($p < .05$) in lumen diameter compared with group B rats. There was an uneven distribution of germinal epithelial cells in groups B, C and D. However, there was degeneration of the epithelia cells in group D when compared to the control and group B rats. Sera levels of malondialdehyde (MDA) and superoxide dismutase (SOD), which are markers of reactive oxygen species, significantly increased (MDA) and decreased (SOD), respectively, in all the experimental groups compared with the control group. Also sera levels of gonadotropic hormones (FSH, LH and testosterone) significantly decreased ($p < .05$) in groups C and D compared with the control group. The study demonstrates that chronic exposure to radiofrequency electromagnetic radiation of cell phone leads to defective testicular function that is associated with increased oxidative stress and decreased gonadotropic hormonal profile.

https://www.ncbi.nlm.nih.gov/pubmed/28261838

Also see: http://www.saferemr.com/2015/09/effect-of-mobile-phones-on-sperm.html

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Activation of autophagy at cerebral cortex and apoptosis at brainstem are differential responses to 835 MHz RF-EMF exposure

Kim JH, Yu DH, Kim HR. Activation of autophagy at cerebral cortex and apoptosis at brainstem are differential responses to 835 MHz RF-EMF exposure. Korean J Physiol Pharmacol. 2017 Mar;21(2):179-188. doi: 10.4196/kjpp.2017.21.2.179. Epub 2017 Feb 21.

Abstract

With the explosive increase in exposure to radiofrequency electromagnetic fields (RF-EMF) emitted by mobile phones, public concerns have grown over the last few decades with regard to the potential effects of EMF exposure on the nervous system in the brain. Many researchers have suggested that RF-EMFs can effect diverse neuronal alterations in the brain, thereby affecting neuronal functions as well as behavior. Previously, we showed that long-term exposure to 835 MHz RF-EMF induces autophagy in the mice brain. In this study, we explore whether short-term exposure to RF-EMF leads to the autophagy pathway in the cerebral cortex and brainstem at 835 MHz with a specific absorption rate (SAR) of 4.0 W/kg for 4 weeks. Increased levels of autophagy genes and proteins such as LC3B-II and Beclin1 were demonstrated and the accumulation of autophagosomes and autolysosomes was observed in cortical neurons whereas apoptosis pathways were up-regulated in the brainstem but not in the cortex following 4 weeks of RF exposure. Taken together, the present study indicates that monthly exposure to RF-EMF induces autophagy in the cerebral cortex and suggests that autophagic degradation in cortical neurons against a stress of 835 MHz RF during 4 weeks could correspond to adaptation to the RF stress environment. However, activation of apoptosis rather than autophagy in the brainstem is suggesting the differential responses to the RF-EMF stresses in the brain system.

https://www.ncbi.nlm.nih.gov/pubmed/28280411

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RF radiation induced genotoxic and carcinogenic effects on chickpea root tip cells

Sadaf Tabasum Qureshi, Sajjad Ahmed Memon, Abdul Rasool Abassi, Mahboob Ali Sial, Farooque Ali Bughio. Radiofrequency radiations induced genotoxic and carcinogenic effects on chickpea (Cicer arietinum L.) root tip cells. Saudi Journal of Biological Sciences. Published online Feb 11, 2017.
http://dx.doi.org/10.1016/j.sjbs.2016.02.011

Abstract

Present study was under taken to predict the possible DNA damages (genotoxicity) and carcinogenicity caused by radiofrequency radiations (RF) to living tissue. Dry seeds of chickpea were treated with GSM cell phone (900 MHz) and laptop (3.31 GHz) as RF source for 24 and 48 h. Untreated seeds were used as (0 h) negative control and Gamma rays (250 Gray) as positive control. Plant chromosomal aberration assay was used as genotoxicity marker. All the treatment of RF inhibits seed germination percentage. 48 h laptop treatment has the most negative effect as compared to untreated control. A decrease was observed in mitotic index (M.I) and increase in abnormality index (A.I) with the increase in exposure duration and frequency in (Hz). Cell membrane damages were also observed only in 48 h exposure of cell phone and laptop (RF). Maximum nuclear membrane damages and ghost cells were again recorded in 48 h exposure of cell phone and laptop. The radiofrequency radiations (900 MHz and 3.31 GHz) are only genotoxic as they induce micronuclei, bi-nuclei, multi-nuclei and scattered nuclei but could be carcinogenic as 48 h incubation of RF induced fragmentation and ghost cells. Therefore cell phones and laptop should not be used unnecessarily to avoid possible genotoxic and carcinogenic effects.

Conclusion

It is concluded that radiofrequency radiations are genotoxic as they induced chromosomal aberrations in chickpea mitotic cells and the presence of ghost cells is clear indication of their carcinogenic potential. To avoid reported DNA damages in this work cell phones should always be used either for short duration or with

hands-free for long duration and they should not be kept in pockets or near body. Laptops should not be used unnecessarily for enjoyment purpose. It must be placed on desk top rather lap to minimize their exposure to human body. Further assay of carcinogenity are recommended on mouse and human cell lines.

http://www.sciencedirect.com/science/article/pii/S1319562X16000589

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ELF-MF exposure affects the robustness of epigenetic programming during granulopoiesis

Manser M, Sater MR, Schmid CD, Noreen F, Murbach M, Kuster N, Schuermann D, Schär P. ELF-MF exposure affects the robustness of epigenetic programming during granulopoiesis. Sci Rep. 2017 Mar 7;7:43345. doi: 10.1038/srep43345.

Abstract

Extremely-low-frequency magnetic fields (ELF-MF) have been classified as "possibly carcinogenic" to humans on the grounds of an epidemiological association of ELF-MF exposure with an increased risk of childhood leukaemia. Yet, underlying mechanisms have remained obscure. Genome instability seems an unlikely reason as the energy transmitted by ELF-MF is too low to damage DNA and induce cancer-promoting mutations. ELF-MF, however, may perturb the epigenetic code of genomes, which is well-known to be sensitive to environmental conditions and generally deranged in cancers, including leukaemia. We examined the potential of ELF-MF to influence key epigenetic modifications in leukaemic Jurkat cells and in human CD34+ haematopoietic stem cells undergoing in vitro differentiation into the neutrophilic lineage. During granulopoiesis, sensitive genome-wide profiling of multiple replicate experiments did not reveal any statistically significant, ELF-MF-dependent alterations in the patterns of active (H3K4me2) and repressive (H3K27me3) histone marks nor in DNA methylation. However, ELF-MF exposure showed consistent effects on the reproducibility of these histone and DNA modification profiles (replicate variability), which appear to be of a stochastic nature but show preferences for the genomic context. The data indicate that ELF-MF exposure stabilizes active chromatin, particularly during the transition from a repressive to an active state during cell differentiation.

https://www.ncbi.nlm.nih.gov/pubmed/28266526

In conclusion, we report that ELF-MF exposure has no significant effect in a deterministic manner on the epigenetic landscapes of leukaemic and differentiating haematopoietic cells. However, our data indicate that ELF-MF exposure may influence the robustness of histone modification and DNA methylation patterning in the course of the global chromatin reorganization associated with neutrophilic differentiation. This, however, did not affect notably the overall dynamics and efficiency of granulopoiesis.

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Spontaneous magnetic alignment behaviour in free-living lizards

Diego-Rasilla FJ, Pérez-Mellado V, Pérez-Cembranos A. Spontaneous magnetic alignment behaviour in free-living lizards. Naturwissenschaften. 2017 Apr;104(3-4):13. doi: 10.1007/s00114-017-1439-7. Epub 2017 Mar 1.

Abstract

Several species of vertebrates exhibit spontaneous longitudinal body axis alignment relative to the Earth's magnetic field (i.e., magnetic alignment) while they are performing different behavioural tasks. Since magnetoreception is still not fully understood, studying magnetic alignment provides evidence for magnetoreception and broadens current knowledge of magnetic sense in animals. Furthermore, magnetic alignment widens the roles of magnetic sensitivity in animals and may contribute to shed new light on

magnetoreception. In this context, spontaneous alignment in two species of lacertid lizards (Podarcis muralis and Podarcis lilfordi) during basking periods was monitored. Alignments in 255 P. muralis and 456 P. lilfordi were measured over a 5-year period. The possible influence of the sun's position (i.e., altitude and azimuth) and geomagnetic field values corresponding to the moment in which a particular lizard was observed on lizards' body axis orientation was evaluated. Both species exhibited a highly significant bimodal orientation along the north-northeast and south-southwest magnetic axis. The evidence from this study suggests that free-living lacertid lizards exhibit magnetic alignment behaviour, since their body alignments cannot be explained by an effect of the sun's position. On the contrary, lizard orientations were significantly correlated with geomagnetic field values at the time of each observation. We suggest that this behaviour might provide lizards with a constant directional reference while they are sun basking. This directional reference might improve their mental map of space to accomplish efficient escape behaviour. This study is the first to provide spontaneous magnetic alignment behaviour in free-living reptiles.

https://www.ncbi.nlm.nih.gov/pubmed/28251303

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Corporate Ties That Bind: An Examination of Corporate Manipulation and Vested Interest in Public Health. Martin J. Walker (Ed.). New York: Skyhorse Publishing. Mar 28, 2017. 24 chapters; 592 pp.

In the 21st century, corporations have worked their way into government and, as they become increasingly more powerful, arguments about their involvement with public health have become increasingly black and white. With corporations at the center of public health and environmental issues, everything chemical or technological is good, everything natural is bad; scientists who are funded by corporations are right and those who are independent are invariably wrong. There is diminishing common ground between the two opposed sides in these arguments.

Corporate Ties that Bind is a collection of essays written by influential academic scholars, activists, and epidemiologists from around the world that scrutinize the corporate reasoning, false science and trickery involving those, like in-house epidemiologists, who mediate the scientific message of organizations who attack and censure independent voices. This book addresses how the growth of corporatism is destroying liberal democracy and personal choice.

Whether addressing asbestos, radiation, PCBs, or vaccine regulation, the essays here address the dangers of trusting corporations and uncover the lengths to which corporations put profits before health.

Foreward: David O. Carpenter

Chapter 3: Lennart Hardell. A Battleground--From Phenoxyacetic Acids, Chlorphenyls and Dioxins to Mobile Phones--Cancer Risks, Greenwashing and Vested Interests

Chapter 10: Christian Blom. Escaping Electrosensitivity.

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Brief Report on the Gaps in the Knowledge about the Health Effects of the RF-EMF Exposures

Leszczynski D. Brief Report on the Gaps in the Knowledge about the Health Effects of the RF-EMF Exposures. unpublished paper. Mar 15, 2017.

https://betweenrockandhardplace.files.wordpress.com/2017/03/brief-report-on-gaps-in-the-knowledge.pdf

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Analysis of mobile phone use among young patients with brain tumors in Japan

Sato Y, Kojimahara N, Yamaguchi N. Analysis of mobile phone use among young patients with brain tumors in Japan. Bioelectromagnetics. 2017 Mar 24. doi: 10.1002/bem.22047.

Abstract

The purpose of this study was to clarify ownership and usage of mobile phones among young patients with brain tumors in Japan. The subjects of this study were patients with brain tumors diagnosed between 2006 and 2010 who were between the ages of 6 and 18 years. The target population for the analysis was 82 patients. Patients were divided into two groups: 16 patients who were mobile phone owners 1 year before diagnosis, and 66 patients who did not own mobile phones (non-owners). Using data on the mobile phone ownership rate obtained from three general-population surveys, we calculated the expected number of mobile phone owners. The three age-adjusted standardized ownership ratios were 0.83 (95% confidence interval [CI]: 0.56-1.22), 0.51 (95% CI: 0.24-1.04), and 0.75 (95% CI: 0.42-1.32). The mobile phone ownership prevalence among the young Japanese patients with brain tumors in the current study does not differ from available estimates for the general population of corresponding age. However, since the use of mobile phones among children is increasing annually, investigations into the health effects of mobile phone use among children should continue.

https://www.ncbi.nlm.nih.gov/pubmed/28342194

Note: This study has some major methodologic limitations including a small sample size. The study did not examine other sources of exposure to RF radiation (e.g., cordless phone use).

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Electronic control of gene expression and cell behaviour in Escherichia coli through redox signalling

Tschirhart T, Kim E, McKay R, Ueda H, Wu HC, Pottash AE, Zargar A, Negrete A, Shiloach J, Payne GF, Bentley WE. Electronic control of gene expression and cell behaviour in Escherichia coli through redox signalling. Nat Commun. 2017 Jan 17;8:14030. doi: 10.1038/ncomms14030.

Abstract

The ability to interconvert information between electronic and ionic modalities has transformed our ability to record and actuate biological function. Synthetic biology offers the potential to expand communication 'bandwidth' by using biomolecules and providing electrochemical access to redox-based cell signals and behaviours. While engineered cells have transmitted molecular information to electronic devices, the potential for bidirectional communication stands largely untapped. Here we present a simple electrogenetic device that uses redox biomolecules to carry electronic information to engineered bacterial cells in order to control transcription from a simple synthetic gene circuit. Electronic actuation of the native transcriptional regulator SoxR and transcription from the PsoxS promoter allows cell response that is quick, reversible and dependent on the amplitude and frequency of the imposed electronic signals. Further, induction of bacterial motility and population based cell-to-cell communication demonstrates the versatility of our approach and potential to drive intricate biological behaviours.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5247576/

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Exposure to radiofrequency radiation emitted from mobile phone jammers adversely affects the quality of human sperm

M.E. Parsanezhad, S.M.J. Mortazavi, T. Doohandeh, B. Namavar Jahromi1, H. Mozdarani, A. Zarei, M. Davari, S. Amjadi,
A. Soleimani, M. Haghani. Exposure to radiofrequency radiation emitted from mobile phone jammers adversely affects the quality of human sperm. International Journal of Radiation Research. 15(1). Jan 2017.

Abstract

Background: The health effect of rapidly increasing everyday exposure of humans to radiofrequency radiation is a major global concern. Mobile phone jammers prevent the mobile phones from receiving signals from base stations by interfering with authorized mobile carriers' services. In spite of the fact that mobile jammer use is illegal, they are occasionally used in offices,
shrines, conference rooms and cinemas. The purpose of this study was to investigate the biological effects of short term exposure of human sperm to radiofrequency radiation emitted from a commercial mobile phone jammer.

Materials and Methods: Fresh semen samples were obtained by masturbation from 50 healthy donors who had referred with their wives to Infertility Treatment Center at the Mother and Child Hospital, Shiraz University of Medical Sciences. Female problem was diagnosed as the reason for infertility in these couples. The semen sample of each participant was divided into 4 aliquots. The first aliquot was subjected to swim-up and exposed to jammer radiation. The second aliquot was not subjected to swimup but was exposed to jammer radiation. The third and fourth aliquots were not exposed to jammer radiation but only the 3rd aliquot was subjected to swim-up.

Results: Semen samples exposed to radiofrequency radiation showed a significant decrease in sperm motility and increase in DNA fragmentation.

Conclusion: Electromagnetic radiation in radiofrequency range emitted from mobile phone jammers may lead to decreased motility and increased DNA fragmentation in human semen. It can be concluded that mobile phone jamming might exert adverse reproductive health effects.

http://bit.ly/2nyVhck

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Pulsed or continuous EMF induce apoptotic signaling pathway in mouse spermatogenic cells in vitro and may affect male fertility

Solek P, Majchrowicz L, Bloniarz D, Krotoszynska E, Koziorowski M. Pulsed or continuous electromagnetic field induce p53/p21-mediated apoptotic signaling pathway in mouse spermatogenic cells in vitro and thus may affect male fertility. Toxicology. 2017 Mar 16. pii: S0300-483X(17)30092-6. doi: 10.1016/j.tox.2017.03.015. [Epub ahead of print]

Abstract

The impact of electromagnetic field (EMF) on the human health and surrounding environment is a common topic investigated over the years. A significant increase in the electromagnetic field concentration arouses public concern about the long-term effects of EMF on living organisms associated with many aspects. In the present study, we investigated the effects of pulsed and continuous electromagnetic field (PEMF/CEMF) on mouse spermatogenic cell lines (GC-1 spg and GC-2 spd) in terms of cellular and biochemical features in vitro. We evaluated the effect of EMF on mitochondrial metabolism, morphology, proliferation rate, viability, cell cycle progression, oxidative stress balance and regulatory proteins. Our results strongly suggest that EMF induces oxidative and nitrosative stress-mediated DNA damage, resulting in p53/p21-dependent cell cycle arrest and apoptosis. Therefore, spermatogenic cells due to the lack of antioxidant enzymes undergo oxidative and

nitrosative stress-mediated cytotoxic and genotoxic events, which contribute to infertility by reduction in healthy sperm cells pool. In conclusion, electromagnetic field present in surrounding environment impairs male fertility by inducing p53/p21-mediated cell cycle arrest and apoptosis.

https://www.ncbi.nlm.nih.gov/pubmed/28323003

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Exposing the G-quadruplex to electric fields: the role played by telomeres in the propagation of DNA errors

Cerón-Carrasco JP, Jacquemin D. Exposing the G-quadruplex to electric fields: the role played by telomeres in the propagation of DNA errors. Phys Chem Chem Phys. 2017 Mar 20. doi: 10.1039/c7cp01034f. [Epub ahead of print]

Abstract

To protect their core machinery from the attack of exogenous agents, cells locate DNA in their nucleus. Nevertheless, some reactive chemical species and physical agents might reach DNA and alter its natural double helix structure. For instance, pulsed electric fields can be used to selectively rewrite the stored genetic information. However, for such modification to be effective, one needs, as a prerequisite, that the replication mechanism is not stopped by the field, so that the changes propagate over the following generations. Here, we use theoretical calculations to demonstrate that while such fields lead to permanent noncanonical Watson-Crick guanine-cytosine (GC) base pairs, the G-quadruplex motifs present in telomeres can more effectively preserve their native forms. Indeed, G-quadruplexes "resist" the perturbations induced by field strengths going up to 60 × 10-4 a.u., a figure constituting the upper limit before the complete destruction of the double helix architecture. Since the induced errors in the DNA base pairs are not transcribed into the telomeres, electric fields can indeed be used as a source of selective mutations in the genetic code.

https://www.ncbi.nlm.nih.gov/pubmed/28317975

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Effect of 1.8 GHz RF EMR on novel object associative recognition memory in mice

Wang K, Lu JM, Xing ZH, Zhao QR, Hu LQ, Xue L, Zhang J, Mei YA. Effect of 1.8 GHz radiofrequency electromagnetic radiation on novel object associative recognition memory in mice. Sci Rep. 2017 Mar 17;7:44521. doi: 10.1038/srep44521.

Abstract

Mounting evidence suggests that exposure to radiofrequency electromagnetic radiation (RF-EMR) can influence learning and memory in rodents. In this study, we examined the effects of single exposure to 1.8 GHz RF-EMR for 30 min on subsequent recognition memory in mice, using the novel object recognition task (NORT). RF-EMR exposure at an intensity of >2.2 W/kg specific absorption rate (SAR) power density induced a significant density-dependent increase in NORT index with no corresponding changes in spontaneous locomotor activity. RF-EMR exposure increased dendritic-spine density and length in hippocampal and prefrontal cortical neurons, as shown by Golgi staining. Whole-cell recordings in acute hippocampal and medial prefrontal cortical slices showed that RF-EMR exposure significantly altered the resting membrane potential and action potential frequency, and reduced the action potential half-width, threshold, and onset delay in pyramidal neurons. These results demonstrate that exposure to 1.8 GHz RF-EMR for 30 min can significantly increase recognition memory in mice, and can change dendritic-spine morphology and neuronal excitability in the hippocampus and prefrontal cortex. The SAR in this study (3.3 W/kg) was outside the range encountered in normal daily life, and its relevance as a potential therapeutic approach for disorders associated with recognition

memory deficits remains to be clarified.

https://www.ncbi.nlm.nih.gov/pubmed/28303965

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Mitochondrial DNA damage and oxidative damage in HL-60 cells exposed to 900MHz RF

Sun Y, Zong L, Gao Z, Zhu S, Tong J, Cao Y. Mitochondrial DNA damage and oxidative damage in HL-60 cells exposed to 900MHz radiofrequency fields. Mutat Res. 2017 Mar 7;797-799:7-14. doi: 10.1016/j.mrfmmm.2017.03.001.

Abstract

HL-60 cells, derived from human promyelocytic leukemia, were exposed to continuous wave 900MHz radiofrequency fields (RF) at 120μW/cm2 power intensity for 4h/day for 5 consecutive days to examine whether such exposure is capable damaging the mitochondrial DNA (mtDNA) mediated through the production of reactive oxygen species (ROS). In addition, the effect of RF exposure was examined on 8-hydroxy-2'-dexoyguanosine (8-OHdG) which is a biomarker for oxidative damage and on the mitochondrial synthesis of adenosine triphosphate (ATP) which is the energy required for cellular functions. The results indicated a significant increase in ROS and significant decreases in mitochondrial transcription factor A, mtDNA polymerase gamma, mtDNA transcripts and mtDNA copy number in RF-exposed cells compared with those in sham-exposed control cells. In addition, there was a significant increase in 8-OHdG and a significant decrease in ATP in RF-exposed cells. The response in positive control cells exposed to gamma radiation (GR, which is also known to induce ROS) was similar to those in RF-exposed cells. Thus, the overall data indicated that RF exposure was capable of inducing mtDNA damage mediated through ROS pathway which also induced oxidative damage. Prior-treatment of RF- and GR-exposed the cells with melatonin, a well-known free radical scavenger, reversed the effects observed in RF-exposed cells.

https://www.ncbi.nlm.nih.gov/pubmed/28340409

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Personal medical electronic devices and walk-through metal detector security systems: assessing EMI effects

Guag J, Addissie B, Witters D. Personal medical electronic devices and walk-through metal detector security systems: assessing electromagnetic interference effects. Biomed Eng Online. 2017 Mar 20;16(1):33. doi: 10.1186/s12938-017-0328-9.

Abstract

BACKGROUND: There have been concerns that Electromagnetic security systems such as walk-through metal detectors (WTMDs) can potentially cause electromagnetic interference (EMI) in certain active medical devices including implantable cardiac pacemakers and implantable neurostimulators. Incidents of EMI between WTMDs and active medical devices also known as personal medical electronic devices (PMED) continue to be reported. This paper reports on emission measurements of sample WTMDs and testing of 20 PMEDs in a WTMD simulation system.

METHODS: Magnetic fields from sample WTMD systems were characterized for emissions and exposure of certain PMEDs. A WTMD simulator system designed and evaluated by FDA in previous studies was used to mimic the PMED exposures to the waveform from sample WTMDs. The simulation system allows for controlled PMED exposure enabling careful study with adjustable magnetic field strengths and exposure duration, and provides flexibility for PMED exposure at elevated levels in order to study EMI effects on the PMED. The

PMED samples consisted of six implantable cardiac pacemakers, six implantable cardioverter defibrillators (ICD), five implantable neurostimulators, and three insulin pumps. Each PMED was exposed in the simulator to the sample WTMD waveforms using methods based on appropriate consensus test standards for each of the device type.

RESULTS: Testing the sample PMEDs using the WTMD simulator revealed EMI effects on two implantable pacemakers and one implantable neurostimulator for exposure field strength comparable to actual WTMD field strength. The observed effects were transient and the PMEDs returned to pre-exposure operation within a few seconds after removal from the simulated WTMD exposure fields. No EMI was observed for the sample ICDs or insulin pumps.

CONCLUSION: The findings are consistent with earlier studies where certain sample PMEDs exhibited EMI effects. Clinical implications were not addressed in this study. Additional studies are needed to evaluate potential PMED EMI susceptibilities over a broader range of security systems.

https://www.ncbi.nlm.nih.gov/pubmed/28320451

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Exposure to EMF from smart utility meters in Great Britain; part I) laboratory measurements

Peyman A, Addison D, Mee T, Goiceanu C, Maslanyj M, Mann S. Exposure to electromagnetic fields from smart utility meters in GB; part I) laboratory measurements. Bioelectromagnetics. 2017 Mar 21. doi: 10.1002/bem.22044. [Epub ahead of print]

Abstract

Laboratory measurements of electric fields have been carried out around examples of smart meter devices used in Great Britain. The aim was to quantify exposure of people to radiofrequency signals emitted from smart meter devices operating at 2.4 GHz, and then to compare this with international (ICNIRP) health-related guidelines and with exposures from other telecommunication sources such as mobile phones and Wi-Fi devices. The angular distribution of the electric fields from a sample of 39 smart meter devices was measured in a controlled laboratory environment. The angular direction where the power density was greatest was identified and the equivalent isotropically radiated power was determined in the same direction. Finally, measurements were carried out as a function of distance at the angles where maximum field strengths were recorded around each device. The maximum equivalent power density measured during transmission around smart meter devices at 0.5 m and beyond was 15 mWm^{-2} , with an estimation of maximum duty factor of only 1%. One outlier device had a maximum power density of 91 mWm^{-2} . All power density measurements reported in this study were well below the 10 $W m^{-2}$

https://www.ncbi.nlm.nih.gov/pubmed/28324620

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The effect of Wi-Fi EMF on object recognition tasks in male rats

Hassanshahi A, Shafeie SA, Fatemi I, Hassanshahi E, Allahtavakoli M, Shabani M, Roohbakhsh A, Shamsizadeh A. The effect of Wi-Fi electromagnetic waves in unimodal and multimodal object recognition tasks in male rats.Neurol Sci. 2017 Mar 22. doi: 10.1007/s10072-017-2920-y. [Epub ahead of print]

Abstract

Wireless internet (Wi-Fi) electromagnetic waves (2.45 GHz) have widespread usage almost everywhere, especially in our homes. Considering the recent reports about some hazardous effects of Wi-Fi signals on the

nervous system, this study aimed to investigate the effect of 2.4 GHz Wi-Fi radiation on multisensory integration in rats. This experimental study was done on 80 male Wistar rats that were allocated into exposure and sham groups. Wi-Fi exposure to 2.4 GHz microwaves [in Service Set Identifier mode (23.6 dBm and 3% for power and duty cycle, respectively)] was done for 30 days (12 h/day). Cross-modal visual-tactile object recognition (CMOR) task was performed by four variations of spontaneous object recognition (SOR) test including standard SOR, tactile SOR, visual SOR, and CMOR tests. A discrimination ratio was calculated to assess the preference of animal to the novel object. The expression levels of M1 and GAT1 mRNA in the hippocampus were assessed by quantitative real-time RT-PCR. Results demonstrated that rats in Wi-Fi exposure groups could not discriminate significantly between the novel and familiar objects in any of the standard SOR, tactile SOR, visual SOR, and CMOR tests. The expression of M1 receptors increased following Wi-Fi exposure. In conclusion, results of this study showed that chronic exposure to Wi-Fi electromagnetic waves might impair both unimodal and cross-modal encoding of information.

https://www.ncbi.nlm.nih.gov/pubmed/28332042

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Assessment of Public Exposure From WLANs in the West Bank-Palestine

Lahham A, Sharabati A, ALMasri H. Assessment of Public Exposure From WLANs in the West Bank-Palestine. Radiat Prot Dosimetry. 2017 Mar 3:1-5. doi: 10.1093/rpd/ncx028.

Abstract

A total of 271 measurements were conducted at 69 different sites including homes, hospitals, educational institutions and other public places to assess the exposure to radiofrequency emission from wireless local area networks (WLANs). Measurements were conducted at different distances from 40 to 10 m from the access points (APs) in real life conditions using Narda SRM-3000 selective radiation meter. Three measurements modes were considered at 1 m distance from the AP which are transmit mode, idle mode, and from the client card (laptop computer). All measurements were conducted indoor in the West Bank environment. Power density levels from WLAN systems were found to vary from 0.001 to ~1.9 μW cm-2 with an average of 0.12 μW cm-2. Maximum value found was in university environment, while the minimum was found in schools. For one measurement case where the AP was 20 cm far while transmitting large files, the measured power density reached a value of ~4.5 μW cm-2. This value is however 221 times below the general public exposure limit recommended by the International Commission on Non-Ionizing Radiation Protection, which was not exceeded in any case. Measurements of power density at 1 m around the laptop resulted in less exposure than the AP in both transmit and idle modes as well. Specific absorption rate for the head of the laptop user was estimated and found to vary from 0.1 to 2 mW/kg. The frequency distribution of measured power densities follows a log-normal distribution which is generally typical in the assessment of exposure resulting from sources of radiofrequency emissions.

https://www.ncbi.nlm.nih.gov/pubmed/28338865

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Effect of acute millimeter wave exposure on dopamine metabolism of NGF-treated PC12 cells

Haas AJ, Le Page Y, Zhadobov M, Sauleau R, Dréan YL, Saligaut C. Effect of acute millimeter wave exposure on dopamine metabolism of NGF-treated PC12 cells. J Radiat Res. 2017 Feb 24:1-7. doi: 10.1093/jrr/rrx004.

Abstract

Several forthcoming wireless telecommunication systems will use electromagnetic frequencies at millimeter waves (MMWs), and technologies developed around the 60-GHz band will soon know a widespread

distribution. Free nerve endings within the skin have been suggested to be the targets of MMW therapy which has been used in the former Soviet Union. So far, no studies have assessed the impact of MMW exposure on neuronal metabolism. Here, we investigated the effects of a 24-h MMW exposure at 60.4 GHz, with an incident power density (IPD) of 5 mW/cm², on the dopaminergic turnover of NGF-treated PC12 cells. After MMW exposure, both intracellular and extracellular contents of dopamine (DA) and 3,4-dihydroxyphenylacetic acid (DOPAC) were studied using high performance liquid chromatography. Impact of exposure on the dopamine transporter (DAT) expression was also assessed by immunocytochemistry. We analyzed the dopamine turnover by assessing the ratio of DOPAC to DA, and measuring DOPAC accumulation in the medium. Neither dopamine turnover nor DAT protein expression level were impacted by MMW exposure. However, extracellular accumulation of DOPAC was found to be slightly increased, but not significantly. This result was related to the thermal effect, and overall, no evidence of non-thermal effects of MMW exposure were observed on dopamine metabolism.

https://www.ncbi.nlm.nih.gov/pubmed/28339776

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SAR Simulations & Safety

Fiedler TM, Ladd ME, Bitz AK. SAR Simulations & Safety. Neuroimage. 2017 Mar 20. pii: S1053-8119(17)30243-4. doi: 10.1016/j.neuroimage.2017.03.035.

Abstract

At ultra-high fields, the assessment of radiofrequency (RF) safety presents several new challenges compared to low-field systems. Multi-channel RF transmit coils in combination with parallel transmit techniques produce time-dependent and spatially varying power loss densities in the tissue. Further, in ultra-high-field systems, localized field effects can be more pronounced due to a transition from the quasistationary to the electromagnetic field regime. Consequently, local information on the RF field is required for reliable RF safety assessment as well as for monitoring of RF exposure during MR examinations. Numerical RF and thermal simulations for realistic exposure scenarios with anatomical body models are currently the only practical way to obtain the requisite local information on magnetic and electric field distributions as well as tissue temperature. In this article, safety regulations and the fundamental characteristics of RF field distributions in ultra-high-field systems are reviewed. Numerical methods for computation of RF fields as well as typical requirements for the analysis of realistic multi-channel RF exposure scenarios including anatomical body models are highlighted. In recent years, computation of the local tissue temperature has become of increasing interest, since a more accurate safety assessment is expected because temperature is directly related to tissue damage. Regarding thermal simulation, bio-heat transfer models and approaches for taking into account the physiological response of the human body to RF exposure are discussed. In addition, suitable methods are presented to validate calculated RF and thermal results with measurements. Finally, the concept of generalized simulation-based specific absorption rate (SAR) matrix models is discussed. These models can be incorporated into local SAR monitoring in multi-channel MR systems and allow the design of RF pulses under constraints for local SAR.

https://www.ncbi.nlm.nih.gov/pubmed/28336426

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Effect of adverse environmental conditions & protective clothing on temperature rise in a human exposed to RF EMF

Moore SM, McIntosh RL, Iskra S, Lajevardipour A, Wood AW. Effect of adverse environmental conditions and protective clothing on temperature rise in a human body exposed to radiofrequency electromagnetic fields. Bioelectromagnetics. 2017 Mar 24. doi: 10.1002/bem.22048.

Abstract

This study considers the computationally determined thermal profile of a finely discretized, heterogeneous human body model, simulating a radiofrequency electromagnetic field (RF-EMF) worker wearing protective clothing subject to RF-EMF exposure, and subject to various environmental conditions including high ambient temperature and high humidity, with full thermoregulatory mechanisms in place. How the human body responds in various scenarios was investigated, and the information was used to consider safety limits in current international RF-EMF safety guidelines and standards. It was found that different environmental conditions had minimal impact on the magnitude of the thermal response due to RF-EMF exposure, and that the current safety factor of 10 applied in international RF-EMF safety guidelines and standards for RF-EMF workers is generally conservative, though it is only narrowly so when workers are subjected to the most adverse environmental conditions.

https://www.ncbi.nlm.nih.gov/pubmed/28342187

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"These Power Lines Make Me Ill": A Typology of Residents' Health Responses to a New High-Voltage Power Line

Porsius JT, Claassen L, Woudenberg F, Smid T, Timmermans DR."These Power Lines Make Me Ill": A Typology of Residents' Health Responses to a New High-Voltage Power Line. Risk Anal. 2017 Mar 17. doi: 10.1111/risa.12786. [Epub ahead of print]

Abstract

Little attention has been devoted to the potential diversity in residents' health responses when exposed to an uncertain environmental health risk. The present study explores whether subgroups of residents respond differently to a new high-voltage power line (HVPL) being put into operation. We used a quasi-experimental prospective field study design with two pretests during the construction of a new HVPL, and two posttests after it was put into operation. Residents living nearby (0-300 m, n = 229) filled out questionnaires about their health and their perception of the environment. We applied latent class growth models to investigate heterogeneity in the belief that health complaints were caused by a power line. Classes were compared on a wide range of variables relating to negative-oriented personality traits, perceived physical and mental health, and perceptions of the environment. We identified five distinct classes of residents, of which the largest (49%) could be described as emotionally stable and healthy with weak responses to the introduction of a new power line. A considerable minority (9%) responded more strongly to the new line being activated. Residents in this class had heard more about the health effects of power lines beforehand, were more aware of the activation of the new line, and reported a decrease in perceived health afterwards. Based on our findings we can conclude that there is a considerable heterogeneity in health responses to a new HVPL. Health risk perceptions appear to play an important role in this typology, which has implications for risk management.

https://www.ncbi.nlm.nih.gov/pubmed/28314060

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Measuring Occupational Exposure to Extremely Low-Frequency Electric Fields at 220 kV Substations

Pirkkalainen H, Heiskanen T, Tonteri J, Elovaara J, Mika P, Korpinen L.Measuring Occupational Exposure to Extremely Low-Frequency Electric Fields at 220 kV Substations. Radiat Prot Dosimetry. 2017 Mar 3:1-4. doi: 10.1093/rpd/ncx023.

Abstract

Earlier studies conducted at 400 and 110 kV substations in Finland have shown that the occupational exposure to electric fields can exceed the action levels (ALs) set by Directive 2013/35/EU. This is a case study investigating the level of occupational exposure experienced by workers at 220 kV substations in order to determine if the actions levels are being exceeded. The measurements were conducted at two old 220 kV substations in Finland. The higher AL of 20 kV m-1 was exceeded at both substations.

https://www.ncbi.nlm.nih.gov/pubmed/28338889

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Effects of power-frequency MF on cardiomyocytes differentiated from human induced pluripotent stem cells

Takahashi M1, Saito A, Jimbo Y, Nakasono S. Evaluation of the effects of power-frequency magnetic fields on the electrical activity of cardiomyocytes differentiated from human induced pluripotent stem cells. J Toxicol Sci. 2017;42(2):223-231. doi: 10.2131/jts.42.223.

Abstract

Although cardiac activity is known to differ between species in many respects, most evaluations of the cardiac effects of low-frequency electric and magnetic fields, which have a stimulant effect on electrically activated cells, have been performed in non-human experimental animals and cells, and the effects in humans have been assessed using theoretical models. In recent years, it has been verified that human cardiomyocytes differentiated from human induced pluripotent stem cells (hiPS-CM) are useful for evaluating human responses to various cardioactive compounds. In this study, we applied hiPSCMs for the first time to evaluate the human cardiac effects of power-frequency magnetic fields (MFs). After preparation of hiPS-CMs, we subjected a hiPS-CM monolayer formed on a multi-electrode array to short-term exposure to a 50 Hz MF at 400 mT with recording of the extracellular field potentials. The field potential duration of the hiPS-CMs did not differ significantly pre- and post-exposure, indicating that under these conditions, exposure to a 50 Hz MF at 400 mT does not affect the electrical activity of hiPSCMs.

https://www.ncbi.nlm.nih.gov/pubmed/28321048

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EMF Seems to Not Influence Transcription via CTCT Motif in Three Plant Promoters

Sztafrowski D, Aksamit-Stachurska A, Kostyn K, Mackiewicz P, Łukaszewicz M. Electromagnetic Field Seems to Not Influence Transcription via CTCT Motif in Three Plant Promoters. Front Plant Sci. 2017 Mar 7;8:178. doi: 10.3389/fpls.2017.00178.

Abstract

It was proposed that magnetic fields (MFs) can influence gene transcription via CTCT motif located in human HSP70 promoter. To check the universality of this mechanism, we estimated the potential role of this motif on plant gene transcription in response to MFs using both bioinformatics and experimental studies. We searched potential promoter sequences (1000 bp upstream) in the potato Solanum tuberosum and thale cress Arabidopsis thaliana genomes for the CTCT sequence. The motif was found, on average, 3.6 and 4.3 times per promoter (148,487 and 134,361 motifs in total) in these two species, respectively; however, the CTCT sequences were not randomly distributed in the promoter regions but were preferentially located near the transcription initiation site and were closely packed. The closer these CTCT sequences to the transcription initiation site, the smaller distance between them in both plants. One can assume that genes with many CTCT motifs in their promoter regions can be potentially regulated by MFs. To check this assumption, we tested the

influence of MFs on gene expression in a transgenic potato with three promoters (16R, 20R, and 5UGT) containing from 3 to 12 CTCT sequences and starting expression of β-glucuronidase as a reported gene. The potatoes were exposed to a 50 Hz 60-70 A/m MF for 30 min and the reporter gene activity was measured for up to 24 h. Although other factors induced the reporter gene activity, the MF did not. It implies the CTCT motif does not mediate in response to MF in the tested plant promoters.

Open Access Paper: https://www.ncbi.nlm.nih.gov/pubmed/28326086

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ELF exposure from mobile and cordless phones for the epidemiological MOBI-Kids study

Calderón C, Ichikawa H, Taki M, Wake K, Addison D, Mee T, Maslanyj M, Kromhout H, Lee AK, Sim MR, Wiart J, Cardis E.
ELF exposure from mobile and cordless phones for the epidemiological MOBI-Kids study. Environ Int. 2017 Jan 23. pii: S0160-4120(17)30047-8. doi: 10.1016/j.envint.2017.01.005. [Epub ahead of print]

Abstract

This paper describes measurements and computational modelling carried out in the MOBI-Kids case-control study to assess the extremely low frequency (ELF) exposure of the brain from use of mobile and cordless phones. Four different communication systems were investigated: Global System for Mobile (GSM), Universal Mobile Telecommunications System (UMTS), Digital Enhanced Cordless Telecommunications (DECT) and Wi-Fi Voice over Internet Protocol (VoIP). The magnetic fields produced by the phones during transmission were measured under controlled laboratory conditions, and an equivalent loop was fitted to the data to produce three-dimensional extrapolations of the field. Computational modelling was then used to calculate the induced current density and electric field strength in the brain resulting from exposure to these magnetic fields. Human voxel phantoms of four different ages were used: 8, 11, 14 and adult. The results indicate that the current densities induced in the brain during DECT calls are likely to be an order of magnitude lower than those generated during GSM calls but over twice that during UMTS calls. The average current density during Wi-Fi VoIP calls was found to be lower than for UMTS by 30%, but the variability across the samples investigated was high. Spectral contributions were important to consider in relation to current density, particularly for DECT phones. This study suggests that the spatial distribution of the ELF induced current densities in brain tissues is determined by the physical characteristics of the phone (in particular battery position) while the amplitude is mainly dependent on communication system, thus providing a feasible basis for assessing ELF exposure in the epidemiological study. The number of phantoms was not large enough to provide definitive evidence of an increase of induced current density with age, but the data that are available suggest that, if present, the effect is likely to be very small.

https://www.ncbi.nlm.nih.gov/pubmed/28126406

Also see: http://www.saferemr.com/2013/05/mobi-kids-childhood-brain-tumor-risk.html

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Corrigendum to "Inferring the 1985-2014 impact of mobile phone use on selected brain cancer subtypes using Bayesian structural time series and synthetic controls"

de Vocht F. Corrigendum to "Inferring the 1985-2014 impact of mobile phone use on selected brain cancer subtypes using Bayesian structural time series and synthetic controls" [Environ. Int. (2016), 97, 100-107]. Environ Int. 2017 Jan 25. pii: S0160-4120(17)30124-1. doi: 10.1016/j.envint.2017.01.015. [Epub ahead of print]

https://www.ncbi.nlm.nih.gov/pubmed/28131518

Also see: Changing Mix of Brain Tumors in U.K. http://microwavenews.com/short-takes-archive/changing-mix-uk-bts

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Effects of RF-EMF Exposure from GSM Mobile Phones on Proliferation Rate of Human Adipose-derived Stem Cells: An In-vitro Study

Shahbazi-Gahrouei D, Hashemi-Beni B, Ahmadi Z. Effects of RF-EMF Exposure from GSM Mobile Phones on Proliferation Rate of Human Adipose-derived Stem Cells: An In-vitro Study. J Biomed Phys Eng. 2016 Dec 1;6(4):243-252. eCollection 2016.

Abstract

BACKGROUND: As the use of mobile phones is increasing, public concern about the harmful effects of radiation emitted by these devices is also growing. In addition, protection questions and biological effects are among growing concerns which have remained largely unanswered. Stem cells are useful models to assess the effects of radiofrequency electromagnetic fields (RF-EMF) on other cell lines. Stem cells are undifferentiated biological cells that can differentiate into specialized cells. Adipose tissue represents an abundant and accessible source of adult stem cells. The aim of this study is to investigate the effects of GSM 900 MHz on growth and proliferation of mesenchymal stem cells derived from adipose tissue within the specific distance and intensity.

MATERIALS AND METHODS: ADSCs were exposed to GSM mobile phones 900 MHz with intensity of 354.6 μW/cm2 square waves (217 Hz pulse frequency, 50% duty cycle), during different exposure times ranging from 6 to 21 min/day for 5 days at 20 cm distance from the antenna. MTT assay was used to determine the growth and metabolism of cells and trypan blue test was also done for cell viability. Statistical analyses were carried out using analysis of one way ANOVA. $P<0.05$ was considered to be statistically significant.

RESULTS: The proliferation rates of human ADSCs in all exposure groups were significantly lower than control groups ($P<0.05$) except in the group of 6 minutes/day which did not show any significant difference with control groups.

CONCLUSION: The results show that 900 MHz RF signal radiation from antenna can reduce cell viability and proliferation rates of human ADSCs regarding the duration of exposure.

https://www.ncbi.nlm.nih.gov/pubmed/28144594

Excerpts

Electromagnetic radiation sources such as cordless phones, telecommunications stations, high-voltage lines, Wi-Fi, wireless, radio and television antenna could be one of the main reasons for human abnormalities if protection protocol recommendations for safety are not used [4]. Since mobile phone cannot be removed from human lives, to protect from the probable effects of radiations, all mobile operators according to CRA (Community Reinvestment Act) agreements with radio communication, must obtain a license to work with radio-waves and microwaves from the radiation protection for installation and the operation of mobile phone equipment. The most of literature and findings of researchers [3-7, 25- 27] agree on the protection methods against irradiation of EMFs. They believe that using some protection methods are recommended like reducing the length of calls, talking to phone in case of emergency, keeping the phone away from vital organs, using special anti-radiation coatings for mobile phones and banning the use of cell phones during pregnancy and childhood, the least presence in environments with high levels of microwave in main stations, consumption of antioxidants such as vitamins A, C, E and green tea in daily diet. Of course, more studies are needed to cover all biological effects of EMFs on living systems.

Conclusion Based on the findings of the present study, it is believed that GSM mobile phone 900 MHz with intensity of 354.6 μW/cm2 five times exposure at 20cm distance may inhibit the proliferation rates of human ADSCs, but no mechanism has been proposed to explain the effects of this radiation. However, further studies for assessing RF-EMF with other intensities, frequencies and different exposure times on stem cells are suggested.

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The Fundamental Reasons Why Laptop Computers should not be Used on Your Lap

S A R Mortazavi, S Taeb, S M J Mortazavi, S Zarei, M Haghani, P Habibzadeh, M B Shojaei-fard. The Fundamental Reasons Why Laptop Computers should not be Used on Your Lap. J Biomed Phys Eng. 2016 Dec 1;6(4):279-284. eCollection 2016.

Abstract

As a tendency to use new technologies, gadgets such as laptop computers are becoming more popular among students, teachers, businessmen and office workers. Today laptops are a great tool for education and learning, work and personal multimedia. Millions of men, especially those in the reproductive age, are frequently using their laptop computers on the lap (thigh). Over the past several years, our lab has focused on the health effects of exposure to different sources of electromagnetic fields such as cellular phones, mobile base stations, mobile phone jammers, laptop computers, radars, dentistry cavitrons and Magnetic Resonance Imaging (MRI). Our own studies as well as the studies performed by other researchers indicate that using laptop computers on the lap adversely affects the male reproductive health. When it is placed on the lap, not only the heat from a laptop computer can warm men's scrotums, the electromagnetic fields generated by laptop's internal electronic circuits as well as the Wi-Fi Radiofrequency radiation hazards (in a Wi-Fi connected laptop) may decrease sperm quality. Furthermore, due to poor working posture, laptops should not be used on the lap for long hours.

https://www.ncbi.nlm.nih.gov/pubmed/28144597

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Characterizing and Mapping of Exposure to Radiofrequency Electromagnetic Fields (20-3,000 Mhz) in Chengdu, China

Zhu G, Gong X, Luo R. Characterizing and Mapping of Exposure to Radiofrequency Electromagnetic Fields (20-3,000 Mhz) in Chengdu, China. Health Phys. 2017 Mar;112(3):266-275. doi: 10.1097/HP.0000000000000599.

Abstract

With radiofrequency exposure caused by electronic applications increasing, some members of the public are worrying about potential health risks. In this paper, methods of performing large-scale radiofrequency exposure evaluation are described. All studied sites were divided into three categories: commercial-area, residential-urban, and residential-rural. Then a series of site investigations were conducted on a car-mounted system in the years 2014 and 2015, aiming to characterize electric field exposure from 12 different radiofrequency sources. The results indicate that the studied environment is safe as indicated by exposure below guidelines and standards. The highest exposure measured in the 2 y of monitoring was from an FM source, 316.23 mV m. Telecommunication sources dominate exposure, contributing the most power density (65-90%). Meanwhile, intergroup differences are discussed and summarized. The spatial distributions of FM and GSM1800 exposure are demonstrated on a map. This study describes an approach for the assessment of the spatiotemporal pattern of radiofrequency exposures in Chengdu and facilitates the identification of any sources causing exposure above relevant guidelines and standards.

https://www.ncbi.nlm.nih.gov/pubmed/28121727

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The effects of human height and mass on the calculated induced electric fields at 50 Hz for comparison with the EMF Directive 2013/35/EU

Findlay RP. The effects of human height and mass on the calculated induced electric fields at 50 Hz for comparison with the EMF Directive 2013/35/EU.J Radiol Prot. 2017 Jan 24;37(1):201-213. doi: 10.1088/1361-6498/37/1/201. [Epub ahead of print]

Abstract

A worker's height and mass can significantly affect the way in which incident low frequency electric and magnetic fields are absorbed in the body. To investigate this, several anatomically realistic human models were produced for heights between 1.56 and 1.96 m and masses between 33 and 113 kg. The human models were derived from the MAXWEL surface-based phantom, the model previously used in the EMF Directive 2013/35/EU Practical Guide to demonstrate how induced electric fields in the body are calculated. Computer simulations were carried out to calculate the low frequency EMF directive exposure limit value (ELV) quantities, i.e. the induced electric fields, in these human model variations from exposure to external 50 Hz magnetic and electric fields. The computational work showed that simple relationships relating the human model's height/weight with the induced electric fields in tissue types such as bone, fat, muscle, brain, spinal cord and retina could be developed. Calculations of parameters that affected absorption and fields required to produce the EMF Directive ELVs were carried out and compared with the action levels (ALs). It was found that the ALs generally provided a conservative estimate of the ELVs for the various human models and exposure situations studied.

https://www.ncbi.nlm.nih.gov/pubmed/28118155

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Risk agents related to work and amyotrophic lateral sclerosis: An occupational medicine focus

Garzillo EM, Miraglia N, Pedata P, Feola D, Lamberti M. Risk agents related to work and amyotrophic lateral sclerosis: An occupational medicine focus. Int J Occup Med Environ Health. 2016;29(3):355-67. doi: 10.13075/ijomeh.1896.00368.

Abstract

Amyotrophic lateral sclerosis (ALS) is a neurodegenerative disease characterized by progressive muscular paralysis reflecting degeneration of motor neurons. In recent years, in addition to several studies about genetic mechanisms leading to motor neurons damage, various epigenetic theories have been developed, involving the study of the patients' work and lifestyle. The work aims at focusing the role of occupational exposure related to ALS by literature data analysis. Articles, selected on the basis of keywords, year of publication and topics, are related to occupational exposure, suggesting an impact on ALS onset. The literature review shows that there are still a lot of biases in the studies design, which actually do not allow to draw unequivocal conclusions.

https://www.ncbi.nlm.nih.gov/pubmed/26988875

Excerpt

Exposure to electromagnetic fields has been studied in epidemiological [62–66], observational [67] and laboratory works [68]. A recent meta-analysis suggests a slightly but significantly increased risk of ALS among workers exposed to an extremely low frequency electromagnetic field (ELF-EMF), but does not deny the possibility of bias in the data analysis [69]. However, in the case of electromagnetic fields, there are many problems: at present, no apparent correlation between the exposure assessment and the observed associations is possible. In order to better assess exogenous risk factors of ALS, a job exposure matrix (JEM) may have to be used, with a detailed exposure index to electric fields and magnetic fields [70].

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Rapid and Delayed Effects of Pulsed Radiofrequency on Neuropathic Pain: Electrophysiological, Molecular, and Behavioral Evidence Supporting Long-Term Depression

Huang RY, Liao CC, Tsai SY, Yen CT, Lin CW, Chen TC, Lin WT, Chang CH, Wen YR.Rapid and Delayed Effects of Pulsed Radiofrequency on Neuropathic Pain: Electrophysiological, Molecular, and Behavioral Evidence Supporting Long-Term Depression. Pain Physician. 2017 Feb;20(2):E269-E283.

Abstract

BACKGROUND: Pulsed radiofrequency (PRF) has been widely employed for ameliorating clinical neuropathic pain. How PRF alters electrophysiological transmission and modulates biomolecular functions in neural tissues has yet to be clarified. We previously demonstrated that an early application of low-voltage bipolar PRF adjacent to the dorsal root ganglion (DRG) reduced acute neuropathic pain in animals. By contrast, the present study investigated how PRF alters postsynaptic sensitization to produce early and delayed effects on neuropathic pain.

OBJECTIVES: Our objective was to test the hypothesis that a 5-minute session of PRF could rapidly produce selective long-term depression (LTD) on C-fiber-mediated spinal sensitization and sustain the effect through the long-lasting inhibition of injury-induced ERK-MAPK activation. This may explain the prolonged analgesic effect of PRF on chronic neuropathic pain.

STUDY DESIGN: Experiments were conducted on both normal rats and neuropathic pain rats that received spinal nerve ligation (SNL) 8 days prior.

SETTING: An animal laboratory in a medical center of a university in Taiwan.

METHODS: We first compared changes in field potentials in the L5 superficial spinal dorsal horn (SDH) that were evoked by conditioning electrical stimuli in the sciatic nerve in male adult rats before (as the baseline) and after PRF stimulation for at least 2 hours. Bipolar PRF was applied adjacent to the L5 DRG at an intensity of 5 V for 5 minutes, whereas the control rats were treated with sham applications. The electrophysiological findings were tested for any correlation with induction of spinal phospho-ERK (p-ERK) in normal and neuropathic pain rats. We then investigated the delayed effect of PRF on SNL-maintained pain behaviors for 2 weeks as well as p-ERK in SDH among the control, SNL, and PRF groups. Finally, potential injury in the DRGs after PRF stimulation was evaluated through behavioral observations and ATF-3, a neuronal stress marker.

RESULTS: In the evoked field-potential study, the recordings mediated through A- and C-afferent fibers were identified as A-component and C-component, respectively. PRF significantly reduced the C-components over 2 hours in both the normal and SNL rats, but it did not affect the A-components. In the SNL rats, the C-component was significantly depressed in the PRF group compared with the sham group. PRF also inhibited acute p-ERK induced by mechanical nociception in both the control and SNL rats. For a longer period, PRF ameliorated SNL-maintained mechanical allodynia for 10 days and thermal analgesia for 14 days, and it significantly reduced late ERK activation within spinal neurons and astrocytes 14 days afterward. Moreover,

PRF in the normal rats did not alter basal withdrawal thresholds or increase the expression and distribution of ATF-3 in the DRGs.

LIMITATIONS: Several issues should be considered before translating the animal results to clinical applications.

CONCLUSIONS: Low-voltage bipolar PRF produces LTD through selective suppression on the C-component, but not on the A-component. It also inhibits ERK activation within neurons and astrocytes in SDHs. The findings suggest that PRF alleviates long-lasting neuropathic pain by selectively and persistently modulating C-fiber-mediated spinal nociceptive hypersensitivity.Key words: Pulsed radiofrequency (PRF), dorsal root ganglion (DRG), neuropathic pain, ERK activation, evoked field potential, ATF-3, long-term depression (LTD), spinal nerve ligation (SNL).
https://www.ncbi.nlm.nih.gov/pubmed/28158164

Excerpt
The specially designed bipolar system has been described previously (27,29). The stimulation electrode was inserted into the left L5 foraminal canal, whereas the reference electrode was placed in contact with the surrounding non-neural tissues. The electrodes were connected to a PXI-5402 Function Generator (National Instruments, Austin, TX) to generate RF pulses with the following parameter settings based on clinical settings: 2-Hz biphasic trains with 500-kHz RF waves, 25-ms train width, and oscillating amplitudes at an intensity of ± 2.5 V. The PRF duration was 300 seconds. The control group received an electrode placement without electricity as a sham stimulation.

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Evaluation of the potential of mobile phone specific electromagnetic fields (UMTS) to produce micronuclei in human glioblastoma cell lines

Halh Al-Serori, Michael Kundi, Franziska Ferk, Miroslav Mišík,Armen Nersesyan, Manuel Murbach, Tamara T. Lah, Siegfried Knasmüller. Evaluation of the potential of mobile phone specific electromagnetic fields (UMTS) to produce micronuclei in human glioblastoma cell lines. Toxicology in Vitro. 40:264-271. April 2017.
http://dx.doi.org/10.1016/j.tiv.2017.01.012

Highlights

• Aim was to find out if mobile phone specific radiation causes chromosomal damage.
• The effect of the UMTS signal was tested in two human glioblastoma cell lines.
• No induction of micronuclei and several other nuclear anomalies were found.
• Induction of programmed cell death was observed in a p53 mutated cell line (U251).
• In p53 proficient cells (U87) the apoptosis rate was not increased.

Abstract

Some epidemiological studies indicate that mobile phones cause glioblastomas in humans. Since it is known that genomic instability plays a key role in the etiology of cancer, we investigated the effects of the universal mobile telecommunications system radiofrequency (UMTS-RF) signal, which is used in “smart” phones, on micronucleus (MN) formation and other anomalies such as nuclear buds (NBUDs) and nucleoplasmatic bridges (NPBs). MN are formed by structural and numerical aberrations, NBs reflect gene amplification and NPBs are formed from dicentric chromosomes. The experiments were conducted with human glioblastoma cell lines, which differ in regard to their p53 status, namely U87 (wild-type) and U251 (mutated). The cells were cultivated for 16 h in presence and absence of fetal calf serum and exposed to different SAR doses (0.25, 0.50 and 1.00 W/kg), which reflect the exposure of humans, in presence and absence of mitomycin C as former studies indicate that RF may cause synergistic effects in combination with this drug. We found no evidence for

induction of MN and other anomalies. However, with the highest dose, induction of apoptosis was observed in U251 cells on the basis of the morphological features of the cells. Our findings indicate that the UMTS-RF signal does not cause chromosomal damage in glioblastoma cells; the mechanisms which lead to induction of programmed cell death will be investigated in further studies.

Excerpts

1950 MHz UMTS

In conclusion, the results of the present study indicate that exposure of cultured human glioblastoma cells to mobile phone specific RF does not cause MN formation. These findings can be taken as an indication that mechanisms other than chromosomal damage lead to induction of glioblastomas, which was observed in a number of epidemiological studies (for review see IARC (2013) Volume 102). However, as described above we found clear evidence for induction of apoptosis in one of the cell lines with defective *p53*. The observation of induction of programmed cell death in a glioma derived cell line indicates that the UMTS signal causes physiological effects (such as primary DNA damage or other processes), which finally leads to the elimination of the cells. Future investigations will be conducted to understand the biological consequences and the molecular mechanisms which cause this phenomenon.

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Numerical Exposure Assessment Method for Low Frequency Range and Application to Wireless Power Transfer

Park S, Kim M. Numerical Exposure Assessment Method for Low Frequency Range and Application to Wireless Power Transfer. PLoS One. 2016 Nov 29;11(11):e0166720. doi: 10.1371/journal.pone.0166720. eCollection 2016.

Abstract

In this paper, a numerical exposure assessment method is presented for a quasi-static analysis by the use of finite-difference time-domain (FDTD) algorithm. The proposed method is composed of scattered field FDTD method and quasi-static approximation for analyzing of the low frequency band electromagnetic problems. The proposed method provides an effective tool to compute induced electric fields in an anatomically realistic human voxel model exposed to an arbitrary non-uniform field source in the low frequency ranges. The method is verified, and excellent agreement with theoretical solutions is found for a dielectric sphere model exposed to a magnetic dipole source. The assessment method serves a practical example of the electric fields, current densities, and specific absorption rates induced in a human head and body in close proximity to a 150-kHz wireless power transfer system for cell phone charging. The results are compared to the limits recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the IEEE standard guidelines.

Open access: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0166720

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Quantitative changes in testicular structure and function in rat exposed to mobile phone radiation

Çetkin M, Kızılkan N, Demirel C, Bozdağ Z, Erkılıç S, Erbağcı H. Quantitative changes in testicular structure and function in rat exposed to mobile phone radiation. Andrologia. 2017 Jan 26. doi: 10.1111/and.12761. [Epub ahead of print]

Abstract

The possible effects of the electromagnetic fields (EMF) generated by mobile phones on reproductive functions have been discussed in recent years. The aim of this study was to evaluate the effects of EMF emitted from mobile phones on the rat testis morphology and histopathology using stereological techniques. We also investigated cortisol, testosterone, FSH and LH levels. A total of thirty-two (n = 32) male Wistar albino rats were used in this study. Animals were randomly divided into four groups as control (C, n = 8), sham (Sh, n = 8), mobile phone speech (Sp, n = 8) and mobile phone standby (ST by). Morphometric measurements were made with the help of a computer-assisted stereological analysis system. The testis weight and volume were significantly lower in the EMF exposed groups. The mean volume fraction of interstitial tissue was higher, but the volume fraction of tubular tissue was lower in the EMF-exposed groups. The mean tubular and germinal tissue volume, seminiferous tubule diameter and germinal epithelium height were also lower in EMF exposed groups. The cortisol levels in the EMF-exposed groups were significantly higher. In conclusion, the EMF created by mobile phones caused morphologic and histological changes by the affecting germinal epithelium tissue negatively.

https://www.ncbi.nlm.nih.gov/pubmed/28124386

Excerpts

In order to generate EMF, mobile phones using GSM mobile phone systems were employed. The highest SAR (specific absorption rate) of the mobile phones was 0.96 W/kg and each of these phones had a 890-915 MHz carrier frequency band, 217 Hz modulation frequency, 250 mW maximum average power and 2 W maximum peak power (Dasdag et al., 1999).

Speech mode was obtained by keeping the mobile phone in the experiment box on speech mode for 2 hr/day. For the standby mode, the mobile phone was put on standby for 12 hr/day.

It was seen at the end of the study that exposure to mobile phones caused degeneration in germinal epithelium tissue and as a result, such parameters as testis volume, tubular tissue volume fraction and volume, germinal epithelium volume, STD, GEH and Johnsen biopsy score were affected adversely. Moreover, exposure to mobile phones was found to increase cortisol levels as well.

Inconclusion, it has been found in our study that EMF generated by mobile phones causes degeneration in the germinal epithelium. As a result of this degeneration, significant decreases were observed in the testis volumes, tubular tissue volumes, STD and GEH of the experimental groups. While EMF increased serum cortisol levels in the experimental group, it caused no change in gonadal hormones. All these findings are considered to be useful for studies examining the effects of EMF on reproductive functions.

Also see: http://www.saferemr.com/2015/09/effect-of-mobile-phones-on-sperm.html

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GSM-like radiofrequency exposure induces apoptosis via caspase-dependent pathway in infant rabbits

Meral O, Ozgur E, Kismali G, Guler G, Alpay M, Sel T, Seyhan N. GSM-like radiofrequency exposure induces apoptosis via caspase-dependent pathway in infant rabbits. Bratisl Lek Listy. 2016;117(11):672-676. doi: 10.4149/BLL_2016_129.

Abstract

BACKGROUND: There have been several Radio Frequency (RF) field researches on various populations and groups of different ages in recent years. However, the most important group for research has been declared as the pregnant women and their babies.

OBJECTIVE: The aim of the study was to analyse the effect on apoptotic factors of RF fields on newborn rabbit

liver tissues.

MATERIALS AND METHODS: Cytochrome c and AIF (Apoptosis Inducing Factor) levels were measured by western blot and caspase 1, 3 and 9 activities were measured by colorimetric method.

RESULTS: Cytochrome c and AIF levels were not altered, but all caspase activities were increased in female infant rabbits that exposed to 1800 MHz GSM-like RF signals when they reached 1 month of age and caspase 1 and caspase 3 levels were decreased in male infant rabbits that exposed to 1800 MHz GSM-like RF signals between 15th and 22nd days of the gestational period. Results showed that 1800 MHz GSM-like RF exposure might lead to apoptosis in infant rabbit's liver tissues.

CONCLUSION: According to the results, we suggest that postnatal RF exposure causes caspase dependent apoptosis in female infant rabbits liver tissues (Tab. 1, Fig. 2, Ref. 27).

https://www.ncbi.nlm.nih.gov/pubmed/28125894

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GSM 900 MHz Microwave Radiation-Induced Alterations of Insulin Level and Histopathological Changes of Liver and Pancreas in Rat

Mortazavi SMJ, Owji SM, Shojaie-fard MB, Ghader-Panah M, Mortazavi SAR, Tavakoli-Golpayegani A, Haghani M, Taeb S, Shokrpour N, Koohi O. GSM 900 MHz Microwave Radiation-Induced Alterations of Insulin Level and Histopathological Changes of Liver and Pancreas in Rat. J Biomed Phys Eng. 2016 Dec 1;6(4):235-242. eCollection 2016.

Abstract

Background: The rapidly increasing use of mobile phones has led to public concerns about possible health effects of these popular communication devices. This study is an attempt to investigate the effects of radiofrequency (RF) radiation produced by GSM mobile phones on the insulin release in rats.

Methods: Forty two female adult Sprague Dawley rats were randomly divided into 4 groups. Group1 were exposed to RF radiation 6 hours per day for 7 days. Group 2 received sham exposure (6 hours per day for 7 days). Groups 3 and 4 received RF radiation 3 hours per day for 7 days and sham exposure (3 hours per day), respectively. The specific absorption rate (SAR) of RF was 2.0 W/kg.

Results: Our results showed that RF radiations emitted from mobile phone could not alter insulin release in rats. However, mild to severe inflammatory changes in the portal spaces of the liver of rats as well as damage in the cells of islet of Langerhans were observed. These changes were linked with the duration of the exposures.

Conclusion: RF exposure can induce inflammatory changes in the liver as well causing damage in the cells of islet of Langerhans.

http://www.jbpe.org/Journal_OJS/JBPE/index.php/jbpe/article/view/447/224

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The effect of the non ionizing radiation on exposed, laboratory cultivated upland cotton plants

Aikaterina L. Stefi, Lukas H. Margaritis, Nikolaos S. Christodoulakis.The effect of the non ionizing radiation on exposed, laboratory cultivated upland cotton (Gossypium hirsutum L.) plants. Flora - Morphology, Distribution, Functional Ecology of Plants. Volume 226:55-64. January 2017. http://dx.doi.org/10.1016/j.flora.2016.11.009.

Highlights

• Upland cotton plants grow under long term microwave radiation.
• They suffer significant biomass reduction of exposed plants.
• Chloroplast structure is severely affected.
• Photosynthetic pigment content reduces.
• Roots do respond to radiation stress.

Abstract

A series of experiments was carried out to investigate possible structural or biochemical alterations in Gossypium hirsutum plants after a long term (21 days) exposure to non ionizing radiation (1882 MHz) emitted from the base unit of a cordless DECT system. Exposed plants, compared to the negative (matched) controls, seem to be seriously affected. Notably lower biomass production for the above ground part and the root was recorded. Reduction of the photosynthetic pigments and severe damage of the chloroplast structure were also observed. It seems that non ionizing radiation can be noxious for plant life functions.

Excerpts

In the middle of one of the two cages, the base unit of a DECT telephone apparatus (General, Model 123) was appropriately positioned. The DECT base was in a 24 h a day, 7 days a week, pulsed transmission mode, at 1882 MHz, as described elsewhere (Margaritis et al., 2014)....

Supplementary, low precision measurements were made in the control cage; with a broadband field meter (TES-92, 50 MHz–3.5 GHz, Electromagnetic radiation detector – TES Electrical Electronic Corp. Taipei, Taiwan, R.O.C.) at the value of 490.1 mV/m. In the nearby cage (exposed), radiation reached the value of 27.46 V/m (27.460 mV/m, at 1882 MHz) (55 fold higher).

Conclusion

The effect of the non-ionizing radiation at the microwave band, on the *Gossypium hirsutum* young plants, after a long term exposure, can be considered as significant. The disastrous effect on chloroplast structure, the reduction of the photosynthetic pigments and the suppression of the photosynthetic potential, are the main causes for the significant reduction of the primary productivity. Moreover, a serious effect on the underground part of the plant was recorded but this cannot be evaluated yet.

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Sustainable perspectives on energy consumption, EMR, environment, health & accident risks associated with mobile phone use

Manivannan Senthil Velmurugan. Sustainable perspectives on energy consumption, EMRF, environment, health and accident risks associated with the use of mobile phones. Renewable and Sustainable Energy Reviews. 67:192-206. January 2017. http://dx.doi.org/10.1016/j.rser.2016.09.011

Abstract

Mobile phones have grown rapidly using today's wireless technology thereby providing a new dimension to simplify daily routine jobs by users. Mobile phone's applications have a great impact on the way of faster and more effective to convey information. In contrast, mobile phones could harm its users. This paper explored detrimental effects of mobile phones on energy consumption, electromagnetic radiofrequency radiation,

environment, health and accidents. The effect of mobile phone's energy consumption can be considered during energy spend for its production and use. The electromagnetic radiofrequency radiation (EMRF) may cause adverse health effects on human. The raw materials which are used to manufacture for mobile phones may cause the severe environmental impacts due to their levels of toxicity. The health hazards are correlated with high-toxic substances released from the mobile phones and its addiction through a prolonged use. Mobile phone usage while driving can cause road traffic collisions and motor vehicle crashes. Furthermore, sustainable perspectives have been suggested as a way to overcoming these detrimental effects of mobile phones.

http://www.sciencedirect.com/science/article/pii/S1364032116305056

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Major influences in households and business spaces — Wi-Fi, telecommunication masts outputs and electrical pollution

Francis Markho, Ioan Tuleasca. Major influences in households and business spaces — Wi-Fi, telecommunication masts outputs and electrical pollution. Electrical and Power Engineering (EPE), 2016 International Conference and Exposition on Electrical and Power Engineering. Oct 20-22, 2016. Iasi, Romania.

Abstract

The paper offers a non-exhaustive perspective, as well as a spectrum of performed measurements, in the field of non-ionizing electromagnetic radiation. Shielding Wi-Fi is shown to be an effective means of counteracting its health risks. The effects of cell phone towers positioning next to living and working spaces is presented and analyzed. Electrical pollution mitigation is described, as well as the problem of earth bound stray electrical currents. Effective actions and measures to be taken for the benefit of future generations are suggested and justified.

Conclusions

The adverse health effects due to Wi-Fi and cell phone towers are well known (Carpenter’s testimony [29] and Dode’s findings [19]) should be more than enough to put the matter to rest in this respect). However, it seems to be no willingness to change the status quo, even if Lloyd’s took
steps [30] to distance themselves from the possible EMF claims related issues. The careless use of this type of technology might cost us dearly in the future in both health sector national budgets blowouts and genetic degeneration.

Dirty electricity (electrical pollution) just completes the picture and adds to the effects of the above mentioned stressors. The seriousness of the problem is compounded by the availability and cheapness of various electrical devices and systems that are responsible for the creation of high
frequency voltage transients in the electrical networks. Mitigating these transients can, fortunately, be performed using shielding and adequate design for electrical circuitry in addition to other appropriate means [31].

The way forward, however, may be linked to broad, thorough and mandatory institutional measures at national and international levels. The first step in this direction was taken by France [32], where the French National Assembly passed a Law that regulates the exposure to electromagnetic field EMF (Law on Sobriety, Transparency, Information and Consultation for Exposure to Electromagnetic Waves, 29
January 2015). The Law addresses a range of EMF-related aspects, from Wi-Fi usage in nurseries (banned) and schools (limited), to mobile phones Specific Absorption Rate SAR labelling and cell phone towers emissions compliance verification. The Electrohypersensitivity EHS issue was also addressed as part of this Law, where a Report on EHS must be presented to the French Parliament within one year.

At international level it may be that not only the Precautionary Principle has to have a role in organising adequate EMF exposure limits, but also specific internationally recognized legal instruments, like the Nuremberg Code of Ethics. According to this Code, one cannot submit human beings to actions causing them harm, where the said human beings are not able to “bring the experiment to an end” [33]. Since the human race is unwittingly submitted to a world-wide encompassing, society-directed, experiment, in the form of biologically adverse, profit driven, imposed EMF exposure, the Code is duly applicable.

Considering the way other crucial health-related issues (asbestos, tobacco, ionizing radiation) were dealt with over the years, it seems that there is a long way ahead in tackling EMF exposure risks. However, this time is different, since our own long term wellbeing as a species is at risk [34], due to the genotoxic effect of the presented stressors.

http://ieeexplore.ieee.org/document/7781450/

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Inaccurate official assessment of RF safety by the Advisory Group on Non-ionising Radiation (AGNIR)

Starkey SJ. Inaccurate official assessment of radiofrequency safety by the Advisory Group on Non-ionising Radiation. Rev Environ Health. 2016 Dec 1;31(4):493-503. doi: 10.1515/reveh-2016-0060.

Abstract

The Advisory Group on Non-ionising Radiation (AGNIR) 2012 report forms the basis of official advice on the safety of radiofrequency (RF) electromagnetic fields in the United Kingdom and has been relied upon by health protection agencies around the world. This review describes incorrect and misleading statements from within the report, omissions and conflict of interest, which make it unsuitable for health risk assessment. The executive summary and overall conclusions did not accurately reflect the scientific evidence available. Independence is needed from the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the group that set the exposure guidelines being assessed. This conflict of interest critically needs to be addressed for the forthcoming World Health Organisation (WHO) Environmental Health Criteria Monograph on Radiofrequency Fields. Decision makers, organisations and individuals require accurate information about the safety of RF electromagnetic signals if they are to be able to fulfil their safeguarding responsibilities and protect those for whom they have legal responsibility.

https://www.ncbi.nlm.nih.gov/pubmed/27902455

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Does cell phone use increase the chances of parotid gland tumor development? A systematic review and meta-analysis

de Siqueira EC, de Souza FT, Gomez RS, Gomes CC, de Souza RP. Does cell phone use increase the chances of parotid gland tumor development? A systematic review and meta-analysis. J Oral Pathol Med. 2016 Dec 9. doi: 10.1111/jop.12531. [Epub ahead of print]

Abstract

BACKGROUND: Prior epidemiological studies had examined the association between cell phone use and the development of tumors in the parotid glands. However there is no consensus about the question of whether cell phone use is associated with increased risk of tumors in the parotid glands. We performed a meta-analysis to evaluate the existing literature about the mean question and to determine their statistical significance.

METHODS: Primary association studies. Papers that associated cell phone use and parotid gland tumors

development were included, with no restrictions regarding publication date, language and place of publication. Systematic literature search using PubMed, Scielo and Embase followed by meta-analysis.

RESULTS AND CONCLUSION: Initial screening included 37 articles and three were included in meta-analysis. Using three independent samples including 5087 subjects from retrospective case-control studies, cell phone use seems to be associated with greater odds (1.28, 95%- confidence interval 1.09 - 1.51) to develop salivary gland tumor. Results should be read with caution due to the limited number of studies available and their retrospective design.

http://bit.ly/2gFfUBh

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Cell phone use is associated with an inflammatory cytokine profile of parotid gland saliva

Siqueira EC, de Souza FT, Ferreira E, Souza RP, Macedo SC, Friedman E, Gomez MV, Gomes CC, Gomez RS. Cell phone use is associated with an inflammatory cytokine profile of parotid gland saliva.. J Oral. Pathol Med. 45(9):682-686. doi: 10.1111/jop.12434. 2016.

Abstract

BACKGROUND: There is controversy on the effects of the non-ionizing radiation emitted by cell phones on cellular processes and the impact of such radiation exposure on health. The purpose of this study was to investigate whether cell phone use alters cytokine expression in the saliva produced by the parotid glands.

METHODS: Cytokine expression profile was determined by enzyme linked immuno sorbent assay (ELISA) in the saliva produced by the parotid glands in healthy volunteers, and correlated with self-reported cell phone use and laterality.

RESULTS: The following parameters were determined, in 83 Brazilian individuals in saliva produced by the parotid glands comparing the saliva from the gland exposed to cell phone radiation (ipsilateral) to that from the contralateral parotid: salivary flow, total protein concentration, interleukin 1 β (IL-1 β), interleukin 6 (IL-6), interleukin 10 (IL-10), interferon γ (IFN-γ), and tumor necrosis factor α (TNF-α) salivary levels by ELISA. After multiple testing correction, decreased IL-10 and increased IL-1β salivary levels in the ipsilateral side compared with the contralateral side ($P < 0.05$) were detected. Subjects who used cell phones for more than 10 years presented higher differences between IL-10 levels in ipsilateral versus contralateral parotids ($P = 0.0012$). No difference was observed in any of the tested parameters in correlation with cell phone monthly usage in minutes.

CONCLUSION: The exposure of parotid glands to cell phones can alter salivary IL-10 and IL-1β levels, consistent with a pro-inflammatory microenvironment that may be related to heat production.

http://1.usa.gov/24cKkun

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Electromagnetic hypersensitivity: Nation-wide survey among general practitioners, occupational physicians & hygienists in the Netherlands

Slottje P, van Moorselaar I, van Strien R, Vermeulen R, Kromhout H, Huss A. Electromagnetic hypersensitivity (EHS) in occupational and primary health care: A nation-wide survey among general practitioners, occupational physicians and hygienists in the Netherlands. Int J Hyg Environ Health. 2016 Dec 2. pii: S1438-4639(16)30385-6. doi: 10.1016/j.ijheh.2016.11.013. [Epub ahead of print]

Abstract

Subjects who attribute health complaints to every day levels of non-ionizing electromagnetic fields (EMF) have been referred to as electrohypersensitive (EHS). Previous surveys in Europe showed that 68-75% of general practitioners had ever been consulted on EHS. Given the lack of data on EHS in the Netherlands in the general population and on EHS in occupational settings, we performed a national survey among three professional groups that are likely in the first line of being consulted by EHS individuals. Results show that about one third of occupational hygienists, occupational physicians and general practitioners had ever been consulted by one or more EHS subjects. Many of these professionals considered a causal relationship between EMF and health complaints to some degree plausible, and their approach often included exposure reduction advice. Given the lack of scientific evidence for EHS and how low level EMF exposure could cause reported health complaints and given the finding that the majority of these professionals felt insufficiently informed about EMF and health, targeted information campaigns might assist them in their evidence based dealing with subjects who attribute symptoms to EMF.

Conclusions

About a third of occupational hygienist, occupational physicians and general practitioners in the Netherlands are consulted by patients attributing symptoms to EMF exposure. Many of these professionals consider a causal relationship between EMF and health complaints to some degree plausible, and their approach often also includes exposure reduction advice. Given the lack of a scientific evidence basis for EMF to cause symptoms and the finding that the majority of these professionals feels insufficiently informed about EMF and health, targeted information campaigns might assist them in their evidence based dealing with patients who attribute symptoms to EMF.

http://www.sciencedirect.com/science/article/pii/S1438463916303856

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Extrapolation techniques evaluating 24 hours of average EMF emitted by radio base station installations: spectrum analyzer measurements of LTE and UMTS signals

Mossetti S, de Bartolo D, Veronese I, Cantone MC, Cosenza C, Nava E. Extrapolation techniques evaluating 24 hours of average electromagnetic field emitted by radio base station installations: spectrum analyzer measurements of LTE and UMTS signals.
Radiat Prot Dosimetry. 2016 Dec 1. [Epub ahead of print]

Abstract

International and national organizations have formulated guidelines establishing limits for occupational and residential electromagnetic field (EMF) exposure at high-frequency fields. Italian legislation fixed 20 V/m as a limit for public protection from exposure to EMFs in the frequency range 0.1 MHz-3 GHz and 6 V/m as a reference level. Recently, the law was changed and the reference level must now be evaluated as the 24-hour average value, instead of the previous highest 6 minutes in a day. The law refers to a technical guide (CEI 211-7/E published in 2013) for the extrapolation techniques that public authorities have to use when assessing exposure for compliance with limits. In this work, we present measurements carried out with a vectorial spectrum analyzer to identify technical critical aspects in these extrapolation techniques, when applied to UMTS and LTE signals. We focused also on finding a good balance between statistically significant values and logistic managements in control activity, as the signal trend in situ is not known. Measurements were repeated several times over several months and for different mobile companies. The outcome presented in this article allowed us to evaluate the reliability of the extrapolation results obtained and to have a starting point for defining operating procedures.

https://www.ncbi.nlm.nih.gov/pubmed/27909155

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Randomised, placebo-controlled trial of transcranial pulsed EMF in patients with multiple chemical sensitivity

Tran MT, Skovbjerg S, Arendt-Nielsen L, Christensen KB, Elberling J. A randomised, placebo-controlled trial of transcranial pulsed electromagnetic fields in patients with multiple chemical sensitivity. Acta Neuropsychiatr. 2016 Dec 6:1-11. [Epub ahead of print]

Abstract

OBJECTIVE: To evaluate the efficacy of transcranially applied pulsed electromagnetic fields (PEMF) on functional impairments and symptom severity in multiple chemical sensitivity (MCS) patients.

METHODS: The study was conducted as a nationwide trial in Denmark using a randomised, parallel-group, double-blind and placebo-controlled design. Sample size was estimated at 40 participants. Eligibility criteria were age 18-75 years and fulfilment of the MCS case criteria. Participants received either PEMF or placebo PEMF (no stimulation) applied transcranially for 6 weeks. The primary outcome was the Life Impact Scale (LIS) of the Quick Environmental Exposure and Sensitivity Inventory (QEESI). Secondary outcomes were the Symptom Severity Scale (SSS) and the Chemical Intolerance Scale of QEESI.

RESULTS: A total of 39 participants were randomised to PEMF or placebo treatment. No significant difference was observed on QEESI LIS between groups with a mean change score of -5.9 in the PEMF group compared with -1.5 in the placebo group (p=0.35, effect size=-0.31). However, a significant decrease was detected on QEESI SSS within and between groups with a mean change score of -11.3 in the PEMF group compared with -3.2 in the placebo group (p=0.03, effect size=-0.60).

CONCLUSION: PEMF treatment of 6 weeks showed no effect on functional impairments in MCS. However, a significant decrease in symptom severity was observed.

https://www.ncbi.nlm.nih.gov/pubmed/27919300

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Mobile-phone Radiation-induced Perturbation of Gene-expression Profiling, Redox Equilibrium & Sporadic-apoptosis Control in the Ovary of Drosophila melanogaster

Manta AK, Papadopoulou D, Polyzos AP, Fragopoulou AF, Skouroliakou AS, Thanos D, Stravopodis DJ, Margaritis LH. Mobile-phone Radiation-induced Perturbation of Gene-expression Profiling, Redox Equilibrium and Sporadic-apoptosis Control in the Ovary of Drosophila melanogaster.
Fly (Austin). 2016 Dec 14:0. [Epub ahead of print]

Abstract

BACKGROUND: The daily use by people of wireless communication devices has increased exponentially in the last decade, begetting concerns regarding its potential health hazards.

METHODS: Drosophila melanogaster four days-old adult female flies were exposed for 30 min to radiation emitted by a commercial mobile phone at a SAR of 0.15 W/kg and a SAE of 270 J/kg. ROS levels and apoptotic follicles were assayed in parallel with a genome-wide microarrays analysis.

RESULTS: ROS cellular contents were found to increase by 1.6 fold (x), immediately after the end of exposure, in follicles of pre-choriogenic stages (germarium - stage 10), while sporadically generated apoptotic

follicles (germarium 2b and stages 7-9) presented with an averaged 2x upregulation in their sub-population mass, 4 h after fly's irradiation with mobile device. Microarray analysis revealed 168 genes being differentially expressed, 2 h post-exposure, in response to radiofrequency (RF) electromagnetic field-radiation exposure (≥1.25x, P<0.05) and associated with multiple and critical biological processes, such as basic metabolism and cellular subroutines related to stress response and apoptotic death.

CONCLUSION: Exposure of adult flies to mobile-phone radiation for 30 min has an immediate impact on ROS production in animal's ovary, which seems to cause a global, systemic and non-targeted transcriptional reprogramming of gene expression, 2 h post-exposure, being finally followed by induction of apoptosis 4 h after the end of exposure. Conclusively, this unique type of pulsed radiation, mainly being derived from daily used mobile phones, seems capable of mobilizing critical cytopathic mechanisms, and altering fundamental genetic programs and networks in D. melanogaster.

https://www.ncbi.nlm.nih.gov/pubmed/27960592

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Effect of electromagnetic waves from mobile phone on immune status of male rats: possible protective role of vitamin D

El-Gohary O, Said MA. Effect of electromagnetic waves from mobile phone on immune status of male rats: possible protective role of vitamin D. Can J Physiol Pharmacol. 2016 Sep 5:1-6. [Epub ahead of print]

Abstract

There are considerable public concerns about the relationship between mobile phone radiation and human health. The present study assesses the effect of electromagnetic field (EMF) emitted from a mobile phone on the immune system in rats and the possible protective role of vitamin D. Rats were randomly divided into six groups: Group I: control group; Group II: received vitamin D (1000 IU/kg/day) orally; Group III: exposed to EMF 1 h/day; Group IV: exposed to EMF 2 h/day; Group V: exposed to EMF 1 h/day and received vitamin D (1000 IU/kg/day); Group VI: exposed to EMF 2 h/day and received vitamin D (1000 IU/kg/day). After 30 days of exposure time, 1 h/day EMF exposure resulted in significant decrease in immunoglobulin levels (IgA, IgE, IgM, and IgG); total leukocyte, lymphocyte, eosinophil and basophil counts; and a significant increase in neutrophil and monocyte counts. These changes were more increased in the group exposed to 2 h/day EMF. Vitamin D supplementation in EMF-exposed rats reversed these results when compared with EMF-exposed groups. In contrast, 7, 14, and 21 days of EMF exposure produced nonsignificant differences in these parameters among all experimental groups. We concluded that exposure to mobile phone radiation compromises the immune system of rats, and vitamin D appears to have a protective effect.

https://www.ncbi.nlm.nih.gov/pubmed/27901344

Excerpts

In the EMF exposure room, there were no other metals, and the use of any other EMF-emitting device except the mobile phone used in the study was not allowed. There was no WiFi or cellular signal in the room. The rats were exposed to EMF (900 MHz at a specific absorption rate of approximately 0.9 W/kg) emitted by Nokia N70 mobile phone (Nokia Corporation, Finland) for 1 h daily (from 0800 to 0900) for groups III and V or 2 h daily (from 0800 to 1000) for groups IV and VI for 30 days. For the used mobile phone (Nokia N70), the highest SAR value under the International Commission on Non-Ionizing Radiation Protection guidelines for use of the device and the European Union SAR value stated by the manufacturer was 0.95 W/kg of body mass (Chan et al. 1997; Sieroń-Stołtny et al. 2015). The mobile phone was placed directly under the cage in which the animals stayed during the exposure. It was kept in the silent mode during the time of exposure; this means that both sound of a bell and sound in the receiver were switched off, so the animals were exposed solely to EMF generated by the mobile phone (Al-Damegh 2012; Hammodi 2011).

Several mechanisms have been proposed to explain the effects of EMF on the immune system. Cell phone radiation results in activation of the hypothalamo-pituitary adrenal system, leading to elevated serum level of corticosteroid, indicating the existence of stress response in rats exposed to cell phone radiation. The elevated corticosteroid level may be the reason for the decreased lymphocytes (Ahmadi et al. 2014; Barnes and Greenebaum 2006). The percentage of lymphocytes and neutrophils are inversely related to each other both in basal and stressed conditions. Thus, the increase in the neutrophil count could be secondary to the decrease in the lymphocyte count (Keller et al. 1983).

Among the putative mechanisms by which EMF from mobile phones may affect biological systems is the interference of EMF with Ca2+ regulatory processes in lymphoid cells (Walleczek 1992) or increasing free radicals' life span and cellular concentration of reactive oxygen species (Balci et al. 2007). This leads to oxidative damage in major cell macromolecules such as lipids and nucleic acids (Lee et al. 2004). Lantow et al. (2006) reported a significant increase in reactive oxygen species production in human monocytes and lymphocytes after exposure to 1800 MHz RF–EMFs. Increased free radicals and interference with Ca2+ regulatory processes can both cause cell growth inhibition, protein misfolding, and DNA breaks (Gye and Park 2012).--

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Different responses of Drosophila to ELF magnetic field: fitness components & locomotor activity

Zmejkoski D, Petković B, Pavković-Lučić S, Prolić Z, Anđelković M, Savić T. Different responses of Drosophila subobscura isofemale lines to extremely low frequency magnetic field (50 Hz, 0.5 mT): fitness components and locomotor activity. Int J Radiat Biol. 2016 Dec 6:1-29. [Epub ahead of print]

Abstract

PURPOSE: Extremely low frequency (ELF) magnetic fields as essential ecological factor may induce specific responses in genetically different lines. The subject of this study was to investigate the impact of ELF magnetic field on fitness components and locomotor activity of five Drosophila subobscura isofemale (IF) lines.

MATERIALS AND METHODS: Each D. subobscura IF line, arbitrarily named: B16/1, B24/4, B39/1, B57/2 and B69/5, was maintained in five full-sib inbreeding generations. Their genetic structures were defined based on the mitochondrial DNA variability. Egg-first instar larvae and one-day-old flies were exposed to ELF magnetic field (50 Hz, 0.5 mT, 48 h) and thereafter, fitness components and locomotor activity of males and females in an open field test were observed for each selected IF line, respectively.

RESULTS: Exposure of egg-first instar larvae to ELF magnetic field shortened developmental time, and did not affect viability and sex ratio of D. subobscura IF lines. Exposure of one-day-old males and females IF lines B16/1 and B24/4 to ELF magnetic field significantly decreased their locomotor activity and this effect lasted longer in females than males.

CONCLUSIONS: These results indicate various responses of D. subobscura IF lines to the applied ELF magnetic field depending on their genetic background.

http://www.tandfonline.com/doi/abs/10.1080/09553002.2017.1268281

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15 Hz square wave magnetic fields affects voltage-gated sodium & potassium channels in neurons

Zheng Y, Dou JR, Gao Y, Dong L, Li G. Effects of 15 Hz square wave magnetic fields on the voltage-gated sodium and potassium channels in prefrontal cortex pyramidal neurons. Int J Radiat Biol. 2016 Dec 7:1-7.

[Epub ahead of print]

Abstract

PURPOSE: Although magnetic fields have significant effects on neurons, little is known about the mechanisms behind their effects. The present study aimed to measure the effects of magnetic fields on ion channels in cortical pyramidal neurons.

MATERIALS AND METHODS: Cortical pyramidal neurons of Kunming mice were isolated and then subjected to 15 Hz, 1 mT square wave (duty ratio 50%) magnetic fields stimulation. Sodium currents (INa), transient potassium currents (IA) and delayed rectifier potassium currents (IK) were recorded by whole-cell patch clamp method.

RESULTS: We found that magnetic field exposure depressed channel current densities, and altered the activation kinetics of sodium and potassium channels. The inactivation properties of INa and IA were also altered.

CONCLUSION: Magnetic field exposure alters ion channel function in neurons. It is likely that the structures of sodium and potassium channels were influenced by the applied field. Sialic acid, which is an important component of the channels, could be the molecule responsible for the reported results.

https://www.ncbi.nlm.nih.gov/pubmed/27924669

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A follow-up study of the association between mobile phone use and symptoms of ill health

Cho YM, Lim HJ, Jang H, Kim K, Choi JW, Shin C, Lee SK, Kwon JH, Kim N. A follow-up study of the association between mobile phone use and symptoms of ill health. Environ Health Toxicol. 2016 Dec 29. doi: 10.5620/eht.e2017001. [Epub ahead of print]

Abstract

Objectives: The duration and frequency of mobile phone calls, and their relationship with various health effects, have been investigated in our previous cross-sectional study. This two-year period follow-up study after aimed to assess the changes in these variables of same subjects.

Methods: The study population comprised 532 non-patient adult subjects sampled from the Korean Genome Epidemiology Study. The subjects underwent a medical examination at a hospital in 2012/2013 and revisited the same hospital in 2014/2015 to have the same examination for the characteristics of mobile phone use performed. In addition, to evaluate the effects on health, the Headache Impact Test-6 (HIT-6), Psychosocial Well-being Index-Short Form (PWI-SF), Beck Depression Inventory (BDI), Korean-Instrumental Activities of Daily Living (K-IADL), Perceived Stress Scale (PSS), Pittsburgh Sleep Quality Index (PSQI), and 12-Item Short Form Health Survey (SF-12) were analyzed. For all these tests, the higher the score, the greater the effect on health. Variances between scores in all the indices in the baseline and follow-up surveys were calculated, and correlations of each index were analyzed.

Results: The average duration per call and HIT-6 score of the subjects decreased significantly compared with those recorded two years ago. The results showed a slight but significant correlation between call duration changes and HIT-6 score changes for female subjects, but not for males. HIT-6 scores in the follow-up survey significantly decreased compared to those in the baseline survey, but long-time call users (subjects whose call duration was ≥5 min in both the baseline and follow-up surveys) had no statistically significant reduction in HIT-6 scores.

Conclusion: This study suggests that increased call duration is a greater risk factor for increases in headache than any other type of adverse health effect, and that this effect can be chronic.

https://www.ncbi.nlm.nih.gov/pubmed/28111420

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Symptoms and the use of wireless communication devices: A prospective cohort study in Swiss adolescents

Schoeni A, Roser K, Röösli M. Symptoms and the use of wireless communication devices: A prospective cohort study in Swiss adolescents.Environ Res. 2017 Jan 20;154:275-283. doi: 10.1016/j.envres.2017.01.004. [Epub ahead of print]

Abstract

BACKGROUND: We investigated whether radiofrequency electromagnetic fields (RF-EMF) from mobile phones and other wireless devices or by the wireless device use itself due to non-radiation related factors in that context are associated with an increase in health symptom reports of adolescents in Central Switzerland.

METHODS: In a prospective cohort study, 439 study participants (participation rate: 36.8%) aged 12-17 years, completed questionnaires about their mobile and cordless phone use, their self-reported symptoms and possible confounding factors at baseline (2012/2013) and one year later (2013/2014). Operator recorded mobile phone data was obtained for a subgroup of 234 adolescents. RF-EMF dose measures considering various factors affecting RF-EMF exposure were computed for the brain and the whole body. Data were analysed using a mixed-logistic cross-sectional model and a cohort approach, where we investigated whether cumulative dose over one year was related to a new onset of a symptom between baseline and follow-up. All analyses were adjusted for relevant confounders.

RESULTS: Participation rate in the follow-up was 97% (425 participants). In both analyses, cross-sectional and cohort, various symptoms tended to be mostly associated with usage measures that are only marginally related to RF-EMF exposure such as the number of text messages sent per day (e.g. tiredness: OR:1.81; 95%CI:1.20-2.74 for cross-sectional analyses and OR:1.87; 95%CI:1.04-3.38 for cohort analyses). Outcomes were generally less strongly or not associated with mobile phone call duration and RF-EMF dose measures.

CONCLUSIONS: Stronger associations between symptoms of ill health and wireless communication device use than for RF-EMF dose measures were observed. Such a result pattern does not support a causal association between RF-EMF exposure and health symptoms of adolescents but rather suggests that other aspects of extensive media use are related to symptoms.

https://www.ncbi.nlm.nih.gov/pubmed/28113068

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Exposure to Radiofrequency Electromagnetic Fields From Wi-Fi in Australian Schools

Karipidis K, Henderson S, Wijayasinghe D, Tjong L, Tinker R.Exposure to Radiofrequency Electromagnetic Fields From Wi-Fi in Australian Schools.Radiat Prot Dosimetry. 2017 Jan 10. doi: 10.1093/rpd/ncw370. [Epub ahead of print]

Note: Typical and peak RF levels were found to be lower than ICNIRP guidelines. However, many researchers believe that the guidelines are inadequate to ensure safety. Furthermore,peak RF levels were averaged over 1 minute which is much too long as very short-term intense pulses may have biologic effects.

Abstract

The increasing use of Wi-Fi in schools and other places has given rise to public concern that the radiofrequency (RF) electromagnetic fields from Wi-Fi have the potential to adversely affect children. The current study measured typical and peak RF levels from Wi-Fi and other sources in 23 schools in Australia. All of the RF measurements were much lower than the reference levels recommended by international guidelines for protection against established health effects. The typical and peak RF levels from Wi-Fi in locations occupied by children in the classroom were of the order of 10-4 and 10-2% of the exposure guidelines, respectively. Typical RF levels in the classroom were similar between Wi-Fi and radio but higher than other sources. In the schoolyard typical RF levels were higher for radio, TV and mobile phone base stations compared to Wi-Fi. The results of this study showed that the typical RF exposure of children from Wi-Fi at school is very low and comparable or lower to other sources in the environment.

Excerpts

Wi-Fi transmissions consist of sequences of RF burst signals or pulses ranging in duration depending on the amount of data being carried by a pulse(15). The proportion of time that Wi-Fi transmits RF signals is called the duty cycle. Joseph et al.(14) in measuring Wi-Fi in 176 different urban locations (outdoors, homes, offices) found a median duty cycle of 1.4% over all the measurements. Particularly in schools, Khalid et al.(10) in measuring Wi-Fi in six schools found a mean duty cycle from the access points of 4.8%. In our study duty cycle was measured separately for the 2.45 and 5 GHz transmissions when performing the stationary Wi-Fi measurements in the centre of the classroom. The median duty cycle for 23 schools that were measured in the current study was 6.3 and 2.4% for 2.45 and 5 GHz transmissions, respectively.

Members of the public often ask about the cumulative exposure that a child receives when using a Wi-Fi device in a classroom in which a number of children are simultaneously using Wi-Fi. When downloading files, most of the transmissions will be from the access point, not the students' device. When downloading and uploading only a portion of the maximum capacity of a network would be used even in a classroom filled with children using Wi-Fi. The Wi-Fi network divides RF transmissions among the access points and client devices therefore the individual RF exposure to a child in a classroom that is using a device consists of sequential exposures from all active devices, the majority of which are located at some distance away(15). For the majority of schools (20) the measurements in the current study were conducted in an empty classroom (to avoid lesson disruption) with an access point and one laptop. In three schools, measurements were conducted with students or teachers present and using Wi-Fi devices. A comparison between measurements conducted in empty classrooms and classrooms with multiple students/teachers using Wi-Fi showed no significant difference in the RF levels ($p > 0.1$ for all); although this may have been due to low numbers (only three schools measured with multiple users in the classroom).

Open Access Paper: http://rpd.oxfordjournals.org/content/early/2017/01/10/rpd.ncw370.long

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Monitoring of RF/Microwave field strength at schools in a pilot district in Samsun/Turkey

Çetin Kurnaz, Begüm Korunur Engiz, Murat Cem Bozkurt. Monitoring of RF/Microwave field strength at schools in a pilot district in Samsun/Turkey. Microwave Symposium (MMS), 2016 16th Mediterranean. 14-16 Nov 2016.

Abstract

As a result of the growing usage of wireless devices and a large number of WLANs installations at schools; determining the exposure levels to students and staff from these systems has become more crucial than before. Since microwave radio links are used to provide connection between wireless devices, proper assessment of exposure to microwave emissions must be carried out. For this reason, in this study

electromagnetic radiation (EMR) measurements were conducted at 92 different schools in Ilkadim district twice in 2016 using PMM 8053 EMR meter. The changes in and statistical properties of electric field strengths (E) are determined on the basis of these measurements. The maximum Es (Emax) are 5.39 V/m and 3.04 V/m for each measurement while the maximum average Es (Eavg) are 2.22 and 2.25 V/m. Even though the measured E levels are below the limits that are determined by the International Commission on Non-Ionizing Radiation Protection (ICNIRP); for providing a wide margin of protection and evaluating the health risks they may cause, regular control/measurement of exposed EMR levels is recommended.

Excerpt

The pie chart showing the distributions of all EMR sources is given in Fig.5. As seen from the figure, 99.16% of total EMR in the medium is emitted by base stations which use 800MHz (LTE800), 900MHz (GSM900), 1800MHz (GSM1800) and 2100MHz (UMTS2100) frequency bands. Among the four of them, GSM900 has the most contribution
with 36.49%**.**

[Note: The paper did not discuss the extent Wi-Fi was used in these schools. WLAN was found to emit 0.024 V/m on average.]

http://ieeexplore.ieee.org/document/7803786/

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RF exposure survey of children and adults: First results from Slovenia

Gajšek P, Struchen B, Valič B. RF exposure survey of children and adults: First results from Slovenia. IEEE Radio and Antenna Days of the Indian Ocean (RADIO). 10-13 Oct. 2016. 10.1109/RADIO.2016.7772027

Abstract

Although RF exposure surveys have been carried out in the general environment using recently developed personal measurement devices (exposure meters), comprehensive measurement of exposure with a true population based sampling frame and a common protocol across countries has never been conducted. Within the FP-7 funded project Geronimo a personal RF exposure measurements in 5 European countries are conducted following a common measurement protocol. First measurements from 49 children and 49 parents in Slovenia yielded an average personal RF-EMF exposure of 0.26 V/m. Average personal RF-EMF exposure by technology was 0.11 V/m from uplink, 0.18 V/m from downlink, 0.15 V/m from broadcasting, 0.07 V/m from DECT and 0.08 V/m from WLAN.

http://ieeexplore.ieee.org/document/7772027/

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Can body-worn devices be used for measuring personal exposure to mm waves?

Thielens A, Martens L, Joseph W. Can body-worn devices be used for measuring personal exposure to mm waves? Bioelectromagnetics. 2017 Jan 20. doi: 10.1002/bem.22036. [Epub ahead of print]

Abstract

Fifth generation (5G) telecommunication networks will require more bandwidth and will use mm waves (30-300 GHz). Consequently, the aperture of antennas that are used for electromagnetic field measurements will be reduced in comparison to the ones currently used for lower frequencies (0.1-6 GHz). In combination with existing limits on incident power density prescribed by exposure guidelines, this provides an upper limit to received powers during exposure measurements. Simultaneously, an increase in the noise floor of transmitted

signals will occur. These effects limit the dynamic range of measurements to 53 dB (2×10^5) at 300 GHz and 73 dB (2×10^7) at 30 GHz, which are determined using a simplified model. Additional propagation losses that exceed this dynamic range can occur during on-body measurements. Therefore, in future wireless networks, an on-body measurement of the incident power density cannot be guaranteed using a single antenna. This effect is problematic for both occupational measurements and epidemiological studies. We propose to use multiple, dynamic antennas on the body instead.

https://www.ncbi.nlm.nih.gov/pubmed/28106915

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Measurements of intermediate-frequency electric and magnetic fields in households

Aerts S, Calderon C, Valič B, Maslanyj M, Addison D, Mee T, Goiceanu C, Verloock L, Van den Bossche M, Gajšek P Vermeulen 5, Röösli M, Cardis E, Martens L, Joseph W.Measurements of intermediate-frequency electric and magnetic fields in households. Environ Res. 2017 Jan 10;154:160-170. doi: 10.1016/j.envres.2017.01.001. [Epub ahead of print]

Highlights

• Survey of residential electric and magnetic fields at intermediate frequencies (IF).
• IF-EF and -MF emitted by 280 household appliances were characterised.
• Strongest emitters were induction cookers, CFLs, LCD-TVs, and microwave ovens.
• No emissions exceeded ICNIRP limits (highest exposure quotient was 1.00).

Abstract

Historically, assessment of human exposure to electric and magnetic fields has focused on the extremely-low-frequency (ELF) and radiofrequency (RF) ranges. However, research on the typically emitted fields in the intermediate-frequency (IF) range (300Hz to 1MHz) as well as potential effects of IF fields on the human body remains limited, although the range of household appliances with electrical components working in the IF range has grown significantly (e.g., induction cookers and compact fluorescent lighting). In this study, an extensive measurement survey was performed on the levels of electric and magnetic fields in the IF range typically present in residences as well as emitted by a wide range of household appliances under real-life circumstances. Using spot measurements, residential IF field levels were found to be generally low, while the use of certain appliances at close distance (20cm) may result in a relatively high exposure. Overall, appliance emissions contained either harmonic signals, with fundamental frequencies between 6kHz and 300kHz, which were sometimes accompanied by regions in the IF spectrum of rather noisy, elevated field strengths, or much more capricious spectra, dominated by 50Hz harmonics emanating far in the IF domain. The maximum peak field strengths recorded at 20cm were 41.5V/m and 2.7A/m, both from induction cookers. Finally, none of the appliance emissions in the IF range exceeded the exposure summation rules recommended by the International Commission on Non-Ionizing Radiation Protection guidelines and the International Electrotechnical Commission (IEC 62233) standard at 20cm and beyond (maximum exposure quotients EQE 1.0 and EQH 0.13).

https://www.ncbi.nlm.nih.gov/pubmed/28086101

Conclusions

Measurements of electric and magnetic fields at intermediate frequencies (IF) were performed in residences in three countries by way of a common protocol. Typical IF fields in the most frequented rooms were assessed as well as emissions from a wide range of household appliances. At distances of 1 m or more from the IF sources, field levels were found to be generally low. However, use of certain appliances at close distances (20–50cm), including induction cookers, LCD screens, microwave ovens and refrigerators with inverter technology, and

(compact) fluorescent lighting, may result in exposures above 5% of public ICNIRP (2010) reference levels. In general, EF and MF emissions of household appliances in the IF range contained either harmonic signals, with fundamental frequencies between 6 and 293 kHz, which were sometimes accompanied by regions in the IF spectrum of rather noisy, elevated field strengths, or much more capricious spectra, seemingly dominated by 50 Hz harmonics emanating far in the IF domain. The maximum peak field strengths recorded in this study were 41.5 V/m and 2.7 A/m (both resulting from induction cookers) and at 20 cm and beyond none of the appliances exceeded the ICNIRP and IEC exposure summation rules (maximum observed electric- and magnetic-field exposure quotients were 1.00 and 0.13, respectively). The results reported here may provide a useful resource for epidemiological studies investigating the potential link between (adverse) health effects and exposure to IF fields.

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Effect of Low Level Subchronic Microwave Radiation on Rat Brain

Deshmukh PS, Megha K, Nasare N, Banerjee BD, Ahmed RS, Abegaonkar MP, Tripathi AK, Mediratta PK. Effect of Low Level Subchronic Microwave Radiation on Rat Brain. Biomed Environ Sci. 2016 Dec;29(12):858-867. doi: 10.3967/bes2016.115.

Abstract

OBJECTIVE: The present study was designed to investigate the effects of subchronic low level microwave radiation (MWR) on cognitive function, heat shock protein 70 (HSP70) level and DNA damage in brain of Fischer rats.

METHODS: Experiments were performed on male Fischer rats exposed to microwave radiation for 90 days at three different frequencies: 900, 1800, and 2450 MHz. Animals were divided into 4 groups: Group I: Sham exposed, Group II: animals exposed to microwave radiation at 900 MHz and specific absorption rate (SAR) 5.953 × 10-4 W/kg, Group III: animals exposed to 1800 MHz at SAR 5.835 × 10-4 W/kg and Group IV: animals exposed to 2450 MHz at SAR 6.672 × 10-4 W/kg. All the animals were tested for cognitive function using elevated plus maze and Morris water maze at the end of the exposure period and subsequently sacrificed to collect brain tissues. HSP70 levels were estimated by ELISA and DNA damage was assessed using alkaline comet assay.

RESULTS: Microwave exposure at 900-2450 MHz with SAR values as mentioned above lead to decline in cognitive function, increase in HSP70 level and DNA damage in brain.

CONCLUSION: The results of the present study suggest that low level microwave exposure at frequencies 900, 1800, and 2450 MHz may lead to hazardous effects on brain.

Open source paper: http://bit.ly/2jhXm84

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Long-term exposure to 835 MHz RF-EMF induces hyperactivity, autophagy and demyelination in the cortical neurons of mice

Kim JH, Yu DH, Huh YH, Lee EH, Kim HG, Kim HR.Long-term exposure to 835 MHz RF-EMF induces hyperactivity, autophagy and demyelination in the cortical neurons of mice. Sci Rep. 2017 Jan 20;7:41129. doi: 10.1038/srep41129.

Abstract

Radiofrequency electromagnetic field (RF-EMF) is used globally in conjunction with mobile communications.

There are public concerns of the perceived deleterious biological consequences of RF-EMF exposure. This study assessed neuronal effects of RF-EMF on the cerebral cortex of the mouse brain as a proxy for cranial exposure during mobile phone use. C57BL/6 mice were exposed to 835 MHz RF-EMF at a specific absorption rate (SAR) of 4.0 W/kg for 5 hours/day during 12 weeks. The aim was to examine activation of autophagy pathway in the cerebral cortex, a brain region that is located relatively externally. Induction of autophagy genes and production of proteins including LC3B-II and Beclin1 were increased and accumulation of autolysosome was observed in neuronal cell bodies. However, proapoptotic factor Bax was down-regulted in the cerebral cortex. Importantly, we found that RF-EMF exposure led to myelin sheath damage and mice displayed hyperactivity-like behaviour. The data suggest that autophagy may act as a protective pathway for the neuronal cell bodies in the cerebral cortex during radiofrequency exposure. The observations that neuronal cell bodies remained structurally stable but demyelination was induced in cortical neurons following prolonged RF-EMF suggests a potential cause of neurological or neurobehavioural disorders.

https://www.ncbi.nlm.nih.gov/pubmed/28106136

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Extremely low-level microwaves attenuate immune imbalance induced by inhalation exposure to low-level toluene in mice

Novoselova EG, Glushkova OV, Khrenov MO, Novoselova TV, Lunin SM, Fesenko EE. Extremely low-level microwaves attenuate immune imbalance induced by inhalation exposure to low-level toluene in mice. Int J Radiat Biol. 2017 Jan 9:1-9. doi: 10.1080/09553002.2017.1270473. [Epub ahead of print]

Abstract

PURPOSE: To clarify whether extremely low-level microwaves (MW) alone or in combination with p38 inhibitor affect immune cell responses to inhalation exposure of mice to low-level toluene.

MATERIALS AND METHODS: The cytokine profile, heat shock proteins expression, and the activity of several signal cascades, namely, NF-κB, SAPK/JNK, IRF-3, p38 MAPK, and TLR4 were measured in spleen lymphocytes of mice treated to air-delivered toluene (0.6 mg/m3) or extremely low-level microwaves (8.15-18 GHz, 1μW/cm2, 1 Hz swinging frequency) or combined action of these two factors.

RESULTS: A single exposure to air-delivered low-level toluene induced activation of NF-κB, SAPK/JNK, IFR-3, p38 MAPK and TLR4 pathways. Furthermore, air toluene induced the expression of Hsp72 and enhanced IL-1, IL-6, and TNF-α in blood plasma, which is indicative of a pro-inflammatory response. Exposure to MW alone also resulted in the enhancement of the plasma cytokine values (e.g. IL-6, TNF-α, and IFN-γ) and activation of the NF-κB, MAPK p38, and especially the TLR4 pathways in splenic lymphocytes. Paradoxically, pre-exposure to MW partially recovered or normalized the lymphocyte parameters in the toluene-exposed mice, while the p38 inhibitor XI additionally increased protective activity of microwaves by down regulating MAPKs (JNK and p38), IKK, as well as expression of TLR4 and Hsp90-α.

CONCLUSIONS: The results suggest that exposure to low-intensity MW at specific conditions may recover immune parameters in mice undergoing inhalation exposure to low-level toluene via mechanisms involving cellular signaling.

EXCERPT: In the present study, we examined the effects of MW on the immunity of toluene-exposed mice. We hypothesized that MW exposure would protect mouse cells from the possible toxic effects of toluene. Indeed, we have previously demonstrated that the extremely low-level centimetre waves improved immunity of tumor-bearing mice, and this anti-tumor effect was mediated by TNF production (Novoselova et al. 2004Novoselova EG, Ogay VB, Sorokina OV, Glushkova OV, Sinotova OA, Fesenko EE.2004. The production of tumor necrosis factor in cells of tumor-bearing mice after total-body microwave irradiation and antioxidant diet. Elec Bio Med. 23:167–180.[Taylor & Francis Online], [Web of Science ®]). These results indicate the

biologic activity of extremely low-level MW that might be used as a tolerable immunomodulatory factor. The present study demonstrated that the p38 Inhibitor XI increased the protective activity of MW via down-regulation of MAPKs (JNK and p38), IKK, as well as expression of TLR4 and Hsp90-α.

In conclusion, we focused on the changes of several signaling cascade activities, plasma cytokine values, TLR4 and heat shock protein expression in mice exposed to a low-level of toluene, with or without MW alone or in combination with p38 Inhibitor XI. Our data demonstrated that a single exposure to low-level air toluene induced a pro-inflammatory response, while MW alone or in combination with the inhibitor, partially recovered or normalized the studied parameters in the murine spleen.

Further studies using appropriate animal models are necessary to provide evidence-based support for new MW facilities to regulate the immune response following exposure to environmental toxins.

https://www.ncbi.nlm.nih.gov/pubmed/28067111

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Adverse and beneficial effects in Chinese hamster lung fibroblast cells following radiofrequency exposure

Sannino A, Zeni O, Romeo S, Massa R, Scarfi MR. Adverse and beneficial effects in Chinese hamster lung fibroblast cells following radiofrequency exposure.Bioelectromagnetics. 2017 Jan 10. doi: 10.1002/bem.22034. [Epub ahead of print]

Abstract

In this study, the effect of radiofrequency (RF) exposure to 1950 MHz, Universal Mobile Telecommunication System signal, was investigated in Chinese hamster lung fibroblast cell line (V79). Genotoxic and cytotoxic effects of 20-h exposure at specific absorption rate (SAR) values from 0.15 W/kg to 1.25 W/kg were measured by means of cytokinesis-block micronucleus (MN) assay. Exposure was carried out blinded under strictly controlled conditions of dosimetry and temperature. The effect of RF exposure alone at four SAR values was tested, that is, 0.15, 0.3, 0.6, and 1.25 W/kg. A statistically significant increase in MN frequency was found in cultures exposed to 0.15 and 0.3 W/kg ($P < 0.05$) compared to sham-exposed ones, in the absence of cytotoxicity. SAR values of 0.6 and 1.25 W/kg did not exert any effect. Moreover, to evaluate the ability of RF to exert protective effects with respect to a chemical mutagen, cell cultures were also pre-exposed for 20 h at 0.3 or 1.25 W/kg, and then treated with 500 ng/ml of mitomycin-C (MMC). A significant reduction in the frequency of MN was detected in cultures pre-exposed to 1.25 W/kg compared to cultures treated with MMC alone ($P < 0.05$), indicating induction of adaptive response. Such a decrease was not induced by pre-exposure at 0.3 W/kg SAR. Taken together, our results indicated that V79 is a sensitive cell model to evidence either adverse or beneficial effects of RF exposure, depending on experimental conditions applied.

Excerpts

The results presented here indicated lack of MN increase in cultures exposed for 20 h to 1950 MHz, UMTS signal, at SAR values of 0.6 and 1.25 W/kg. On the contrary, exposure to 0.15 and 0.3 W/kg SAR resulted in a statistically significant increase in MN frequency ($P < 0.05$), compared to sham controls. Concerning 0.3 W/kg, such an increase was also detected in three more independent experiments, carried out to evaluate RF-induced AR (Table 3). On the whole, an average MN increase of 55% was gained on seven independent experiments, in absence of cytotoxicity, although some experimental variability was recorded.

The observed effect was non-thermal, since chromosomal damage has been recorded at 0.15 and 0.3 W/kg SAR but not at higher values (0.6 and 1.25 W/kg)....

Consistent with results presented here, Xu et al. [2013] identified Chinese hamster fibroblasts as a sensitive cell model in a comparative study where different cell types were exposed to RF. The authors exposed six cell types to 1800 MHz, GSM, 3 W/kg SAR, and 24 h exposure (5 min on/10 min off cycles), resulting in a significant increase in DNA damage, evaluated as gamma foci formation in Chinese hamster lung cells and human skin fibroblasts, but not in other cell types tested [Xu et al., 2013].

The dependency of the effect on cell type has been also reported by other authors, who demonstrated that the same RF exposure conditions resulted in affecting certain cell types but not others, when protein expression [Sanchez et al., 2006; Zimmerman et al., 2012; Lu et al., 2014], enzyme activity [Hoyto et al., 2007], oxidative stress [Lantow et al., 2006], or cell proliferation [Trillo et al., 2011] were investigated.

We do not have an explanation for the chromosomal damage detected in this investigation. Rather, due to dependence of the effect on SAR level, our findings seem in agreement with the theory of “window” effects, proposed to explain several non-linear results in bioelectromagnetic research [Postow and Swicord, 1986]. Effects have been reported at some frequencies but not at others, or at lower but not at higher SAR levels of the same frequency, or at certain modulations but not at others, either in vivo or in vitro [Dutta et al., 1992; Panagopoulos and Margaritis, 2010a,b].

https://www.ncbi.nlm.nih.gov/pubmed/28072461

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Study of potential health effects of electromagnetic fields of telephony and Wi-Fi, using chicken embryo development as animal model

Woelders H, de Wit A, Lourens A, Stockhofe N, Engel B, Hulsegge I, Schokker D, van Heijningen P, Vossen S, Bekers D, Zwamborn P. Study of potential health effects of electromagnetic fields of telephony and Wi-Fi, using chicken embryo development as animal model.Bioelectromagnetics. 2017 Jan 16. doi: 10.1002/bem.22026. [Epub ahead of print]

Abstract

The objective of this study is to investigate possible biological effects of radiofrequency electromagnetic fields (RF-EMF) as used in modern wireless telecommunication in a well-controlled experimental environment using chicken embryo development as animal model. Chicken eggs were incubated under continuous experimental exposure to GSM (1.8 GHz), DECT (1.88 GHz), UMTS (2.1 GHz), and WLAN (5.6 GHz) radiation, with the appropriate modulation protocol, using a homogeneous field distribution at a field strength of approximately 3 V/m, representing the maximum field level in a normal living environment. Radiation-shielded exposure units/egg incubators were operating in parallel for exposed and control eggs in a climatized homogeneous environment, using 450 eggs per treatment in three successive rounds per treatment. Dosimetry of the exposure (field characteristics and specific absorption rate) were studied. Biological parameters studied included embryo death during incubation, hatching percentage, and various morphological and histological parameters of embryos and chicks and their organs, and gene expression profiles of embryos on day 7 and day 18 of incubation by microarray and qPCR. No conclusive evidence was found for induced embryonic mortality or malformations by exposure to the used EMFs, or for effects on the other measured parameters. Estimated differences between treatment groups were always small and the effect of treatment was not significant. In a statistical model that ignored possible interaction between rounds and exposure units, some of the many pairwise comparisons of exposed versus control had P-values lower than 0.05, but were not significant after correction for multiple testing.

https://www.ncbi.nlm.nih.gov/pubmed/28092407

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Effects of extremely low-frequency electromagnetic field on expression levels of some antioxidant genes in human MCF-7 cells

Mahmoudinasab H, Sanie-Jahromi F, Saadat M. Effects of extremely low-frequency electromagnetic field on expression levels of some antioxidant genes in human MCF-7 cells. Mol Biol Res Commun. 2016 Jun;5(2):77-85.

Abstract

In the past three decades, study on the biological effects of extremely low-frequency electromagnetic fields (ELF-EMFs) has been of interest to scientists. Although the exact mechanism of its effect is not fully understood, free radical processes has been proposed as a possible mechanism. This study was designed to evaluate the effect of 50-Hz EMFs on the mRNA levels of seven antioxidant genes (CAT, SOD1, SOD2, GSTO1, GSTM3, MSGT1, and MSGT3) in human MCF-7 cells. The EMF exposure patterns were: 1) 5 min field-on/5 min filed-off, 2) 15 min field-on/15 min field-off, 3) 30 min field-on continuously. In all three exposure conditions we tried to have total exposure time of 30 minutes. Control cultures were located in the exposure apparatus when the power was off. The experiments were done at two field intensities; 0.25 mT and 0.50 mT. The RNA extraction was done at two times; immediately post exposure and two hours post exposure. The mRNA levels were determined using quantitative real-time polymerase chain reaction. MTT assay for three exposure conditions in the two field intensities represented no cytotoxic effect on MCF-7 cells. Statistical comparison showed a significant difference between 0.25 mT and 0.50 mT intensities for "the 15 min field-on/15 min field-off condition" (Fisher's exact test, P=0.041), indicating that at 0.50 mT intensity field, the number of down-regulated and/or up-regulated genes increased compared with the other ones. However, there is no statistical significant difference between the field intensities for the two others EMF exposure conditions.

https://www.ncbi.nlm.nih.gov/pubmed/28097161

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Investigation of terahertz radiation influence on rat glial cells

Borovkova M, Serebriakova M, Fedorov V, Sedykh E, Vaks V, Lichutin A, Salnikova A, Khodzitsky M. Investigation of terahertz radiation influence on rat glial cells. Biomed Opt Express. 2016 Dec 14;8(1):273-280. doi: 10.1364/BOE.8.000273. eCollection 2017.

Abstract

We studied an influence of continuous terahertz (THz) radiation (0.12 - 0.18 THz, average power density of 3.2 mW/cm2) on a rat glial cell line. A dose-dependent cytotoxic effect of THz radiation is demonstrated. After 1 minute of THz radiation exposure a relative number of apoptotic cells increased in 1.5 times, after 3 minutes it doubled. This result confirms the concept of biological hazard of intense THz radiation. Diagnostic applications of THz radiation can be restricted by the radiation power density and exposure time.

Excerpts

... It is known that THz radiation causes a variety of biological effects, including some at the cellular level. Detailed reviews on this issue can be found in papers [2–7]. Influence of THz radiation on cells is revealed in the change of genes activity and cell membrane status. It was also reported before, that THz radiation changes the electrical charge of the membrane of human red blood cells [8, 9], causes a violation of the adhesive properties of the nerve cell membrane of a snail and mollusk [10, 11]. An indication of the structural damage is the increase in membrane permeability, as it was shown in some experiments with human red blood cells and lymphocytes [12], and laboratory rats red blood cells [13, 14].

Among the cellular effects, the cytotoxic effect of THz radiation is also an issue of concern for many scientists.

Currently, there is no consensus on this issue. Some studies have demonstrated that this effect does not occur [18–25], whereas in other works the effect was clearly displayed [10–12, 26–28]. Particularly, experiments in papers [19, 20, 25, 28] showed different results after exposure of THz radiation of approximately same frequency (0.10 – 0.15 THz) and power density (0.04 – 5 mW/cm2). In all mentioned experiments, registration of the effect was carried out using adequate methods; however, the samples under exposure were different. It is possible that presence or lack of the effect is associated with the properties and characteristics of some particular cells. For this investigation, glial cells were selected as the samples of the experiment. They are highly sensitive to the ionic changes in environment [29]. One of the mechanisms of THz radiation impact on living systems may be a disturbing effect on the status of the cell endogenous field, which will lead to changes in the ionic fluxes from a cell to environment and vice versa, and affect cell viability.

Conclusion In this investigation, we demonstrated a dose-dependent cytotoxic effect of THz radiation on rat glial cells. In the experiment, a C6 rat glial cell line was exposed by continuous THz radiation (0.12 – 0.18 THz) at average power density of 3.2 mW/cm^2. After one minute of exposure, a relative number of apoptotic cells increased by a factor of 1.5, after 5 minutes it became 2.4 times higher than the initial value. This result confirms the concept of biological hazard of intense THz radiation. Therefore, we claim that diagnostic applications of THz radiation can be restricted by the radiation power density and exposure time.

https://www.osapublishing.org/boe/abstract.cfm?uri=boe-8-1-273

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State of knowledge on biological effects at 40–60 GHz

Yves Le Dréan, Yonis Soubere Mahamoud, Yann Le Page, Denis Habauzit, Catherine Le Quément, Maxim Zhadobov, Ronan Sauleau. State of knowledge on biological effects at 40–60 GHz. Comptes Rendus Physique, 14(5):402-411. 2013.

Abstract

Millimetre waves correspond to the range of frequencies located between 30 and 300 GHz. Many applications exist and are emerging in this band, including wireless telecommunications, imaging and monitoring systems. In addition, some of these frequencies are used in therapy in Eastern Europe, suggesting that interactions with the human body are possible. This review aims to summarise current knowledge on interactions between millimetre waves and living matter. Several representative examples from the scientific literature are presented. Then, possible mechanisms of interactions between millimetre waves and biological systems are discussed.

http://www.sciencedirect.com/science/article/pii/S1631070513000480

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Temperature distribution and Specific Absorption Rate inside a child's head

Vladimir Stanković, Dejan Jovanović, Dejan Krstić, Vera Marković, Nenad Cvetković. Temperature distribution and Specific Absorption Rate inside a child's head. International Journal of Heat and Mass Transfer, Volume 104, January 2017, Pages 559-565.

Highlights

• The numerical analysis of SAR and temperature distribution within a child head.
• Determination of SAR and increasing of temperature within biological tissues.
• Dependence of the SAR and temperature values on the distance.
• Comparison of results obtained by numerical calculation with experimental results.

Abstract

This paper represents the numerical analysis of Specific Absorption Rate (SAR) and temperature distribution within a real child head model exposed to mobile phone radiation at the frequency of f = 900 MHz. In this research the SAR and temperature distribution are obtained by numerical solutions of the equation of electromagnetic waves propagation and by bioheat equation, respectively, and are shown inside different biological tissues and organs during exposure to electromagnetic radiation from a mobile phone. As electromagnetic properties of tissues depend on the electromagnetic waves frequency, the value of SAR and temperature will be different for different tissues and organs. The maximum absorption of electromagnetic energy is in the surface layers of the model, whereby this value is greater than the maximum allowed value defined by standards. Furthermore, the increase in temperature is the highest in those biological tissues and organs that are closest to the source of radiation i.e. a mobile phone. Moving away from a mobile phone, the temperature decreases, but more slowly than the SAR values. In the analysis of the temperature rise resulting from tissues and organs heating due to the effects of electromagnetic fields on a child's head, special attention will be given to the maximum temperature increase in the brain.

Conclusion

This study investigated the distribution of SAR and temperature rise in the anatomical model of a child's head exposed to electromagnetic fields from mobile phones. It was determined that although the values of SAR and temperature decrease with the distance from the source of radiation, it is not possible to establish a direct connection between these quantities. This is primarily because the SAR represents instantaneous heating of tissue. The distribution of temperature will vary compared to the distribution of SAR due to different mechanisms of heat transfer in the thermal model of a child's head.

Although the value of SAR in the brain is below the maximum allowable values, the fact that the SAR levels in certain tissues and organs of the model are significantly above the maximum allowable value must not be disregarded. It is precisely these areas of a child's head that should be the focus of further research of possible unwanted effects of mobile phone radiation.

On the other hand, the temperature of the brain does not exceed 0.7 C, which is below the threshold for causing undesirable thermal effects on neurons [29], while in other parts of the head the temperature does not exceed 1 C.

Of course, it should be noted that the exposure to electromagnetic radiation for 15 min was simulated. Therefore, the obtained results suggest that, in addition to a dosimetry analysis, it is also necessary to perform the thermal analysis of the impact of mobile phone radiation.

http://bit.ly/2jcBjz9

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Personal radiofrequency electromagnetic field exposure measurements in Swiss adolescents

Roser K, Schoeni A, Struchen B, Zahner M, Eeftens M, Fröhlich J, Röösli M. Personal radiofrequency electromagnetic field exposure measurements in Swiss adolescents.Environ Int. 2016 Dec 27. pii: S0160-4120(16)30527-X. doi: 10.1016/j.envint.2016.12.008. [Epub ahead of print]

Abstract

BACKGROUND: Adolescents belong to the heaviest users of wireless communication devices, but little is known about their personal exposure to radiofrequency electromagnetic fields (RF-EMF).

OBJECTIVES: The aim of this paper is to describe personal RF-EMF exposure of Swiss adolescents and evaluate exposure relevant factors. Furthermore, personal measurements were used to estimate average contributions of various sources to the total absorbed RF-EMF dose of the brain and the whole body.

METHODS: Personal exposure was measured using a portable RF-EMF measurement device (ExpoM-RF) measuring 13 frequency bands ranging from 470 to 3600MHz. The participants carried the device for three consecutive days and kept a time-activity diary. In total, 90 adolescents aged 13 to 17years participated in the study conducted between May 2013 and April 2014. In addition, personal measurement values were combined with dose calculations for the use of wireless communication devices to quantify the contribution of various RF-EMF sources to the daily RF-EMF dose of adolescents.

RESULTS: Main contributors to the total personal RF-EMF measurements of 63.2μW/m2 (0.15V/m) were exposures from mobile phones (67.2%) and from mobile phone base stations (19.8%). WLAN at school and at home had little impact on the personal measurements (WLAN accounted for 3.5% of total personal measurements). According to the dose calculations, exposure from environmental sources (broadcast transmitters, mobile phone base stations, cordless phone base stations, WLAN access points, and mobile phones in the surroundings) contributed on average 6.0% to the brain dose and 9.0% to the whole-body dose.

CONCLUSIONS: RF-EMF exposure of adolescents is dominated by their own mobile phone use. Environmental sources such as mobile phone base stations play a minor role.

https://www.ncbi.nlm.nih.gov/pubmed/28038972

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Where's Your Phone? A Survey of Where Women Aged 15-40 Carry Their Smartphone and Related Risk Perception: A Survey and Pilot Study

Redmayne M. Where's Your Phone? A Survey of Where Women Aged 15-40 Carry Their Smartphone and Related Risk Perception: A Survey and Pilot Study. PLoS One. 2017 Jan 6;12(1):e0167996. doi: 10.1371/journal.pone.0167996. eCollection 2017.

Abstract

Smartphones are now owned by most young adults in many countries. Installed applications regularly update while the phone is in standby. If it is kept near the body, this can lead to considerably higher exposure to

radiofrequency electromagnetic radiation than occurred without internet access. Very little is known about current smartphone carrying habits of young women. This survey used an online questionnaire to ask about smartphone location under several circumstances to inform the power calculation for a women's health study. They were also asked about risk perceptions. Data was analysed using Pearson chi square. Three age categories were made: 15-20, 21-30, 31-40. Smartphones were generally kept on standby (96% by day, 83% at night). Of all participants, in the last week the most common locations of the phone when not in use or during passive use was off-body (86%), in the hand (58%), a skirt/trouser pocket (57%), or against the breast (15%). Pocket and near-the-breast storage were significant by age (χ215.04, p = 0.001 and χ210.96, p = 0.04, respectively), both positively influenced by the youngest group. The same influence lay in the association between holding the phone (χ211.082, p = 0.004) and pocket-storage (χ219.971, p<0.001) during passive use. For calls, 36.5% solely used the phone against the head. More than half kept the phone 20-50 cms from their head at night (53%), while 13% kept it closer than 20 cms. Many (36%) thought RF-EMR exposure was related to health problems while 16% did not. There was no relationship between thinking RF-EMR exposure causes health problems in general and carrying the phone against the upper or lower body (p = 0.69 and p = 0.212, respectively). However, calls with the phone against the head were positively related to perception of health risk (χ2 6.695, p = 0.035). Our findings can be used in the power calculation for a case-control study.

http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0167996

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Effect of cell phone-like electromagnetic radiation on primary human thyroid cells

Silva V, Hilly O, Strenov Y, Tzabari C, Hauptman Y, Feinmesser R. Effect of cell phone-like electromagnetic radiation on primary human thyroid cells. Int J Radiat Biol. 2016;92(2):107-15. doi: 10.3109/09553002.2016.1117678. Epub 2015 Dec 21.

Abstract

PURPOSE: To evaluate the potential carcinogenic effects of radiofrequency energy (RFE) emitted by cell phones on human thyroid primary cells.

MATERIALS AND METHODS: Primary thyroid cell culture was prepared from normal thyroid tissue obtained from patients who underwent surgery at our department. Subconfluent thyroid cells were irradiated under different conditions inside a cell incubator using a device that simulates cell phone-RFE. Proliferation of control and irradiated cells was assessed by the immunohistochemical staining of antigen Kiel clone-67 (Ki-67) and tumor suppressor p53 (p53) expression. DNA ploidy and the stress biomarkers heat shock protein 70 (HSP70) and reactive oxygen species (ROS) was evaluated by fluorescence-activated cell sorting (FACS).

RESULTS: Our cells highly expressed thyroglobulin (Tg) and sodium-iodide symporter (NIS) confirming the origin of the tissue. None of the irradiation conditions evaluated here had an effect neither on the proliferation marker Ki-67 nor on p53 expression. DNA ploidy was also not affected by RFE, as well as the expression of the biomarkers HSP70 and ROS.

CONCLUSION: Our conditions of RFE exposure seem to have no potential carcinogenic effect on human thyroid cells. Moreover, common biomarkers usually associated to environmental stress also remained unchanged. We failed to find an association between cell phone-RFE and thyroid cancer. Additional studies

are recommended.

https://www.ncbi.nlm.nih.gov/pubmed/26689947

Note: This study did not expose the cell samples to cell phone radiation. The RFE exposure in this simulation did not resemble cell phone radiation.

"Subconfluent thyroid cells were irradiated ... using a device consisting of a Radio Frequency (RF) generator (Fluke 60602A, manufactured by Fluke, Everett, WA) and an RF power amplifier (EMPower 7044, Holbrook, NY). The RF generator, located outside the incubator, was set to the desired power and connected to the power amplifier, which was connected to a panel antenna that was fixed inside the incubator."

"... an antenna was placed inside the cell incubator and set at 900 or 895 MHz and 80 or 210 μW/cm2 to simulate the radiation emitted by mobile phones."

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Environmental and health aspects of mobile phone production and use: Suggestions for innovation and policy

Senthil velmurugan Manivannan. Environmental and health aspects of mobile phone production and use: Suggestions for innovation and policy. Environmental Innovation and Societal Transitions, 21:69-79. December 2016.

Abstract

Mobile phones are universally popular due to their convenience. But their production and use can cause various environmental, energy and health effects. The present study addresses the adverse effects of mobile phones, and proposed remedies to overcome them. It pays special attention to the role of technical innovation. It is suggested that governments and the mobile telecommunication industry need to work together to develop realistic and effective regulations for design, manufacture, energy consumption, recycling and reuse of mobile phones so as to mitigate and minimize the various negative impacts.

http://www.sciencedirect.com/science/article/pii/S2210422416300260

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Effects of smartphone use with and without blue light at night in healthy adults: A randomized, double-blind, cross-over, placebo-controlled comparison

Jung-Yoon Heo, Kiwon Kim, Maurizio Fava, David Mischoulon, George I. Papakostas, Min-Ji Kim, Dong Jun Kim, Kyung-Ah Judy Chang, Yunhye Oh, Bum-Hee Yu, Hong Jin Jeon. Effects of smartphone use with and without blue light at night in healthy adults: A randomized, double-blind, cross-over, placebo-controlled comparison. Journal of Psychiatric Research. Available online 12 December 2016

Abstract

Smartphones deliver light to users through Light Emitting Diode (LED) displays. Blue light is the most potent wavelength for sleep and mood. This study investigated the immediate effects of smartphone blue light LED on humans at night. We investigated changes in serum melatonin levels, cortisol levels, body temperature, and psychiatric measures with a randomized, double-blind, cross-over, placebo-controlled design of two 3-day

admissions. Each subject played smartphone games with either conventional LED or suppressed blue light from 7:30 to 10:00PM (150 min). Then, they were readmitted and conducted the same procedure with the other type of smartphone. Serum melatonin levels were measured in 60-min intervals before, during and after use of the smartphones. Serum cortisol levels and body temperature were monitored every 120 min. The Profile of Mood States (POMS), Epworth Sleepiness Scale (ESS), Fatigue Severity Scale (FSS), and auditory and visual Continuous Performance Tests (CPTs) were administered. Among the 22 participants who were each admitted twice, use of blue light smartphones was associated with significantly decreased sleepiness (Cohen's d = 0.49, Z = 43.50, p = 0.04) and confusion-bewilderment (Cohen's d = 0.53, Z = 39.00, p = 0.02), and increased commission error (Cohen's d = −0.59, t = −2.64, p = 0.02). Also, users of blue light smartphones experienced a longer time to reach dim light melatonin onset 50% (2.94 vs. 2.70 h) and had increases in body temperature, serum melatonin levels, and cortisol levels, although these changes were not statistically significant. Use of blue light LED smartphones at night may negatively influence sleep and commission errors, while it may not be enough to lead to significant changes in serum melatonin and cortisol levels.

Conclusion

In conclusion, this study suggests that nighttime exposure to the blue light LED display of smartphones may negatively affect sleep and commission errors. This was reflected by the suppression of melatonin production, as indicated by the prolonged time to melatonin onset, and the increase in body temperature, although these changes were not great enough to be statistically significant. These findings indicate that sleep and cognitive functions may be more sensitive markers of exposure of blue light from smartphone LED displays than the physiological changes of melatonin, cortisol, and body temperature.

http://www.sciencedirect.com/science/article/pii/S0022395616307786

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Radiofrequency exposure in the Neonatal Medium Care Unit

I. Calvente, A. Vázquez-Pérez, M.F. Fernández, M.I. Núñez, A. Múñoz-Hoyos. Radiofrequency exposure in the Neonatal Medium Care Unit. Environmental Research, 152:66-72. January 2017.

Highlights

- The increasing use of RF-EMF suggests an urgent need for more research in this field.
- Health consequences of RF-EMF exposure on infants are not well known.
- Description of RF-EMF exposure is vital in further study mechanisms on infant health.
- Considering newborns vulnerability, it is wise to adopt a prudent avoidance strategy.

Abstract

The aims of this study were to characterize electromagnetic fields of radiofrequency (RF-EMF) levels generated in a Neonatal Medium Care Unit and to analyze RF-EMF levels inside unit's incubators. Spot and long-term measurements were made with a dosimeter. The spot measurement mean was 1.51±0.48 V/m. Higher values were found in the proximity to the window and to the incubator evaluated. Mean field strength for the entire period of 17 h was 0.81 (±0.07) V/m and the maximum value was 1.58 V/m for long-term RF-EMF measurements in the incubator. Values found during the night period were higher than those found during the day period. It is important to consider RF-EMF exposure levels in neonatal care units, due to some evidence of adverse health effects found in children and adults. Characterization of RF-EMF exposure may be important to further investigate the mechanisms and underlying effects of electromagnetic fields (EMF) on infant health. A prudent avoidance strategy should be adopted because newborns are at a vulnerable stage of development and the actual impact of EMF on premature infants is unknown.

http://www.sciencedirect.com/science/article/pii/S0013935116306570

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Long-term recall accuracy for mobile phone calls in young Japanese people

Kiyohara K, Wake K, Watanabe S, Arima T, Sato Y, Kojimahara N, Taki M, Cardis E, Yamaguchi N. Long-term recall accuracy for mobile phone calls in young Japanese people: A follow-up validation study using software-modified phones. J Expo Sci Environ Epidemiol. 2016 Dec 21. doi: 10.1038/jes.2016.73. [Epub ahead of print]

Abstract

This study examined changes in recall accuracy for mobile phone calls over a long period. Japanese students' actual call statuses were monitored for 1 month using software-modified phones (SMPs). Three face-to-face interviews were conducted to obtain information regarding self-reported call status during the monitoring period: first interview: immediately after the monitoring period; second interview: after 10-12 months; third interview: after 48-55 months. Using the SMP records as the "gold standard", phone call recall accuracy was assessed for each interview. Data for 94 participants were analyzed. The number of calls made was underestimated considerably and the duration of calls was overestimated slightly in all interviews. Agreement between self-report and SMP records regarding the number of calls, duration of calls and laterality (i.e., use of the dominant ear while making calls) gradually deteriorated with the increase in the interval following the monitoring period (number of calls: first interview: Pearson's r=0.641, third interview: 0.396; duration of calls: first interview: Pearson's r=0.763, third interview: 0.356; laterality: first interview: weighted-κ=0.677, third interview: 0.448). Thus, recall accuracy for mobile phone calls would be consistently imperfect over a long period, and the results of related epidemiological studies should be interpreted carefully.

https://www.ncbi.nlm.nih.gov/pubmed/28000687

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Assessment of General Public Exposure to LTE signals compared to other Cellular Networks Present in Thessaloniki, Greece

Gkonis F, Boursianis A, Samaras T. Assessment of General Public Exposure to LTE signals compared to other Cellular Networks Present in Thessaloniki, Greece. Radiat Prot Dosimetry. 2016 Dec 15. [Epub ahead of print]

Abstract

To assess general public exposure to electromagnetic fields from Long Term Evolution (LTE) base stations, measurements at 10 sites in Thessaloniki, Greece were performed. Results are compared with other mobile cellular networks currently in use. All exposure values satisfy the guidelines for general public exposure of the International Commission on Non-Ionizing Radiation Protection (ICNIRP), as well as the reference levels by the Greek legislation at all sites. LTE electric field measurements were recorded up to 0.645 V/m. By applying the ICNIRP guidelines, the exposure ratio for all LTE signals is between 2.9 × 10-5 and 2.8 × 10-2 From the measurements results it is concluded that the average and maximum power density contribution of LTE downlink signals to the overall cellular networks signals are 7.8% and 36.7%, respectively.

https://www.ncbi.nlm.nih.gov/pubmed/27986964

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Numerical compliance testing of human exposure to electromagnetic radiation from smart-watches

Hong SE, Lee AK, Kwon JH, Pack JK. Numerical compliance testing of human exposure to electromagnetic

radiation from smart-watches. Phys Med Biol. 2016 Oct 7;61(19):6975-6992. Epub 2016 Sep 20.

Abstract

In this study, we investigated the electromagnetic dosimetry for smart-watches. At present, the standard for compliance testing of body-mounted and handheld devices specifies the use of a flat phantom to provide conservative estimates of the peak spatial-averaged specific absorption rate (SAR). This means that the estimated SAR using a flat phantom should be higher than the SAR in the exposure part of an anatomical human-body model. To verify this, we numerically calculated the SAR for a flat phantom and compared it with the numerical calculation of the SAR for four anatomical human-body models of different ages. The numerical analysis was performed using the finite difference time domain method (FDTD). The smart-watch models were used in the three antennas: the shorted planar inverted-F antenna (PIFA), loop antenna, and monopole antenna. Numerical smart-watch models were implemented for cellular commutation and wireless local-area network operation at 835, 1850, and 2450 MHz. The peak spatial-averaged SARs of the smart-watch models are calculated for the flat phantom and anatomical human-body model for the wrist-worn and next to mouth positions. The results show that the flat phantom does not provide a consistent conservative SAR estimate. We concluded that the difference in the SAR results between an anatomical human-body model and a flat phantom can be attributed to the different phantom shapes and tissue structures.

https://www.ncbi.nlm.nih.gov/pubmed/?term=27648862

These results show that the flat phantom does not always yield a conservative estimate of the spatial peak SAR for the implemented smart-watch model at all exposure scenarios. A conservative exposure estimate for limb-worn device can be obtained by applying a multiplication factor between 1.1 and 2.6 to conventionally estimated values.

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Effects of Simulated Mobile Phone Electromagnetic Radiation on Fertilization and Embryo Development

Chen H, Qu Z, Liu W. Effects of Simulated Mobile Phone Electromagnetic Radiation on Fertilization and Embryo Development. Fetal Pediatr Pathol. 2016 Dec 16:1-7. [Epub ahead of print]

Abstract

This study investigated the effects of 935-MHz electromagnetic radiation (ER) on fertilization and subsequent embryonic development in mice. Ovulating mice were irradiated at three ER intensities for 4 h/day (d) or 2 h/d for three consecutive days; the ova were then harvested for in vitro fertilization to observe the 6-h fertilization rate (6-FR), 72-h morula rate (72-MR), and 110-h blastula rate (110-BR). Compared with the control group, the 6-FR, 72-MR, and 110-BR were decreased in the low ER intensity group, but the differences were not significant; in the mid- and high-intensity ER groups, 72-MR and 110-BR in the 4 h/d and 2 h/d subgroups were decreased, showing significant differences compared with the control group. Moreover, the comparison between 4 h/d and 2 h/d subgroups showed significant differences. Mid- and high-intensity ER at 935 MHz can reduce the fertilization rate in mice, and reduce the blastulation rate, thus reducing the possibility of embryo implantation.

https://www.ncbi.nlm.nih.gov/pubmed/27983879

Excerpts

Electromagnetic radiation devices consisted of four parts: a signal source (with frequency ranging from 935 to 960 MHz and magnetic field strength ranging from –15 db to +15 db), a rectifier (220 VAC/27 VDC; 300 W), a

power amplifier, and a specific antenna with a length of 15 cm.

The mice were divided into seven groups by using a random table method: low-intensity (2 h/d and 4 h/d subgroups), mid-intensity (570 μW/cm^2: 2 h/d and 4 h/d subgroups), high-intensity (1400 μW/cm^2: 2 h/d and 4 h/d subgroups), and control groups.

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Chronic Nonmodulated Microwave Radiations in Mice Produce Anxiety-like and Depression-like Behaviours and Calcium- and NO-related Biochemical Changes in the Brain

Kumar M, Singh SP, Chaturvedi CM. Chronic Nonmodulated Microwave Radiations in Mice Produce Anxiety-like and Depression-like Behaviours and Calcium- and NO-related Biochemical Changes in the Brain. Exp Neurobiol. 2016 Dec;25(6):318-327. doi: 10.5607/en.2016.25.6.318. Epub 2016 Dec 19.

Abstract

The present study was aimed to investigate behavioural and biochemical effects of chronic exposure of amplitude modulated and non-modulated microwave radiation on laboratory mice. Chronic microwave exposures were executed with 2.45 GHz of either modulated (power density, 0.029 mW/cm2; specific absorption rate, 0.019 W/Kg with sinusoidal modulation of 400 Hz) or nonmodulated continuous sinusoidal wave (power density, 0.033 mW/cm2; specific absorption rate, 0.023 W/Kg) for 2 hrs daily for 1 month. Mice subjected to non-modulated microwave exposure had significantly increased acetylcholinesterase activity and increased intracellular calcium and nitric oxide levels in the cerebral cortex and hippocampus, and also had increased glucose and corticosterone levels in blood compared to control mice. These non-modulated microwave-exposed mice exhibited anxiety-like and depression-like behaviours. In contrast, mice exposed to modulated microwave for the same period did not show such changes in concomitant biochemical and behavioural analyses. These results suggest that chronic non-modulated microwave, but not modulated microwave, radiation may cause anxiety-like and depression-like behaviours and calcium- and NO-related biochemical changes in the brain.

Open Access: http://bit.ly/2hHU23D

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Pulsed magnetic field improves seed quality of aged green pea seeds by homeostasis of free radical content

Bhardwaj J, Anand A, Pandita VK, Nagarajan S. Pulsed magnetic field improves seed quality of aged green pea seeds by homeostasis of free radical content. J Food Sci Technol. 2016 Nov;53(11):3969-3977. doi: 10.1007/s13197-016-2392-8. Epub 2016 Nov 30.

Abstract

To elucidate the mechanism responsible for magnetic field induced seed invigoration in aged seeds an experiment was conducted on six year old garden pea seeds stored under controlled (20 °C and 40% RH) condition. Aged seeds were magnetoprimed by exposing to pulsed magnetic field (PMF) of 100 mT for 1 h in three pulsed modes. The 6 min on and off PMF showed significant improvement in germination (7.6%) and vigor (84.8%) over aged seeds. Superoxide and hydrogen peroxide production increased in germinating primed seeds by 27 and 52%, respectively, over aged seeds. Nicotinamide adenine dinucleotide (reduced) (NADH) peroxidase and superoxide dismutase involved in generation of hydrogen peroxide showed increased activity in PMF primed seeds. Increase in catalase, ascorbate peroxidase and glutathione reductase activity after 36 h of imbibition in primed seeds demonstrated its involvement in seed recovery during magnetopriming. An increase in total antioxidants also helped in maintaining the level of free radicals for promoting germination

of magnetoprimed seeds. A 44% increase in level of protein carbonyls after 36 h indicated involvement of protein oxidation for counteracting and/or utilizing the production of ROS and faster mobilization of reserve proteins. Higher production of free radicals in primed seeds did not cause lipid peroxidation as malondialdehyde content was low. Lipoxygenase was involved in the germination associated events as the magnitude of activity was higher in primed aged seeds compared to aged seeds. Our study elucidated that PMF mediated improvement in seed quality of aged pea seeds was facilitated by fine tuning of free radicals by the antioxidant defense system and protein oxidation.

https://www.ncbi.nlm.nih.gov/pubmed/28035152

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Lennart Hardell's lecture at the Royal Society of Medicine

Hardell L. Using the Bradford Hill viewpoints to evaluate the evidence on radio frequency radiation from mobile phones to head tumours. London: Royal Society of Medicine, Oct 13, 2016.

Professor Lennart Hardell discusses the risks of brain tumours in relation to wireless and mobile phones. Professor Hardell also describes how Bradford Hill's 1965 presidential address on association or causation provided a helpful framework for the evaluation of the brain tumour risk from electromagnetic fields.

This 31 minute lecture was filmed at the 'Association or causation in miasmas and mixtures: current reflections on Bradford Hill's 1965 contribution to public health' meeting at the Royal Society of Medicine in London.

http://bit.ly/HardellRSM

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When theory and observation collide: Can non-ionizing radiation cause cancer?

Havas, M. When theory and observation collide: Can non-ionizing radiation cause cancer? Environmental Pollution (2016). http://dx.doi.org/10.1016/j.envpol.2016.10.018

Highlights

• There is sufficient scientific evidence of cellular damage caused by non-ionizing radiation well below thermal guidelines.
• Applying the ionization model to non-ionizing radiation is inappropriate as mechanisms of biological interactions differ.
• Free radicals can and do cause cancer and non-ionizing radiation can and does increase free-radicals.

Abstract

This paper attempts to resolve the debate about whether non-ionizing radiation (NIR) can cause cancer–a debate that has been ongoing for decades. The rationale, put forward mostly by physicists and accepted by many health agencies, is that, “since NIR does not have enough energy to dislodge electrons, it is unable to cause cancer.” This argument is based on a flawed assumption and uses the model of ionizing radiation (IR) to explain NIR, which is inappropriate. Evidence of free-radical damage has been repeatedly documented among humans, animals, plants and microorganisms for both extremely low frequency (ELF) electromagnetic fields (EMF) and for radio frequency (RF) radiation, neither of which is ionizing. While IR directly damages DNA, NIR interferes with the oxidative repair mechanisms resulting in oxidative stress, damage to cellular components including DNA, and damage to cellular processes leading to cancer. Furthermore, free radical damage explains the increased cancer risks associated with mobile phone use, occupational exposure to NIR (ELF

EMF and RFR), and residential exposure to power lines and RF transmitters including mobile phones, cell phone base stations, broadcast antennas, and radar installations.

Summary

This paper presents a highly probable mechanism that involves an increase in free-radicals, which–in turn–explains the increased risk of cancers documented in epidemiological studies that are associated with environmental exposure to RFR and ELF-EMFs at levels well below international guidelines.

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Mechanism of low-level microwave radiation effect on nervous system

Hiie Hinrikus, Maie Bachmann, Denis Karai & Jaanus Lass. Mechanism of low-level microwave radiation effect on nervous system. Electromagnetic Biology and Medicine. Pages 1-11. Published online: 22 Nov 2016

Abstract

The aim of this study is to explain the mechanism of the effect of low-level modulated microwave radiation on brain bioelectrical oscillations. The proposed model of excitation by low-level microwave radiation bases on the influence of water polarization on hydrogen bonding forces between water molecules, caused by this the enhancement of diffusion and consequences on neurotransmitters transit time and neuron resting potential. Modulated microwave radiation causes periodic alteration of the neurophysiologic parameters and parametric excitation of brain bioelectric oscillations. The experiments to detect logical outcome of the mechanism on physiological level were carried out on 15 human volunteers. The 450-MHz microwave radiation modulated at 7, 40 and 1000 Hz frequencies was applied at the field power density of 0.16 mW/cm2. A relative change in the EEG power with and without radiation during 10 cycles was used as a quantitative measure. Experimental data demonstrated that modulated at 40 Hz microwave radiation enhanced EEG power in EEG alpha and beta frequency bands. No significant alterations were detected at 7 and 1000 Hz modulation frequencies. These results are in good agreement with the theory of parametric excitation of the brain bioelectric oscillations caused by the periodic alteration of neurophysiologic parameters and support the proposed mechanism. The proposed theoretical framework has been shown to predict the results of experimental study. The suggested mechanism, free of the restrictions related to field strength or time constant, is the first one providing explanation of low-level microwave radiation effects.

Conclusions

The proposed mechanism of low-level microwave radiation effect on nervous system bases on the existing knowledge: rotation of water molecules, related to that perturbation of hydrogen bonds and alteration in diffusion. Alterations in diffusion affect neurophysiologic parameters as neurotransmitters transit time and neuron resting potential. Periodic alteration of the neurophysiologic parameters caused by modulated microwave radiation is expected to result in parametric excitation of brain bioelectric oscillation. Experimental results with a low-level 450-MHz microwave radiation pulse-modulated at 7, 40 and 1000 Hz showed a statistically significant enhancement of the EEG power in alpha, beta1 and beta2 frequency bands at 40 Hz and no significant effect at 7 and 1000 Hz modulation frequencies. The experimental results are in agreement with the nonlinear theory of parametric excitation of the brain bioelectric oscillations inside first zones on instability. The proposed theoretical framework predicts the results of experimental study. The suggested mechanism, free of the restrictions related to field strength or time constant, is the first one providing explanation of low-level microwave radiation effects.

http://www.tandfonline.com/doi/full/10.1080/15368378.2016.1251451

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Long-term Electromagnetic Field Measurement and Assessment for a Shopping Mall

Engiz BK, Kurnaz C. Long-term Electromagnetic Field Measurement and Assessment for a Shopping Mall. Radiat Prot Dosimetry. 2016 Nov 24. [Epub ahead of print]

Abstract

As a result of the dense deployment of wireless devices and base stations, measuring and evaluating the electromagnetic (EM) exposure levels they emit have become important to human health especially if they exceed the limits defined in the standards. Base stations, Wi-Fi equipment and other electronic devices are used heavily, especially in densely crowded places like shopping centers. In this study, electric field strength (E) measurements were conducted at one of the largest shopping malls in Turkey. Broadband E measurements were performed using PMM 8053 EM field strength meter for 24 h a day for the duration of one week while frequency selective measurements were carried out with SRM-3006 EM field strength meter. It is concluded from the measurements that the mean measured total E in the band between 100 kHz and 3 GHz is 0.59 V/m while the maximum E is 7.88 V/m, which are both below the limit determined by International Commission on Non-Ionizing Radiation Protection. Evolutions show that E can increase by up to 55% during the daytime. Analyses demonstrate that 71.3% of total E is caused by UMTS2100, 16.3% is produced by GSM900, 6.2% by LTE, 3.5% by Wi-Fi, and 2.7% is generated by devices that use the remaining frequency bands. Based on the detailed statistical analysis of long-term E measurement results, it can be concluded that the measured E levels are not in normal distribution and that they are statistically different with respect to days. Furthermore, distribution of E can be best modeled with the non-parametric approach.

https://www.ncbi.nlm.nih.gov/pubmed/27885087

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Multiple assessment methods of prenatal exposure to RF radiation from telecommunication in the Mothers and Children's Environmental Health (MOCEH) study

Choi KH, Ha M, Burm E, Ha EH, Park H, Kim Y, Lee AK, Kwon JH, Choi HD, KimN. Multiple assessment methods of prenatal exposure to radio frequency radiation from telecommunication in the Mothers and Children's Environmental Health (MOCEH) study. Int J Occup Med Environ Health. 2016 Nov 18;29(6):959-972. doi: 10.13075/ijomeh.1896.00803. Epub 2016 Nov 3.

Abstract

OBJECTIVES: To evaluate prenatal exposure to radiofrequency radiation (RFR) from telecommunication using a mobile phone questionnaire, operator data logs of mobile phone use and a personal exposure meter (PEM).

MATERIAL AND METHODS: The study included 1228 mother-infants pairs from the Mothers and Children's Environmental Health (MOCEH) study - a multicenter prospective cohort study ongoing since 2006, in which participants were enrolled at ≤ 20 weeks of pregnancy, with a follow-up of a child birth and growth to assess the association between prenatal environmental exposure and children's health. The questionnaire included the average calling frequency per day and the average calling time per day. An EME Spy 100 PEM was used to measure RFR among 269 pregnant women from November 2007 to August 2010. The operators' log data were obtained from 21 participants. The Spearman's correlation test was performed to evaluate correlation coefficient and 95% confidence intervals between the mobile phone use information from the questionnaire, operators' log data, and data recorded by the PEM.

RESULTS: The operators' log data and information from the self-reported questionnaire showed significantly high correlations in the average calling frequency per day ($\rho = 0.6$, $p = 0.004$) and average calling time per day ($\rho = 0.5$, $p = 0.02$). The correlation between information on the mobile phone use in the self-reported questionnaire and exposure index recorded by the PEM was poor. But correlation between the information of

the operators' log data and exposure index for transmission of mobile communication was significantly high: correlation coefficient (p-value) was 0.44 (0.07) for calling frequency per day, and it was 0.49 (0.04) for calling time per day.

CONCLUSIONS: The questionnaire information on the mobile phone use showed moderate to high quality. Using multiple methods for exposure assessment might be better than using only one method.

https://www.ncbi.nlm.nih.gov/pubmed/27869246?dopt=Abstract

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Mobile phone signal exposure triggers a hormesis-like effect in Atm+/+ and Atm-/- mouse embryonic fibroblasts

Sun C, Wei X, Fei Y, Su L, Zhao X, Chen G, Xu Z. Mobile phone signal exposure triggers a hormesis-like effect in Atm+/+ and Atm-/- mouse embryonic fibroblasts. Sci Rep. 2016 Nov 18;6:37423. doi: 10.1038/srep37423.

Abstract

Radiofrequency electromagnetic fields (RF-EMFs) have been classified by the International Agency for Research on Cancer as possible carcinogens to humans; however, this conclusion is based on limited epidemiological findings and lacks solid support from experimental studies. In particular, there are no consistent data regarding the genotoxicity of RF-EMFs. Ataxia telangiectasia mutated (ATM) is recognised as a chief guardian of genomic stability. To address the debate on whether RF-EMFs are genotoxic, we compared the effects of 1,800 MHz RF-EMF exposure on genomic DNA in mouse embryonic fibroblasts (MEFs) with proficient (Atm+/+) or deficient (Atm-/-) ATM. In Atm+/+ MEFs, RF-EMF exposure for 1 h at an average special absorption rate of 4.0 W/kg induced significant DNA single-strand breaks (SSBs) and activated the SSB repair mechanism. This effect reduced the DNA damage to less than that of the background level after 36 hours of exposure. In the Atm-/- MEFs, the same RF-EMF exposure for 12 h induced both SSBs and double-strand breaks and activated the two repair processes, which also reduced the DNA damage to less than the control level after prolonged exposure. The observed phenomenon is similar to the hormesis of a toxic substance at a low dose. To the best of our knowledge, this study is the first to report a hormesis-like effect of an RF-EMF.

https://www.ncbi.nlm.nih.gov/pubmed/27857169?dopt=Abstract

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Effects of exposure to 2100 MHz GSM-like RF EMF on auditory system of rats

Çeliker M, Özgür A, Tümkaya L, Terzi S, Yılmaz M, Kalkan Y, Erdoğan E. Effects of exposure to 2100MHz GSM-like radiofrequency electromagnetic field on auditory system of rats. Braz J Otorhinolaryngol. 2016 Nov 5. pii: S1808-8694(16)30222-1. doi: 10.1016/j.bjorl.2016.10.004.

Abstract

INTRODUCTION: The use of mobile phones has become widespread in recent years. Although beneficial from the communication viewpoint, the electromagnetic fields (EMF) generated by mobile phones may cause unwanted biological changes in the human body.

OBJECTIVE: In this study, we aimed to evaluate the effects of 2100MHz Global System for Mobile communication (GSM-like) electromagnetic field (EMF), generated by an EMF generator, on the auditory system of rats by using electrophysiological, histopathologic and immunohistochemical methods.

METHODS: Fourteen adult Wistar albino rats were included in the study. The rats were divided randomly into two groups of seven rats each. The study group was exposed continuously for 30days to a 2100MHz EMF with a signal level (power) of 5.4dBm (3.47mW) to simulate the talk mode on a mobile phone. The control group was not exposed to the aforementioned EMF. After 30days, the Auditory Brainstem Responses (ABRs) of both groups were recorded and the rats were sacrificed. The cochlear nuclei were evaluated by histopathologic and immunohistochemical methods.

RESULTS: The ABR records of the two groups did not differ significantly. The histopathologic analysis showed increased degeneration signs in the study group (p=0.007). In addition, immunohistochemical analysis revealed increased apoptotic index in the study group compared to that in the control group (p=0.002).

CONCLUSION: The results support that long-term exposure to a GSM-like 2100MHz EMF causes an increase in neuronal degeneration and apoptosis in the auditory system.

https://www.ncbi.nlm.nih.gov/pubmed/27865708?dopt=Abstract

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Protective Role of Vitamin C on the Metabolic and Enzymatic Activities of the Liver in Male Rats After Exposure to Wi-Fi Routers

Shekoohi-Shooli F, Mortazavi SM, Shojaei-Fard MB, Nematollahi S, Tayebi M. Evaluation of the Protective Role of Vitamin C on the Metabolic and Enzymatic Activities of the Liver in the Male Rats After Exposure to 2.45 GHz Of Wi-Fi Routers. J Biomed Phys Eng. 2016 Sep 1;6(3):157-164. eCollection 2016.

Abstract

BACKGROUND: The use of devices emitted microwave radiation such as mobile phones, wireless fidelity (Wi-Fi) routers, etc. is increased rapidly. It has caused a great concern; the researchers should identify its effects on people's health. We evaluated the protective role of Vitamin C on the metabolic and enzymatic activities of the liver after exposure to Wi-Fi routers.

MATERIAL AND METHODS: 70 male Wistar rats weighing 200-250 g were randomly divided into 7 groups (10 rats in each group).The first stage one-day test: Group A (received vitamin C 250 mg/kg/day orally together with 8- hour/day Wi-Fi exposure). Group B (exposed to Wi-Fi radiation). Group C (received vitamin C). Group D or Control (was neither exposed to radiation of Wi-Fi modem nor did receive vitamin C). The second phase of experiment had done for five consecutive days. It involved Group E (received vitamin C), Group F (exposed to Wi-Fi radiation), Group G (received vitamin C together with Wi-Fi radiation). The distance between animals' restrainers was 20 cm away from the router antenna. Finally, blood samples were collected and assayed the level of hepatic enzymes including alkaline phosphatase (ALP), alanine amino transferase (ALT) aspartate amino transferase (ASL), gamma glutamyl transferase (GGT) and the concentration of Blood Glucose, Cholesterol, Triglyceride (TG), High density lipoprotein (HDL) and low density lipoprotein (LDL).

RESULTS: Data obtained from the One day test showed an increase in concentration of blood glucose, decrease in Triglyceride level and GGT factor ($P<0.05$), however no observed significant difference on the Cholesterol, HDL, LDL level and hepatic enzymes activities in compare to control group. Groups of the five-day test showed reduction in the amount of blood glucose, elevation of cholesterol level and LDL relative to control group ($P<0.05$).

CONCLUSION: WiFi exposure may exert alternations on the metabolic parameters and hepatic enzymes activities through stress oxidative and increasing of free radicals, but the use of vitamin C protects them from changing induced. Also taking optimum dose of vitamin C is essential for radioprotective effect and maintaining optimum health.

https://www.ncbi.nlm.nih.gov/pubmed/27853723?dopt=Abstract

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Development of a source-exposure matrix for occupational EMF exposure assessment in the INTEROCC study

Vila J, Bowman JD, Figuerola J, Moriña D, Kincl L, Richardson L, Cardis E. Development of a source-exposure matrix for occupational exposure assessment of electromagnetic fields in the INTEROCC study. J Expo Sci Environ Epidemiol. 2016 Nov 9. doi: 10.1038/jes.2016.60.

Abstract

To estimate occupational exposures to electromagnetic fields (EMF) for the INTEROCC study, a database of source-based measurements extracted from published and unpublished literature resources had been previously constructed. The aim of the current work was to summarize these measurements into a source-exposure matrix (SEM), accounting for their quality and relevance. A novel methodology for combining available measurements was developed, based on order statistics and log-normal distribution characteristics. Arithmetic and geometric means, and estimates of variability and maximum exposure were calculated by EMF source, frequency band and dosimetry type. The mean estimates were weighted by our confidence in the pooled measurements. The SEM contains confidence-weighted mean and maximum estimates for 312 EMF exposure sources (from 0 Hz to 300 GHz). Operator position geometric mean electric field levels for radiofrequency (RF) sources ranged between 0.8 V/m (plasma etcher) and 320 V/m (RF sealer), while magnetic fields ranged from 0.02 A/m (speed radar) to 0.6 A/m (microwave heating). For extremely low frequency sources, electric fields ranged between 0.2 V/m (electric forklift) and 11,700 V/m (high-voltage transmission line-hotsticks), whereas magnetic fields ranged between 0.14 μT (visual display terminals) and 17 μT (tungsten inert gas welding). The methodology developed allowed the construction of the first EMF-SEM and may be used to summarize similar exposure data for other physical or chemical agents.

https://www.ncbi.nlm.nih.gov/pubmed/27827378

Excerpt

This work allowed the construction of a SEM containing estimated exposure statistics for the most common occupational sources of EMF exposure, identified through the INTEROCC study questionnaire. This database represents a new approach for occupational exposure assessment, based on EMF sources independent of occupation. The SEM will be available online as a free-access tool at http://www.crealradiation.com/index.php/es/databases. Although the current version does not include all possible EMF sources, it can be updated with new or newly identified measurements and sources.

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Impact of RF EMF on cucumber and tomato plants

F. Al-Kathiri, K. Al-Raisi, K. Al-Hinai, M. Al-Droushi, M. Khan, Z. Nadir. Impact of RF electromagnetic field on cucumber and tomato plants. Information Technology, Electronics and Mobile Communication Conference (IEMCON), 2016 IEEE 7th Annual. 13-15 Oct 2016.

Abstract

Agriculture sector is one of the essential sectors to any nation. This sector is a challenging domain worldwide due to multiple biotic and abiotic stresses. The search for finding new agricultural technologies to enhance the crop productivity is a prime goal. Exposure of crop seeds or plants from short to longer term radio frequency

and electromagnetic fields may have positive or negative effects on plant growth/development and final productivity. The focus of the research work was to study the impact of fixed radio frequency and electromagnetic field exposures on cucumber and tomato plants growth/development and leaf membrane stability. Initial results of studies showed that the electromagnetic field treatment generated a little stressed environment to crop plants. Both crop plants demonstrated reduced plant growth and development with impaired membrane. This phenomenon was more distinct as the treatment time proceeded. The higher electrolyte leakage coupled with reduced plant growth and development may be a function of free radical processes prompted by the EMF environment.

http://ieeexplore.ieee.org/document/7746234/

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An Investigation on the Effect of ELF Pulsed Electromagnetic Fields on Human Electrocardiograms

Fang Q, Mahmoud SS, Yan J, Li H. An Investigation on the Effect of Extremely Low Frequency Pulsed Electromagnetic Fields on Human Electrocardiograms (ECGs). Int J Environ Res Public Health. 2016 Nov 23;13(11). pii: E1171.

Abstract

For this investigation, we studied the effects of extremely low frequency pulse electromagnetic fields (ELF-PEMF) on the human cardiac signal. Electrocardiograms (ECGs) of 22 healthy volunteers before and after a short duration of ELF-PEMF exposure were recorded. The experiment was conducted under single-blind conditions. The root mean square (RMS) value of the recorded data was considered as comparison criteria. We also measured and analysed four important ECG time intervals before and after ELF-PEMF exposure. Results revealed that the RMS value of the ECG recordings from 18 participants (81.8% of the total participants) increased with a mean value of 3.72%. The increase in ECG voltage levels was then verified by a second experimental protocol with a control exposure. In addition to this, we used hyperbolic T-distributions (HTD) in the analysis of ECG signals to verify the change in the RR interval. It was found that there were small shifts in the frequency-domain signal before and after EMF exposure. This shift has an influence on all frequency components of the ECG signals, as all spectrums were shifted. It is shown from this investigation that a short time exposure to ELF-PEMF can affect the properties of ECG signals. Further study is needed to consolidate this finding and discover more on the biological effects of ELF-PEMF on human physiological processes.

https://www.ncbi.nlm.nih.gov/pubmed/27886102

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Effects of ELF pulsed electromagnetic fields on glioblastoma cells

Zeinab Akbarnejad, Hossein Eskandary, Cristian Vergallo, Seyed Noureddin Nematollahi-Mahani, Luciana Dini, Fatemeh Darvishzadeh-Mahani & Ahmadi Meysam. Effects of extremely low-frequency pulsed electromagnetic fields (ELF-PEMFs) on glioblastoma cells (U87)
Pages 1-10. Published online: 22 Nov 2016. http://dx.doi.org/10.1080/15368378.2016.1251452

Abstract

The impact of extremely low-frequency pulsed electromagnetic fields (ELF-PEMFs) at various frequencies and amplitudes was investigated on cell cycle, apoptosis and viability of the Glioblastoma Multiforme (GBM) cell line (U87), in vitro. The GBM is a malignant brain tumor with high mortality in humans and poorly responsive to the most common type of cancer treatments, such as surgery, chemotherapy and radiation therapy. U87 cells with five experimental groups (I–V) were exposed to various ELF-PEMFs for 2, 4 and 24 h, as follows: (I) no

exposure, control; (II) 50 Hz 100 ± 15 G; (III) 100 Hz 100 ± 15 G; (IV) 10 Hz 50 ± 10 G; (V) 50 Hz 50 ± 10 G. The morphology properties, cell viability and gene expression of proteins involved in cell cycle regulation (Cyclin-D1 and P53) and apoptosis (Caspase-3) were investigated. After 24 h, the cell viability and Cyclin-D1 expression increased in Group II (30%, 45%), whereas they decreased in Groups III (29%, 31%) and IV (21%, 34%); P53 and Caspase-3 elevated only in Group III; and no significant difference was observed in Group V, respectively, compared with the control ($p < 0.05$). The data suggest that the proliferation and apoptosis of human GBM are influenced by exposure to ELF-PEMFs in different time-dependent frequencies and amplitudes. The fact that some of the ELF-PEMFs frequencies and amplitudes favor U87 cells proliferation indicates precaution for the use of medical devices related to the MFs on cancer patients. On the other hand, some other ELF-PEMFs frequencies and intensities arresting U87 cells growth could open the way to develop novel therapeutic approaches.

Conclusion

In conclusion, our findings showed that the antiproliferative and proliferative effects of ELF-PEMFs depend on frequency, amplitude and exposure time. There is no doubt that other MF properties should be further addressed. However, our results can offer significant preliminary indication on the appropriateness of the applied range to prevent cell proliferation and induce cell death in cancer patients. Thus, the up- and downregulation of Cyclin-D1, P53 and Caspase-3 in the presence of ELF-PEMF can be a starting point for further investigations on the relationship between ELF-PEMF exposure and cancer cells as well as the exploration of their possible adjuvant use in anticancer therapies.

http://www.tandfonline.com/doi/full/10.1080/15368378.2016.1251452

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Exposure of children to ELF magnetic fields in France: Results of the EXPERS study

Magne I, Souques M, Bureau I, Duburcq A, Remy E, Lambrozo J. Exposure of children to extremely low frequency magnetic fields in France: Results of the EXPERS study. J Expo Sci Environ Epidemiol. 2016 Nov 9. doi: 10.1038/jes.2016.59.

Abstract

The assessment of magnetic field exposure in children is an important point in the context of epidemiological issues. EXPERS is the first study ever carried out measuring personal exposure to extremely low frequency magnetic fields at a national scale, involving 977 French children with 24 h personal measurements. Descriptive statistical analyses were performed for all the children, and only for children where no alarm clock was identified, as in some cases this requirement of the measurement protocol was not respected. The proportion of children with a 24 h arithmetic mean of ≥0.4 μT was 3.1% when considering all children and 0.8% when excluding alarm clocks. The alarm clocks were the main variable linked to the child exposure measurements. Magnetic field exposure increased when the home was located close to a high voltage power line. However, none of the 0.8% of children living at <125 m to a 225 kV line or <200 m to a 400 kV overhead line had a personal exposure of >0.4 μT. A multiple correspondence analysis showed the difficulty to build a statistical model predicting child exposure. The distribution of child personal exposure was significantly different from the distribution of exposure during sleep, questioning the exposure assessment in some epidemiological studies.

https://www.ncbi.nlm.nih.gov/pubmed/27827377

Conclusion

The EXPERS study is the first study of magnetic field personal exposure of children, with a significant number of subjects, at the scale of a country. It is also the first study on this subject in France. We looked for a

relationship between the subjects' characteristics and their exposure, and observed differences depending on the indicator chosen (AM, GM or median). We studied the AM in more detail and found a strong correlation between the highest exposures and alarm clocks because of non-respect of the measurement protocol. That is why we performed two analyses, one over all the children, and one over the children for whom no alarm clock was identified on the magnetic field measurements during the night. The proportion of children with an AM ≥0.4 μT was 3.1% when considering all children and 0.8% when excluding those with alarm clocks.

The magnetic field exposure was found to be correlated and increased when the home was located close to a 63 to 400 kV overhead line. However, few children were concerned and none of them had a personal exposure of >0.4 μT.

On the contrary, the magnetic field exposure was found to be correlated and decreased when the home was located close to a MV overhead line. We hypothesize that this result is an artifact, because these grids are mainly found in rural areas, and the exposure was inversely correlated with the size of urban areas.

We looked for correlations between the 24 h exposure (AM, GM and median). Excepted the alarm clocks, no other variable was significantly linked to the child exposure. This result was confirmed by a multiple correspondence analysis that showed that it would be difficult to build a model to predict the child exposure from the collected variables.

The distribution of the 24 h AM, which is the personal exposure of children, was found to be significantly different from the distribution of the AM during the sleep of children, or of the TWA that was calculated from AM during sleep and school periods. This result questions the exposure assessment in some epidemiological studies.

The same work will be done for the adults of the EXPERS study. More detailed focus will be done for electric grids.

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Effects of repeated 9 and 30-day exposure to ELF EMF on social recognition behavior & estrogen receptors expression in olfactory bulb of female rats

Bernal-Mondragón C, Arriaga-Avila V, Martínez-Abundis E, Barrera-Mera B, Mercado-Gómez O, Guevara-Guzmán R. Effects of repeated 9 and 30-day exposure to extremely low-frequency electromagnetic fields on social recognition behavior and estrogen receptors expression in olfactory bulb of Wistar female rats. Neurol Res. 2016 Nov 28:1-11. [Epub ahead of print]

Abstract

OBJECTIVE: We investigated the short- and long-term effects of extremely low-frequency electromagnetic fields (EMF) on social recognition behavior and expression of α- and β-estrogen receptors (ER).

METHODS: Rats were exposed to 60-Hz electromagnetic fields for 9 or 30 days and tested for social recognition behavior. Immunohistochemistry and western blot assays were performed to evaluate α- and β-ER expression in the olfactory bulb of intact, ovariectomized (OVX), and ovariectomized+estradiol (E2) replacement (OVX+E2).

RESULTS: Ovariectomization showed impairment of social recognition after 9 days of EMF exposure and a complete recovery after E2 replacement and so did those after 30 days. Short EMF exposure increased expression of β-ER in intact, but not in the others. Longer exposure produced a decrease in intact but an increase in OVX and OVX+E2.

DISCUSSION: Our findings suggest a significant role for β-estrogen receptors and a lack of effect for α-

estrogen receptors on a social recognition task.

ABBREVIATIONS: EMF: extremely low frequency electromagnetic fields; ERs: estrogen receptors; OB: olfactory bulb; OVX: ovariectomized; OVX + E2: ovariectomized + estradiol replacement; IEI: interexposure interval; β-ER: beta estrogen receptor; E2: replacement of estradiol; GAPDH: glyceraldehyde-3-phosphate dehydrogenase; WB: Western blot; PBS: phosphate-buffer saline; PB: phosphate-buffer.

https://www.ncbi.nlm.nih.gov/pubmed/27892794

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Self-reported mobile phone use and semen parameters among men from a fertility clinic

Lewis RC, Mínguez-Alarcón L, Meeker JD, Williams PL, Mezei G, Ford JB, Hauser R; EARTH Study Team. Self-reported mobile phone use and semen parameters among men from a fertility clinic. Reprod Toxicol. 2016 Nov 9. pii: S0890-6238(16)30408-7.

Abstract

There is increasing concern that use of mobile phones, a source of low-level radio-frequency electromagnetic fields, may be associated with poor semen quality, but the epidemiologic evidence is limited and conflicting. The relationship between mobile phone use patterns and markers of semen quality was explored in a longitudinal cohort study of 153 men that attended an academic fertility clinic in Boston, Massachusetts. Information on mobile phone use duration, headset or earpiece use, and the body location in which the mobile phone was carried was ascertained via nurse-administered questionnaire. Semen samples (n=350) were collected and analyzed onsite. To account for multiple semen samples per man, linear mixed models with random intercepts were used to investigate the association between mobile phone use and semen parameters. Overall, there was no evidence for a relationship between mobile phone use and semen quality.

Conflict of Interest: Ryan Lewis and Gabor Mezei work for Exponent, Inc., a company that provides consultation on the potential human health risks associated with exposure to environmental agents, including RF- EMFs. All other authors declare no conflict of interest.

Acknowledgement: This research was supported by grant R01 ES009718 from the National Institute of Environmental Health Sciences, National Institutes of Health, and project 1-SP0239 from the **Electric Power Research Institute**.

https://www.ncbi.nlm.nih.gov/pubmed/27838386

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International Commission on Non-Ionizing Radiation Protection: Two announcements

Oct 2016

Update HF Guidelines

ICNIRP has been working on its new high-frequency (HF) guidelines, which will cover the 100 kHz – 300 GHz range of the non-ionizing radiation (NIR) spectrum. This will replace the HF portion of the 1998 ICNIRP guidelines. A draft of the new HF guidelines was presented at ICNIRP's 8th International NIR Workshop in Cape Town, South Africa, in May 2016. This provided an opportunity to share the direction of the ICNIRP thinking, and to obtain preliminary comments from the Workshop participants. At that time ICNIRP was planning to have a public consultation document ready by the end of 2016. However, as some of the issues that were raised regarding the HF guidelines are requiring considerable additional thought and development,

this time frame is no longer feasible. ICNIRP will provide updates on the progress in due course.

http://www.icnirp.org/en/activities/news/news-article/update-on-hf-guidelines.html

Upcoming Workshop

An International Workshop on Non-Ionizing Radiation Protection will take place on 2nd December 2016 in Tokyo, Japan. ICNIRP technically co-sponsors the workshop which is financially sponsored by National Institute of Information and Communications Technology (NICT). The main topics of the workshop are the revision of the ICNIRP HF guidelines and NIR protection related to 5G system. The workshop is opened for scientific experts of NIR. Please contact nict-nir-ws@stage.ac, if you consider attending the workshop. Further information regarding the program will be posted shortly.

http://www.icnirp.org/en/activities/news/news-article/tokyo-workshop-2016.html

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Intracranial Distribution of Gliomas in Relation to Mobile Phone Exposure: Analyses From the INTERPHONE Study

Grell, K., Frederiksen, K., Schutz, J., Cardis, E., Armstrong, B., Siemiatycki, J., Krewski, D. R., McBride, M. L., Johansen, C.,Auvinen, A., Hours, M., Blettner, M., Sadetzki, S., Lagorio, S., Yamaguchi, N., Woodward, A., Tynes, T., Feychting, M., Fleming, S. J., Swerdlow, A. J., Andersen, P. K. The Intracranial Distribution of Gliomas in Relation to Exposure From Mobile Phones: Analyses From the INTERPHONE Study. Am J Epidemiol 2016 0: p. kww082v1-11.

Abstract

When investigating the association between brain tumors and use of mobile telephones, accurate data on tumor position are essential, due to the highly localized absorption of energy in the human brain from the radio-frequency fields emitted. We used a point process model to investigate this association using information that included tumor localization data from the INTERPHONE Study (Australia, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, New Zealand, Norway, Sweden, and the United Kingdom). Our main analysis included 792 regular mobile phone users diagnosed with a glioma between 2000 and 2004. Similar to earlier results, we found a statistically significant association between the intracranial distribution of gliomas and the self-reported location of the phone. When we accounted for the preferred side of the head not being exclusively used for all mobile phone calls, the results were similar. The association was independent of the cumulative call time and cumulative number of calls. However, our model used reported side of mobile phone use, which is potentially influenced by recall bias. The point process method provides an alternative to previously used epidemiologic research designs when one is including localization in the investigation of brain tumors and mobile phone use.

Excerpts

... the INTERPHONE Study (6) ... is the largest investigation of mobile phone use and brain tumors to have been carried out to date. INTERPHONE observed no increased glioma risk in mobile phone users except for the decile with the highest reported cumulative call time (>1,640 hours), with uncertain interpretation (6).

... increased occurrence of tumors in the part of the brain closest to the phone would be expected if there were a causal association.

... our aim was to use the 3-dimensional point process model of Grell et al. (31) to analyze the INTERPHONE

localization data for glioma and thereby further investigate the association between glioma and mobile phone use. Our use of a case-only approach removed possible differential bias between cases and controls ...

Overall, levels of use were low compared with today's levels due to the period of data collection, 2000–2004, when mobile phones were less common.

The 3-dimensional distribution of gliomas within the brain was skewed towards the self-reported preferred ear for mobile phone use.

Our results concur with the observation of a statistically significant excess of gliomas on the self-reported side of mobile phone use (28).

Taken together, our results suggest that ever using a mobile phone regularly is associated with glioma localization in the sense that more gliomas occurred closer to the ear on the side of the head where the mobile phone was reported to have been used the most. However, this trend was not related to amount of mobile phone use, making it less likely that the association observed is caused by a relationship between mobile phone use and cancer risk. We cannot draw firm conclusions about cause and effect, but our approach has several strengths in comparison with traditional epidemiologic approaches. Our results may have been affected by recall bias in the reported side of phone use. Nevertheless, it provides an alternative for future research related to mobile phone use.

http://aje.oxfordjournals.org/cgi/content/abstract/kww082v1

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Inferring the 1985–2014 impact of mobile phone use on selected brain cancer subtypes

Frank de Vocht. Inferring the 1985–2014 impact of mobile phone use on selected brain cancer subtypes using Bayesian structural time series and synthetic controls. Environment International. 97:100-107. December 2016.

Highlights

• English brain cancer subtypes incidences were compared to synthetic control trends.
• No evidence of increases in GBM, glioma and parietal lobe neoplasms not predicted.
• Malignant neoplasms of the temporal lobe however, have increased faster than expected.
• This corresponded to additional 35% increase, or 188 (95%CI 48–324) cases annually.
• Tumour location and temporal associations correspond with mobile phone use as risk factor.

Abstract

Background Mobile phone use has been increasing rapidly in the past decades and, in parallel, so has the annual incidence of certain types of brain cancers. However, it remains unclear whether this correlation is coincidental or whether use of mobile phones may cause the development, promotion or progression of specific cancers. The 1985–2014 incidence of selected brain cancer subtypes in England were analyzed and compared to counterfactual ‘synthetic control’ timeseries.

Methods Annual 1985–2014 incidence of malignant glioma, glioblastoma multiforme, and malignant neoplasms of the temporal and parietal lobes in England were modelled based on population-level covariates using Bayesian structural time series models assuming 5,10 and 15 year minimal latency periods. Post-latency counterfactual ‘synthetic England’ timeseries were nowcast based on covariate trends. The impact of mobile phone use was inferred from differences between measured and modelled time series.

Results There is no evidence of an increase in malignant glioma, glioblastoma multiforme, or malignant neoplasms of the parietal lobe not predicted in the ‘synthetic England’ time series. Malignant neoplasms of the

temporal lobe however, have increased faster than expected. A latency period of 10 years reflected the earliest latency period when this was measurable and related to mobile phone penetration rates, and indicated an additional increase of 35% (95% Credible Interval 9%:59%) during 2005–2014; corresponding to an additional 188 (95%CI 48–324) cases annually.

Conclusions A causal factor, of which mobile phone use (and possibly other wireless equipment) is in agreement with the hypothesized temporal association, is related to an increased risk of developing malignant neoplasms in the temporal lobe.

http://www.sciencedirect.com/science/article/pii/S0160412016303865

Excerpts

The annual incidence of malignant neoplasms of the temporal lobe however, has been increasing faster than expected, with a period of 10 years post-1995 reflecting the earliest latency period when this additional increase was measurable. Post-2005 an additional increase of 35% (95%CI 9%:59%) was evident compared to the counterfactual time series in the 'synthetic England'; corresponding to an average of an additional 188 (95%CI 48–324) cases of malignant neoplasms of the temporal lobe annually. Addition of mobile phone penetration in the models showed a reduction of 15% in the effect size for 5-year latency (Table 2), indicating observed increased incidence can, at least in part, by attributed to mobile phone use (Note that unfortunately longer latencies cannot be explored in these time series).

These analyses indicate excess brain cancer risk is observed in the lobes where most of the electromagnetic energy is absorbed (depending on side of the head where the phone is held when calling) (Cardis et al., 2008), which has been observed previously (Barchana et al., 2012 and Khurana et al., 2009). As such, it does not specifically exclude a specific association with gliomas (if these occur in the temporal lobe), which was reported in Interphone (Interphone Study Group, 2010), and of which about one in three occur in the temporal lobe (Larjavaara et al., 2007). A stronger causal argument could have been made if these analyses could have been stratified by laterality, with ipsilateral RF exposure having been linked to increased cerebral blood flow (Huber et al., 2005) and glucose metabolism (Volkow et al., 2011), as well as to increased risk of glioma in the temporal lobe (Barchana et al., 2012 and Hardell and Carlberg, 2015), although not in all studies (Hartikka et al., 2009 and Larjavaara et al., 2011), but this was not possible.

In summary, these analyses indicate that a causal factor, of which mobile phone use (and possibly other wireless equipment) is in agreement with the hypothesized spatial and temporal associations, is related to an increased risk of developing a malignant neoplasm in the temporal lobe. More specifically, if the calculated population impact is interpreted as a causal effect and is completely contributed to mobile phone use, then the population impact is an additional 188 cases annually in England; corresponding to about 1700 cases (range 436 to 2918) in the period 2005–2014 that would not have occurred otherwise. For reference, this corresponds to 0.02%–0.12% of new cancers during this period. If the relative effect is interpreted as a population relative risk, then a very moderate 1.35 (95%CI 1.09:1.59) is observed after a minimum 10-year latency.

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Electrosmog and Autoimmune Disease

Marshall, T.G. & Heil, T.J.R. Electrosmog and Autoimmune Disease. Immunol Res (2016). doi:10.1007/s12026-016-8825-7

Abstract

Studies in mice have shown that environmental electromagnetic waves tend to suppress the murine immune system with a potency similar to NSAIDs, yet the nature of any Electrosmog effects upon humans remains controversial. Previously, we reported how the human Vitamin-D receptor (VDR) and its ligand, 1,25-

dihydroxyvitamin-D (1,25-D), are associated with many chronic inflammatory and autoimmune diseases. We have shown how olmesartan, a drug marketed for mild hypertension, acts as a high-affinity partial agonist for the VDR, and that it seems to reverse disease activity resulting from VDR dysfunction. We here report that structural instability of the activated VDR becomes apparent when observing hydrogen bond behavior with molecular dynamics, revealing that the VDR pathway exhibits a susceptibility to Electrosmog. Further, we note that characteristic modes of instability lie in the microwave frequency range, which is currently populated by cellphone and WiFi communication signals, and that the susceptibility is ligand dependent. A case series of 64 patient-reported outcomes subsequent to use of a silver-threaded cap designed to protect the brain and brain stem from microwave Electrosmog resulted in 90% reporting “definite” or “strong” changes in their disease symptoms. This is much higher than the 3–5% rate reported for electromagnetic hypersensitivity in a healthy population and suggests that effective control of environmental Electrosmog immunomodulation may soon become necessary for successful therapy of autoimmune disease.

https://www.ncbi.nlm.nih.gov/pubmed/27412293

Excerpt

There is no reason to suspect that a pulsed electromagnetic wave of 1 ls duration (1000 times slower than a typical molecular response) might cause any less damage to biology than a continuous wave of the same magnitude. It is therefore important to have very-fast-acting peak reading signal level meters when measuring the biological interaction potential of electromagnetic waves. Much of the research literature in this field is criticized as not being sufficiently authoritative because experiments have not been conducted under the current pragma of placebo control and simplistic ($p = 0.05$) analysis of results. Research in this area will only move forward when critics start to examine qualitative study outcomes—for example, observations which might indicate that a Faraday cage should have been an element of a study’s experimental methodology, or that a 2–3 days acclimatization or immune—washout might have changed the study results.

Furthermore, it seems likely that signals a million times lower than those currently being used in research may be sufficient to elicit a tangible change in human biology. In order to better understand the amplitude at which bioeffects become apparent, it is important that experimental guidelines be delineated which ensure that Electrosmog does not confound a study’s results.

Finally, we need to plan how to handle subjects whose symptoms become untenable (due to immunopathology) during acclimatization to an Electrosmog-quiet environment, or during immune washout. We cannot ignore the increasing body of evidence showing electromagnetic effects on the immune system. The ‘‘controversial’’ nature of electromagnetic hypersensitivity will not diminish until we grasp the complexity of the task we face in defining exactly how electromagnetic waves interact with human biology.

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A cross-sectional study of the association between mobile phone use and symptoms of ill health

Cho YM, Lim HJ, Jang H, Kim K, Choi JW, Shin C, Lee SK, Kwon JH, Kim N. A cross-sectional study of the association between mobile phone use and symptoms of ill health. Environ Health Toxicol. 2016 Oct 26. doi: 10.5620/eht.e2016022. [Epub ahead of print]

Abstract

Objectives: This study analyzed the associations between mobile phone call frequency and duration with non-specific symptoms.

Methods: This study was conducted with a population group including 532 non-patient adults established by the Korean Genome Epidemiology Study. The pattern of phone call using a mobile phone was investigated through face-to-face interview. Structured methods applied to quantitatively assess health effects are

Headache Impact Test-6 (HIT-6), Psychosocial Well-being Index-Short Form, Beck Depression Inventory, Korean-Instrumental Activities of Daily Living, Perceived Stress Scale (PSS), Pittsburgh Sleep Quality Index, and 12-Item Short Form Health Survey where a higher score represents a higher greater health effect.

Results: The average daily phone call frequency showed a significant correlation with the PSS score in female subjects. Increases in the average duration of one phone call were significantly correlated with increases in the severity of headaches in both sexes. The mean (standard deviation) HIT-6 score in the subgroup of subjects whose average duration of one phone call was 5 minutes or longer was 45.98 (8.15), as compared with 42.48 (7.20) in those whose average duration of one phone call was <5 minutes. The severity of headaches was divided into three levels according to the HIT-6 score (little or no impact/moderate impact/substantial or severe impact), and a logistic regression analysis was performed to investigate the association between an increased phone call duration and the headache severity. When the average duration of one phone call was 5 minutes or longer, the odds ratio (OR) and the 95% confidence intervals (CI) for the moderate impact group were 2.22 and 1.18-4.19, respectively. The OR and 95% CI for the substantial or severe impact group were 4.44 and 2.11-8.90, respectively.

Conclusions: Mobile phone call duration was not significantly associated with stress, sleep, cognitive function, or depression, but was associated with the severity of headaches.

https://www.ncbi.nlm.nih.gov/pubmed/27802500?dopt=Abstract

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Association Between Portable Screen-Based Media Device Access or Use and Sleep Outcomes: A Systematic Review and Meta-analysis

Carter B, Rees P, Hale L, Bhattacharjee D, Paradkar MS. Association Between Portable Screen-Based Media Device Access or Use and Sleep Outcomes: A Systematic Review and Meta-analysis.JAMA Pediatr. 2016 Oct 31. doi: 10.1001/jamapediatrics.2016.2341. [Epub ahead of print]

Abstract

Importance: Sleep is vital to children's biopsychosocial development. Inadequate sleep quantity and quality is a public health concern with an array of detrimental health outcomes. Portable mobile and media devices have become a ubiquitous part of children's lives and may affect their sleep duration and quality.

Objective: To conduct a systematic review and meta-analysis to examine whether there is an association between portable screen-based media device (eg, cell phones and tablet devices) access or use in the sleep environment and sleep outcomes.

Data Sources: A search strategy consisting of gray literature and 24 Medical Subject Headings was developed in Ovid MEDLINE and adapted for other databases between January 1, 2011, and June 15, 2015. Searches of the published literature were conducted across 12 databases. No language restriction was applied.

Study Selection: The analysis included randomized clinical trials, cohort studies, and cross-sectional study designs. Inclusion criteria were studies of school-age children between 6 and 19 years. Exclusion criteria were studies of stationary exposures, such as televisions or desktop or personal computers, or studies investigating electromagnetic radiation.

Data Extraction and Synthesis: Of 467 studies identified, 20 cross-sectional studies were assessed for methodological quality. Two reviewers independently extracted data.

Main Outcomes and Measures: The primary outcomes were inadequate sleep quantity, poor sleep quality, and excessive daytime sleepiness, studied according to an a priori protocol.

Results: Twenty studies were included, and their quality was assessed. The studies involved 125 198 children (mean [SD] age, 14.5 [2.2] years; 50.1% male). There was a strong and consistent association between bedtime media device use and inadequate sleep quantity (odds ratio [OR], 2.17; 95% CI, 1.42-3.32) (P < .001, I2 = 90%), poor sleep quality (OR, 1.46; 95% CI, 1.14-1.88) (P = .003, I2 = 76%), and excessive daytime sleepiness (OR, 2.72; 95% CI, 1.32-5.61) (P = .007, I2 = 50%). In addition, children who had access to (but did not use) media devices at night were more likely to have inadequate sleep quantity (OR, 1.79; 95% CI, 1.39-2.31) (P < .001, I2 = 64%), poor sleep quality (OR, 1.53; 95% CI, 1.11-2.10) (P = .009, I2 = 74%), and excessive daytime sleepiness (OR, 2.27; 95% CI, 1.54-3.35) (P < .001, I2 = 24%).

Conclusions and Relevance: To date, this study is the first systematic review and meta-analysis of the association of access to and the use of media devices with sleep outcomes. Bedtime access to and use of a media device were significantly associated with the following: inadequate sleep quantity, poor sleep quality, and excessive daytime sleepiness. An integrated approach among teachers, health care professionals, and parents is required to minimize device access at bedtime, and future research is needed to evaluate the influence of the devices on sleep hygiene and outcomes.

https://www.ncbi.nlm.nih.gov/pubmed/27802500?dopt=Abstract

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Mapping of RF EMF exposure levels in outdoor environment and comparing with reference levels for general public health

Cansiz M, Abbasov T, Kurt MB, Celik AR. Mapping of radio frequency electromagnetic field exposure levels in outdoor environment and comparing with reference levels for general public health. J Expo Sci Environ Epidemiol. 2016 Nov 2. doi: 10.1038/jes.2016.64. [Epub ahead of print].

Abstract

In this study, radio frequency electromagnetic field exposure levels were measured on the main streets in the city center of Diyarbakır, Turkey. Measured electric field levels were plotted on satellite imagery of Diyarbakır and were compared with exposure guidelines published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Exposure measurements were performed in dense urban, urban and suburban areas each day for 7 consecutive days. The measurement system consisted of high precision and portable spectrum analyzer, three-axis electric field antenna, connection cable and a laptop which was used to record the measurement samples as a data logger. The highest exposure levels were detected for two places, which are called Diclekent and Batıkent. It was observed that the highest instantaneous electric field strength value for Batıkent was 7.18 V/m and for Diclekent was 5.81 V/m. It was statistically determined that the main contributor band to the total exposure levels was Universal Mobile Telecommunications System band. Finally, it was concluded that all measured exposure levels were lower than the reference levels recommended by ICNIRP for general public health.

https://www.ncbi.nlm.nih.gov/pubmed/27805622?dopt=Abstract

Excerpt

There are several reasons for why these two places have the highest exposure levels. Each place has a base station for mobile phone and these two base stations have common features. They have both GSM and UMTS antennas, which were installed on the first floor level. Moreover, these base stations are very close to the main streets. As seen in Figure 2, one base station is 115 m far away from Batıkent point and the other one is 165 m far away from Diclekent point. Therefore, exposure levels around these places were measured high. On the contrary, FM and terrestrial TV transmitters were far away from the streets where mobile measurements were taken.

The RF EMF exposure levels on the main streets in the city center of Diyarbakır were shown on the satellite map and then two highest RF EMF exposure levels were detected. By means of this method, considering these thematic maps for public health, RF planning engineers who work for mobile network operators may avoid the installation of new base stations in locations where existing RF exposure levels are already very high.

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The influence of prenatal 10 GHz microwave radiation exposure on a developing mice brain

Sharma A, Kesari KK, Saxena VK, Sisodia R. The influence of prenatal 10 GHz microwave radiation exposure on a developing mice brain.Gen Physiol Biophys. 2016 Oct 27. [Epub ahead of print]

Abstract

Our objective was to investigate alterations in the developing mice brain after intrauterine microwave exposure from different gestation days (0.25 and 11.25) till term. Pregnant mice from 0.25 and 11.25 days of gestation were isolated from an inbred colony and divided into sham-exposed (control) and microwave-exposed (10 GHz) groups. The follow-up study of mice at 3 weeks of age showed significant reduction in the brain and body weight of microwave-exposed group. Results showed an increased level of lipid peroxidation, decreased level of glutathione and protein after microwave exposure on both 0.25 and 11.25 day of gestation. Moreover, changes in cytoarchitechure of hippocampus and cerebellum of the brain and reduction in Purkinje cell number were observed statistically significant after microwave exposure from both 0.25 and 11.25 days of gestation. In conclusion, the degree of severity of damage in neonatal mice brain was much higher, when exposure started from 0.25 day of gestation compared to 11.25 days of gestation.

https://www.ncbi.nlm.nih.gov/pubmed/27787231

Also see: http://www.saferemr.com/2014/06/joint-statement-on-pregnancy-and.html

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Thermal Response of Human Skin to Microwave Energy: A Critical Review

Foster KR, Ziskin MC, Balzano Q.Thermal Response of Human Skin to Microwave Energy: A Critical Review. Health Phys. 2016 Dec;111(6):528-541.

Abstract

This is a review/modeling study of heating of tissue by microwave energy in the frequency range from 3 GHz through the millimeter frequency range (30-300 GHz). The literature was reviewed to identify studies that reported RF-induced increases in skin temperature. A simple thermal model, based on a simplified form of Pennes' bioheat equation (BHTE), was developed, using parameter values taken from the literature with no further adjustment. The predictions of the model were in excellent agreement with available data. A parametric analysis of the model shows that there are two heating regimes with different dominant mechanisms of heat transfer. For small irradiated areas (less than about 0.5-1 cm in radius) the temperature increase at the skin surface is chiefly limited by conduction of heat into deeper tissue layers, while for larger irradiated areas, the steady-state temperature increase is limited by convective cooling by blood perfusion. The results support the use of this simple thermal model to aid in the development and evaluation of RF safety limits at frequencies

above 3 GHz and for millimeter waves, particularly when the irradiated area of skin is small. However, very limited thermal response data are available, particularly for exposures lasting more than a few minutes to areas of skin larger than 1-2 cm in diameter. The paper concludes with comments about possible uses and limitations of thermal modeling for setting exposure limits in the considered frequency range.

https://www.ncbi.nlm.nih.gov/pubmed/27798477?dopt=Abstract

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Magnetic Fields Modulate Blue-Light-Dependent Regulation of Neuronal Firing by Cryptochrome

Giachello CN, Scrutton NS, Jones AR, Baines RA. Magnetic Fields Modulate Blue-Light-Dependent Regulation of Neuronal Firing by Cryptochrome. J Neurosci. 2016 Oct 19;36(42):10742-10749. https://www.ncbi.nlm.nih.gov/pubmed/27798129?dopt=Abstract

Abstract

Many animals are able to sense the Earth's geomagnetic field to enable behaviors such as migration. It is proposed that the magnitude and direction of the geomagnetic field modulates the activity of cryptochrome (CRY) by influencing photochemical radical pair intermediates within the protein. However, this proposal will remain theoretical until a CRY-dependent effect on a receptor neuron is shown to be modified by an external magnetic field (MF). It is established that blue-light (BL) photoactivation of CRY is sufficient to depolarize and activate Drosophila neurons. Here, we show that this CRY-dependent effect is significantly potentiated in the presence of an applied MF (100 mT). We use electrophysiological recordings from larval identified motoneurons, in which CRY is ectopically expressed, to show that BL-dependent depolarization of membrane potential and increased input resistance are markedly potentiated by an MF. Analysis of membrane excitability shows that these effects of MF exposure evoke increased action potential firing. Almost nothing is known about the mechanism by which a magnetically induced change in CRY activity might produce a behavioral response. We further report that specific structural changes to the protein alter the impact of the MF in ways that are strikingly similar to those from recent behavioral studies into the magnetic sense of Drosophila These observations provide the first direct experimental evidence to support the hypothesis that MF modulation of CRY activity is capable of influencing neuron activity to allow animal magnetoreception.

SIGNIFICANCE STATEMENT: The biophysical mechanism of animal magnetoreception is still unclear. The photoreceptor protein cryptochrome has risen to prominence as a candidate magnetoreceptor molecule based on multiple reports derived from behavioral studies. However, the role of cryptochrome as a magnetoreceptor remains controversial primarily because of a lack of direct experimental evidence linking magnetic field (MF) exposure to a change in neuronal activity. Here, we show that exposure to an MF (100 mT) is sufficient to potentiate the ability of light-activated cryptochrome to increase neuronal action potential firing. Our results provide critical missing evidence to show that the activity of cryptochrome is sensitive to an external MF that is capable of modifying animal behavior.

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Athermal effects of continuous microwave irradiation on growth and antibiotic sensitivity of Pseudomonas aeruginosa PAO1

Nakouti I, Hobbs G, Teethaisong Y, Phipps D. A demonstration of athermal effects of continuous microwave irradiation on the growth and antibiotic sensitivity of Pseudomonas aeruginosa PAO1. Biotechnol Prog. 2016 Oct 28. doi: 10.1002/btpr.2392. [Epub ahead of print]

Abstract

Stress, caused by exposure to microwaves (2.45GHz) at constant temperature (37± 0.5o C), alters the growth

profile of Pseudomonas aeruginosa PAO1. In the absence of microwave treatment a simple, highly reproducible growth curve was observed over 24 hours or more. Microwave treatment caused no reduction in growth during the first 6 hours, but at a later stage (>12hours) the growth was markedly different to the controls. Secondary growth, typical of the presence of persisters clearly became apparent, as judged by both the dissolved oxygen and the cell density profiles. These treated cells showed distinct morphological changes, but on re-growth these cells reverted to normal. The Microwave Induced Persisters were subject to antibiotic challenge (tobramycin) and showed increased sensitivity when compared to the un-stressed planktonic cells. This is in marked contrast to antibiotic induced persisters which show increased resistance. This provides evidence for both a non-thermal effect of microwaves

https://www.ncbi.nlm.nih.gov/pubmed/27792273

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Exposure to extremely low frequency electromagnetic fields alters the behaviour, physiology and stress protein levels of desert locusts

Wyszkowska J, Shepherd S, Sharkh S, Jackson CW, Newland PL.Exposure to extremely low frequency electromagnetic fields alters the behaviour, physiology and stress protein levels of desert locusts.Sci Rep. 2016 Nov 3;6:36413. doi: 10.1038/srep36413.

Abstract

Electromagnetic fields (EMFs) are present throughout the modern world and are derived from many man-made sources including overhead transmission lines. The risks of extremely-low frequency (ELF) electromagnetic fields are particularly poorly understood especially at high field strengths as they are rarely encountered at ground level. Flying insects, however, can approach close to high field strength transmission lines prompting the question as to how these high levels of exposure affect behaviour and physiology. Here we utilise the accessible nervous system of the locust to ask how exposure to high levels of ELF EMF impact at multiple levels. We show that exposure to ELF EMFs above 4 mT leads to reduced walking. Moreover, intracellular recordings from an identified motor neuron, the fast extensor tibiae motor neuron, show increased spike latency and a broadening of its spike in exposed animals. In addition, hind leg kick force, produced by stimulating the extensor tibiae muscle, was reduced following exposure, while stress-protein levels (Hsp70) increased. Together these results suggest that ELF EMF exposure has the capacity to cause dramatic effects from behaviour to physiology and protein expression, and this study lays the foundation to explore the ecological significance of these effects in other flying insects.

https://www.ncbi.nlm.nih.gov/pubmed/27808167?dopt=Abstract

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Environmental risk factors for dementia: a systematic review

Lewis O. J. Killin, John M. Starr, Ivy J. Shiue, Tom C. Russ. Environmental risk factors for dementia: a systematic review. BMC Geriatrics. DOI: 10.1186/s12877-016-0342-y. Published: 12 October 2016

Abstract

Background Dementia risk reduction is a major and growing public health priority. While certain modifiable risk factors for dementia have been identified, there remains a substantial proportion of unexplained risk. There is evidence that environmental risk factors may explain some of this risk. Thus, we present the first comprehensive systematic review of environmental risk factors for dementia.

Methods We searched the PubMed and Web of Science databases from their inception to January 2016, bibliographies of review articles, and articles related to publically available environmental data. Articles were included if they examined the association between an environmental risk factor and dementia. Studies with another outcome (for example, cognition), a physiological measure of the exposure, case studies, animal studies, and studies of nutrition were excluded. Data were extracted from individual studies which were, in turn, appraised for methodological quality. The strength and consistency of the overall evidence for each risk factor identified was assessed.

Results We screened 4784 studies and included 60 in the review. Risk factors were considered in six categories: air quality, toxic heavy metals, other metals, other trace elements, occupational-related exposures, and miscellaneous environmental factors. Few studies took a life course approach. There is at least moderate evidence implicating the following risk factors: air pollution; aluminium; silicon; selenium; pesticides; vitamin D deficiency; and electric and magnetic fields.

Conclusions Studies varied widely in size and quality and therefore we must be circumspect in our conclusions. Nevertheless, this extensive review suggests that future research could focus on a short list of environmental risk factors for dementia. Furthermore, further robust, longitudinal studies with repeated measures of environmental exposures are required to confirm these associations.

Excerpt: Two systematic reviews examined low and extremely low frequency **electric and magnetic fields** and, while the evidence is mixed, there seems to be an association with dementia risk and this was corroborated by a prospective study in Switzerland which found that living close to power lines for over 15 years was associated with a doubling of Alzheimer's disease mortality (but not the occupational study mentioned above [63]) [73, 74]. Its findings are difficult to interpret, but a prospective study in Denmark found that **mobile phone** subscription was associated with a decreased risk of subsequent hospital admission with dementia [75].

http://bmcgeriatr.biomedcentral.com/articles/10.1186/s12877-016-0342-y

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RF EMF exposures in kindergarten children

Bhatt CR, Redmayne M, Billah B, Abramson MJ, Benke G.Radiofrequency-electromagnetic field exposures in kindergarten children.J Expo Sci Environ Epidemiol. 2016 Oct 19. doi: 10.1038/jes.2016.55.

Abstract

The aim of this study was to assess environmental and personal radiofrequency-electromagnetic field (RF-EMF) exposures in kindergarten children. Ten children and 20 kindergartens in Melbourne, Australia participated in personal and environmental exposure measurements, respectively. Order statistics of RF-EMF exposures were computed for 16 frequency bands between 88 MHz and 5.8 GHz. Of the 16 bands, the three highest sources of environmental RF-EMF exposures were: Global System for Mobile Communications (GSM) 900 MHz downlink (82 mV/m); Universal Mobile Telecommunications System (UMTS) 2100MHz downlink (51 mV/m); and GSM 900 MHz uplink (45 mV/m). Similarly, the three highest personal exposure sources were: GSM 900 MHz downlink (50 mV/m); UMTS 2100 MHz downlink, GSM 900 MHz uplink and GSM 1800 MHz downlink (20 mV/m); and Frequency Modulation radio, Wi-Fi 2.4 GHz and Digital Video Broadcasting-Terrestrial (10 mV/m). The median environmental exposures were: 179 mV/m (total all bands), 123 mV/m (total mobile phone base station downlinks), 46 mV/m (total mobile phone base station uplinks), and 16 mV/m (Wi-Fi 2.4 GHz). Similarly, the median personal exposures were: 81 mV/m (total all bands), 62 mV/m (total mobile phone base station downlinks), 21 mV/m (total mobile phone base station uplinks), and 9 mV/m (Wi-Fi 2.4 GHz). The measurements showed that environmental RF-EMF exposure levels exceeded the personal RF-EMF exposure levels at kindergartens.

https://www.ncbi.nlm.nih.gov/pubmed/27759027?dopt=Abstract

Excerpt

In conclusion, this study provides evidence to support that of the 16 frequency bands measured the mobile phone base station DL exposure of GSM 900 MHz is the largest contributor to the total environmental and personal RF-EMF exposures in kindergartens in Melbourne. Wi-Fi exposure was found to be very low compared with mobile phone base station exposure. Environmental exposure levels at kindergartens located <300 m away from the nearest base station were higher compared with those located >300 m. The measurements suggested that the personal RF-EMF exposure levels were lower compared with the environmental RF-EMF levels at kindergartens.

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Personal exposure from RF EMF in Australia and Belgium using on-body calibrated exposimeters

Bhatt CR, Thielens A, Billah B, Redmayne M, Abramson MJ, Sim MR, Vermeulen R, Martens L, Joseph W, Benke G.Assessment of personal exposure from radiofrequency-electromagnetic fields in Australia and Belgium using on-body calibrated exposimeters.Environ Res. 2016 Nov;151:547-563. doi: 10.1016/j.envres.2016.08.022.

Abstract

The purposes of this study were: i) to demonstrate the assessment of personal exposure from various RF-EMF sources across different microenvironments in Australia and Belgium, with two on-body calibrated exposimeters, in contrast to earlier studies which employed single, non-on-body calibrated exposimeters; ii) to systematically evaluate the performance of the exposimeters using (on-body) calibration and cross-talk measurements; and iii) to compare the exposure levels measured for one site in each of several selected microenvironments in the two countries. A human subject took part in an on-body calibration of the exposimeter in an anechoic chamber. The same subject collected data on personal exposures across 38 microenvironments (19 in each country) situated in urban, suburban and rural regions. Median personal RF-EMF exposures were estimated: i) of all microenvironments, and ii) across each microenvironment, in two countries. The exposures were then compared across similar microenvironments in two countries (17 in each country). The three highest median total exposure levels were: city center (4.33V/m), residential outdoor (urban) (0.75V/m), and a park (0.75V/m) [Australia]; and a tram station (1.95V/m), city center (0.95V/m), and a park (0.90V/m) [Belgium]. The exposures across nine microenvironments in Melbourne, Australia were lower than the exposures across corresponding microenvironments in Ghent, Belgium ($p<0.05$). The personal exposures across urban microenvironments were higher than those for rural or suburban microenvironments. Similarly, the exposure levels across outdoor microenvironments were higher than those for indoor microenvironments.

https://www.ncbi.nlm.nih.gov/pubmed/?term=27588949

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November/December 2016 issue of the *Journal of Exposure Science & Environmental Epidemiology:* three EMF papers

Kosuke Kiyohara, Kanako Wake, Soichi Watanabe, Takuji Arima, Yasuto Sato, Noriko Kojimahara, Masao Taki and Naohito Yamaguchi.Recall accuracy of mobile phone calls among Japanese young people. J Expo Sci Environ Epidemiol 26: 566-574; advance online publication, March 18, 2015; doi:10.1038/jes.2015.13. https://www.ncbi.nlm.nih.gov/pubmed/?term=25783661

Benjamin Struchen, Ilaria Liorni, Marta Parazzini, Stephanie Gängler, Paolo Ravazzani and Martin Röösli. Analysis of personal and bedroom exposure to ELF-MFs in children in Italy and Switzerland. J Expo Sci Environ Epidemiol 26: 586-596; advance online publication, December 16, 2015; doi:10.1038/jes.2015.80. https://www.ncbi.nlm.nih.gov/pubmed/?term=26669849

Madhuri Sudan, Jørn Olsen,Torben Sigsgaard and Leeka Kheifets. Trends in cell phone use among children in the Danish national birth cohort at ages 7 and 11 years. J Expo Sci Environ Epidemiol 26: 606-612; advance online publication, March 23, 2016; doi:10.1038/jes.2016.17.
https://www.ncbi.nlm.nih.gov/pubmed/?term=27005743

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Electromagnetic Shielding of Building Walls: From Roman times to the present age

Davide Micheli, Paolo Gianola, Giorgio Bertin, Andrea Delfini, Roberto Pastore, Mario Marchetti, Roberto Diana. Electromagnetic Shielding of Building Walls: From Roman times to the present age. IEEE Antennas and Propagation Magazine. 58(5). Oct. 2016.

Abstract

We have investigated the electromagnetic (EM) shielding effectiveness (SE) of building walls built in different ages. The measurements were carried out in the city of Rome, analyzing different building typologies from Roman Empire historical ruins up to modern reinforced concrete and steel/glass buildings. The method consisted of a measurement performed by means of a portable two-port vector network analyzer (VNA) connected to a couple of light antennas located in opposite positions with respect to the middle wall. The explored frequencies were in the range of 0.7-5.0 GHz, which many countries have currently adopted for mobile-phone radio access network (RAN) and satellite positioning services. The SE measurements showed values of up to 100 dB, and the analysis of the results showed that ancient Romans building walls and steel/glass building structures have the highest shielding capability. A numerical simulation of the outdoor-to-indoor transition attenuation and a statistical analysis of the signal code power in the live RAN of Telecom Italia integrate the discussion of the results.

http://ieeexplore.ieee.org/document/7551182/

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Biological and health effects of radiofrequency fields: Good study design and quality publications

Vijayalaxmi. Biological and health effects of radiofrequency fields: Good study design and quality publications. http://dx.doi.org/10.1016/j.mrgentox.2016.09.007.

Highlights

• Good study design for in vitro, in vivo and human investigations.
• Methods for statistical analyses.
• Check-list in quality publications.
• Conclusions.

Abstract

During recent decades, researchers have used several different parameters to evaluate the biological and health effects of in vitro and in vivo exposure to non-ionizing radiofrequency fields in animals, humans and their isolated cells. The data reported in many of publications in peer-reviewed scientific journals were reviewed by the international and national expert groups of scientists for human risk assessment of exposure to

radiofrequency fields. The criteria used for such assessment depended on the study design, methodology and reporting of the data in the publication. This paper describes the requirements for good study design and quality publications, and provides guidance and a checklist for researchers studying radiofrequency fields and other environmental agents.

Conclusions

Investigations on the biological and health effects of RF exposure require close collaboration between biologists and engineers who have expertise in RF exposure assessment. The design of the studies as well as reporting the data in peer-reviewed publications should be of high quality. Detailed description of RF dosimetry is crucial and essential. Independent investigators should be able to replicate/confirm the observations under the same/improved experimental conditions. Such data are invaluable in strengthening the scientific knowledge which is essential for international and national evaluation of risk from RF exposure.

http://www.sciencedirect.com/science/article/pii/S1383571816302376

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Preliminary evidence that nanoparticle devices protect against EMR by reducing oxidative stress & inflammatory status

Francisco Ortiz, Beatriz I. Fernández-Gil, Ana Guerra-Librero, Luis C. López, Darío Acuña-Castroviejo, Germaine Escames. Preliminary evidence suggesting that nonmetallic and metallic nanoparticle devices protect against the effects of environmental electromagnetic radiation by reducing oxidative stress and inflammatory status. European Journal of Integrative Medicine, 8(5):835-840, October 2016.

Abstract

Introduction There is increasing interest in evaluating the potential health risks and biologic effects of exposure to extremely low-frequency magnetic fields (ELF-MF) and electromagnetic radiation (EMR), like those associated with personal computers, cellular phones, and environmental radiation (e.g., cellular towers, high-voltage power lines, radar). ELF-MF may generate free radicals in biological organisms, which leads to hyperoxidative status. Here, we investigated the potential efficacy of protective devices constructed with nonmetallic and metallic nanoparticles, which are conductors and semiconductors of electromagnetic energy.

Methods In a before and after study, 20 healthy subjects who regularly used cellular phones and were exposed to typical environmental EMF were given one of three different (ELF-MF) protective devices. Blood samples were drawn at baseline and one month after using the devices to examine redox and inflammatory status.

Results We found that, 30 days after using the devices, plasma levels of lipid peroxidation, nitrites, and interferon-γ decreased significantly. Furthermore, the disulfide glutathione/glutathione ratio decreased, which indicated reduced intracellular oxidative damage. These data suggested that continuous use of devices that contain nonmetallic and metallic nanoparticles could protect healthy subjects from EMF-induced oxidative/inflammatory damage.

Conclusion Thus, for the first time, we have shown that the devices tested could be useful in counteracting the deleterious effects of EMF pollution by neutralizing harmful radiation before it reaches the body.

Funding. This work was partially supported by Pranan Technologies Ltd. (Pamplona, Spain). This study was partially supported by grants from Pranan Technologies (Navarra, Spain) and from the Consejería de Innovación, Ciencia, y Empresa, Junta de Andalucía, Spain (CTS-101).

http://www.sciencedirect.com/science/article/pii/S1876382016301111

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The electromagnetic basis of social interactions

A. R. Liboff. The electromagnetic basis of social interactions. Electromagnetic Biology & Medicine. Published online: 27 Oct 2016 http://dx.doi.org/10.1080/15368378.2016.1241180

Abstract

It has been established that living things are sensitive to extremely low-frequency magnetic fields at vanishingly small intensities, on the order of tens of nT. We hypothesize, as a consequence of this sensitivity, that some fraction of an individual's central nervous system activity can be magnetically detected by nearby individuals. Even if we restrict the information content of such processes to merely simple magnetic cues that are unconsciously received by individuals undergoing close-knit continuing exposure to these cues, it is likely that they will tend to associate these cues with the transmitting individual, no less than would occur if such signals were visual or auditory. Furthermore, following what happens when one experiences prolonged exposure to visual and like sensory inputs, it can be anticipated that such association occurring magnetically will eventually also enable the receiving individual to bond to the transmitting individual. One can readily extrapolate from single individuals to groups, finding reasonable explanations for group behavior in a number of social situations, including those occurring in families, animal packs, gatherings as found in concerts, movie theaters and sports arenas, riots and selected predatory/prey situations. The argument developed here not only is consistent with the notion of a magnetic sense in humans, but also provides a new approach to electromagnetic hypersensitivity, suggesting that it may simply result from sensory overload.

http://www.tandfonline.com/doi/full/10.1080/15368378.2016.1241180

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Protozoa: A Method for Monitoring of the Morphofunctional Disorders in Cells Exposed in the Cell Phone EMF

Uskalova DV, Igolkina YV, Sarapultseva EI. Intravital Computer Morphometry on Protozoa: A Method for Monitoring of the Morphofunctional Disorders in Cells Exposed in the Cell Phone Communication Electromagnetic Field. Bull Exp Biol Med. 2016 Aug;161(4):554-7. doi: 10.1007/s10517-016-3459-2. Epub 2016 Sep 3.

Abstract

Morphofunctional disorders in unicellular aquatic protozoa - Spirostomum ambiguum infusorians after 30-, 60-, and 360-min exposure in electromagnetic field at a radiation frequency of 1 GHz and energy flow density of 50 μW/cm(2) were analyzed by intravital computer morphometry. Significant disorders in morphometric values correlated with low mobility of the protozoa. The results suggested the use of intravital computer morphometry on the protozoa for early diagnosis of radiation-induced effects of the mobile communication electromagnetic field, for example, low mobility of spermatozoa.

Excerpt

In 2003 sanitary epidemiological regulations and Sanitary Regulations and Standards 2.1.8/2.2.4.1190-03 were introduced in Russia. These regulations set up the **most stringent in the world maximal allowable values for energy flow density (EFD) – 10 μW/cm**2 **at a frequency of 900-1800 MHz for whole-body absorbed energy flow (SAR0 of 44 mW/kg**) [5]. These standards are based on observations carried out with participation of few volunteers and in model experiments on warm-blooded animals, cultured cells, lower animals, and plants [13]. It should be noted that communication network operators use several technologies

and wireless communication standards simultaneously, as a result of which the mean EMF levels in the Moscow region increased by an order of magnitude higher than the allowed values [2].

https://www.ncbi.nlm.nih.gov/pubmed/?term=27591872

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Microwaves and Alzheimer's disease

Zhang X, Huang WJ, Chen WW. Microwaves and Alzheimer's disease. Exp Ther Med. 2016 Oct;12(4):1969-1972.

Abstract

Alzheimer's diseases (AD) is the most common type of dementia and a neurodegenerative disease that occurs when the nerve cells in the brain die. The cause and treatment of AD remain unknown. However, AD is a disease that affects the brain, an organ that controls behavior. Accordingly, anything that can interact with the brain may affect this organ positively or negatively, thereby protecting or encouraging AD. In this regard, modern life encompasses microwaves for all issues including industrial, communications, medical and domestic tenders, and among all applications, the cell phone wave, which directly exposes the brain, continues to be the most used. Evidence suggests that microwaves may produce various biological effects on the central nervous system (CNS) and many arguments relay the possibility that microwaves may be involved in the pathophysiology of CNS disease, including AD. By contrast, previous studies have reported some beneficial cognitive effects and that microwaves may protect against cognitive impairment in AD. However, although many of the beneficial effects of microwaves are derived from animal models, but can easily be extrapolated to humans, whether microwaves cause AD is an important issue that is to be addressed in the current review.

Open Access Paper: http://bit.ly/ADwireless

Also see: http://www.saferemr.com/2016/10/does-wireless-radiation-from-cell.html

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Environmental risk factors for dementia: a systematic review

Lewis O. J. Killin, John M. Starr, Ivy J. Shiue, Tom C. Russ. Environmental risk factors for dementia: a systematic review. BMC Geriatrics. 12 October 2016. DOI: 10.1186/s12877-016-0342-y

Abstract

Background Dementia risk reduction is a major and growing public health priority. While certain modifiable risk factors for dementia have been identified, there remains a substantial proportion of unexplained risk. There is evidence that environmental risk factors may explain some of this risk. Thus, we present the first comprehensive systematic review of environmental risk factors for dementia.

Methods We searched the PubMed and Web of Science databases from their inception to January 2016, bibliographies of review articles, and articles related to publically available environmental data. Articles were included if they examined the association between an environmental risk factor and dementia. Studies with another outcome (for example, cognition), a physiological measure of the exposure, case studies, animal studies, and studies of nutrition were excluded. Data were extracted from individual studies which were, in turn, appraised for methodological quality. The strength and consistency of the overall evidence for each risk factor identified was assessed.

Results We screened 4784 studies and included 60 in the review. Risk factors were considered in six

categories: air quality, toxic heavy metals, other metals, other trace elements, occupational-related exposures, and miscellaneous environmental factors. Few studies took a life course approach. There is at least moderate evidence implicating the following risk factors: air pollution; aluminium; silicon; selenium; pesticides; vitamin D deficiency; and electric and magnetic fields.

Conclusions Studies varied widely in size and quality and therefore we must be circumspect in our conclusions. Nevertheless, this extensive review suggests that future research could focus on a short list of environmental risk factors for dementia. Furthermore, further robust, longitudinal studies with repeated measures of environmental exposures are required to confirm these associations.

http://bmcgeriatr.biomedcentral.com/articles/10.1186/s12877-016-0342-y

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Review paper: Proteomic impacts of electromagnetic fields on the male reproductive system

Sepehrimanesh, M. & Davis, D.L. Proteomic impacts of electromagnetic fields on the male reproductive system. Comp Clin Pathol (2016). doi:10.1007/s00580-016-2342-x Published online Oct 13, 2016.

Abstract

The use of mobile phones and other wireless transmitting devices is increasing dramatically in developing and developed countries, as is the rate of infertility. A number of respected infertility clinics in Australia, India, USA, and Iran are reporting that those who regularly use mobile phones tend to have reduced sperm quantity and quality. Some experimental studies have found that human sperm exposed to electromagnetic fields (EMF), either simulated or from mobile phones, developed biomarkers of impaired structure and function, as well as reduced quantity. These encompass pathological, endocrine, and proteomic changes. Proteins perform a vast array of functions within living organisms, and the proteome is the entire array of proteins—the ultimate biomolecules in the pathways of DNA transcription to translation. Proteomics is the art and science of studying all proteins in cells, using different techniques. This paper reviews proteomic experimental and clinical evidence that EMF acts as a male-mediated teratogen and contributor to infertility.

http://link.springer.com/article/10.1007%2Fs00580-016-2342-x

Not yet archived in PubMed.

Also see: http://www.saferemr.com/2015/09/effect-of-mobile-phones-on-sperm.html

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Investigation of bias related to differences between case and control interview dates in five INTERPHONE countries

Michelle C. Turner, Siegal Sadetzki, Chelsea E. Langer, Rodrigo Villegas, Jordi Figuerola, Bruce K. Armstrong, Angela Chetrit, Graham G. Giles,
Daniel Krewski, Martine Hours, Mary L. McBride, Marie-Elise Parent, Lesley Richardson, Jack Siemiatycki, Alistair Woodward, Elisabeth Cardis.
Investigation of bias related to differences between case and control interview dates in five INTERPHONE countries. Annals of Epidemiology. http://dx.doi.org/10.1016/j.annepidem.2016.09.013, Epub first Oct 8, 2016.

Abstract

Purpose Associations between cellular telephone use and glioma risk have been examined in several epidemiological studies including the 13-country INTERPHONE study. Although results showed no positive association between cellular telephone use and glioma risk overall, no increased risk for long term users, and

no exposure-response relationship, there was an elevated risk for those in the highest decile of cumulative call time. However, results may be biased as data were collected during a period of rapidly increasing cellular telephone use, and as controls were usually interviewed later in time than cases.

Methods Further analyses were conducted in a subset of five INTERPHONE study countries (Australia, Canada, France, Israel, New Zealand) using a post-hoc matching strategy to optimize proximity of case to control interview dates and age.

Results Though results were generally similar to the original INTERPHONE study, there was some attenuation of the reduced odds ratios and stronger positive associations among long term users and those in the highest categories for cumulative call time and number of calls (8-9th and 10th decile).

Conclusions Proximity and symmetry in timing of case to control interviews should be optimized when exposure patterns are changing rapidly with time.

http://www.sciencedirect.com/science/article/pii/S1047279716303702

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Carl Blackman discusses ELF and RF health effects

Carl F. Blackman.Comment on “Milham & Stetzer (2016) Tumor-specific frequencies and ocular melanoma.” Electromag Biol Med http://dx.doi.org/10.1080/15368378.2016.1234390
http://www.tandfonline.com/doi/full/10.1080/15368378.2016.1234390

Bio

Dr. Blackman is a biophysicist who worked as a research scientist in the US Environmental Protection Agency (EPA) from 1970 until his recent retirement. He researched electric and magnetic field interactions with biological systems until the U.S. Congress cut off EPA funding for EMF research in the 1990's. His work resulted in several discoveries including multiple effect "windows" of intensity and frequency, and the demonstration that the earth's magnetic field was involved in biological responses to EMF. He collaborated on the development of math models used to predict EMF conditions that cause biological responses. He and his colleagues discovered that melatonin can modulate gap junction intercellular communication and partially oppose the action of tumor-promoting agents to close this communication.They also demonstrated that the biological action of melatonin can be altered by magnetic field exposure. He is one of six founders of the Bioelectromagnetics Society (BEMS) in 1978, served as president in 1990-1991, and as a member of the editorial board of the Society's journal for 14 years. He served on the WHO committee to evaluate the health implications of radiofrequency radiation exposure (Environmental Health Criteria #137, 1993), and on an IARC committee that evaluated the carcinogenic potential of low frequency electric and magnetic fields in 2001 (Volume 80, 2002). In 2014 he received the BEMS d'Arsonval Award to recognize extraordinary accomplishment in bioelectromagnetics.

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RF Exposure Amongst Employees of Mobile Network Operators and Broadcasters

Ian Litchfield, Martie van Tongeren, Tom Sorahan. Radiofrequency Exposure Amongst Employees of Mobile Network Operators and Broadcasters. Radiation Protection Dosimetry. *doi: 10.1093/rpd/ncw283* First published online: October 13, 2016

Abstract

Little is known about personal exposure to radiofrequency (RF) fields amongst employees in the

telecommunications industry responsible for installing and maintaining transmitters. IARC classified RF exposure as a possible carcinogen, although evidence from occupational studies was judged to be inadequate. Hence, there is a need for improved evidence of any potentially adverse health effects amongst the workforce occupationally exposed to RF radiation. In this study, results are presented from an exposure survey using data from personal monitors used by employees in the broadcasting and telecommunication industries of the UK. These data were supplemented by spot measurements using broadband survey metres and information on daily work activities provided by employee questionnaires. The sets of real-time personal data were categorised by four types of site determined by the highest powered antenna present (high, medium or low power and ground-level sites). For measurements gathered at each type of site, the root mean square and a series of box plots were produced. Results from the daily activities diaries suggested that riggers working for radio and television broadcasters were exposed to much longer periods as compared to colleagues working for mobile operators. Combining the results from the measurements and daily activity diaries clearly demonstrate that exposures were highest for riggers working for broadcasting sites. This study demonstrates that it is feasible to carry out exposure surveys within these populations that will provide reliable estimates of exposure that can be used for epidemiological studies of occupational groups exposed to RF fields.

Open Access Paper: http://m.rpd.oxfordjournals.org/content/early/2016/10/13/rpd.ncw283.full

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Treatment of Neuropathic Pain Using Pulsed Radiofrequency: A Meta-analysis

Shi Y, Wu W. Treatment of Neuropathic Pain Using Pulsed Radiofrequency: A Meta-analysis.Pain Physician. 2016 Sep-Oct;19(7):429-44.

Abstract

BACKGROUND: Neuropathic pain (NP) is a major public health problem worldwide. Because of the unclear mechanism of NP, its treatment is one of the most difficult medical problems. As a targeted, noninvasive, safe therapy, pulsed radiofrequency (PRF) provides a new method for the treatment of NP; however, its effect on this treatment still lacks support from evidence-based medicine.

OBJECTIVE: To conduct a meta-analysis of available randomized controlled trials and to evaluate the effectiveness and clinical utility of PRF for the treatment of NP.

STUDY DESIGN: Meta-analysis.

SETTING: All selected studies were randomized controlled trials.

METHOD: A systematic and comprehensive database search was performed of the PubMed, CENTRAL, EMBASE.com, Cochrane Library, Chinese Biomedical Literature, and Wanfang databases for literature published from the establishment of the databases to December 19, 2015. According to inclusion and exclusion criteria, the results of randomized controlled trials supporting PRF for NP treatment were collected. The risk of bias tool described in the Cochrane Handbook version 5.1.0 was used to assess the quality of each trial. Meta-analysis was performed using RevMan 5.3 software.

RESULTS: A total of 12 randomized controlled trials involving 592 patients met the inclusion criteria. Overall, the results of the meta-analysis showed that, compared with the control group, PRF had a better effect on postherpetic neuralgia (PHN) in terms of pain score (one week, one month, and 3 months), excellent and good rate (one day, one month), and efficiency rate (one day). But PRF did not have a better effect on radicular pain in pain score (3 months). Side effects were less frequently found with the PRF treatment.

LIMITATIONS: Although we repeatedly tested the key words and used a manual method to prevent the loss of studies, due to the limitation of the included studies, some of the data were insufficient to complete the meta-

analysis, and we were unable to obtain the original data from some studies. Some studies did not report the blind design, which decreased the quality of the current study.

CONCLUSION: PRF did not have a better effect on radicular pain, and PRF is an effective and safe therapeutic alternative for the analgesia of PHN. However, for a high recurrence rate over a long period, repeated PRF treatment has limitations.

https://www.ncbi.nlm.nih.gov/pubmed/27676660?dopt=Abstract

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Effect of Electromagnetic Interference on Human Body Communication

Jung-Hwan Hwang ; Tae-Wook Kang ; Jong-Hwa Kwon ; Seong-Ook Park. Effect of Electromagnetic Interference on Human Body Communication.
IEEE Transactions on Electromagnetic Compatibility. PP(99):1-10. 22 September 2016.DOI: 10.1109/TEMC.2016.2598582

Abstract

In human body communication (HBC), the human body is used as a medium for transmitting data between devices as a replacement for wired and wireless technologies. The human body functions as an antenna in the low-frequency band used by HBC. Owing to this antenna function, electromagnetic waves radiating from electronic devices or wireless services cause electromagnetic interference (EMI) in HBC devices. This paper addresses such EMI in HBC devices. The interference signal caused by EMI was measured while the human subject, who was using an HBC device, was exposed to a general EMI environment at multiple sites. Using the interference model obtained from the measured interference signals, bit-error-rate degradation caused by the interference signal was simulated. The interference model presented in this paper can be effectively used to achieve reliable data communication in various HBC devices.

http://ieeexplore.ieee.org/document/7574274/

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Effect of DECT non-ionizing radiation on cultivated plants of Arabidopsis thaliana

Aikaterina L. Stefia, Lukas H. Margaritisb, Nikolaos S. Christodoulakisa. The effect of the non-ionizing radiation on cultivated plants of Arabidopsis thaliana (Col.). Flora - Morphology, Distribution, Functional Ecology of Plants. Volume 223, August 2016, Pages 114–120. http://dx.doi.org/10.1016/j.flora.2016.05.008

Highlights

• Arabidopsis thaliana plants grow under long term microwave radiation.
• Minor structural changes observed.
• Chloroplast number affected.
• Photosynthetic pigment content affected.
• Total biomass reduced.

Abstract

A series of experiments was carried out to investigate any structural or biochemical alterations on Arabidopsis thaliana (Col.) plants after a long term exposure to non ionizing radiation emitted from the base unit of a

cordless DECT system. Exposed plants, compared to their control counterparts, seem to be affected concerning their biomass and leaf structure. Their leaves are thinner and possess fewer chloroplasts. SEM observations of the exposed leaves reveal that the only feature affected is the pubescence which almost disappears while TEM investigation revealed minor structural effects in the chloroplasts. The reduction in the number of chloroplasts as well as the decrease of stroma thylakoids and photosynthetic pigments are probably the main reasons for a weak photosynthetic potential and a consequent reduction of the biomass production.

http://www.sciencedirect.com/science/article/pii/S0367253016300780?np=y

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RF radiation (900 MHz)-induced DNA damage and cell cycle arrest in testicular germ cells in mice

Pandey N, Giri S, Das S, Upadhaya P. Radiofrequency radiation (900 MHz)-induced DNA damage and cell cycle arrest in testicular germ cells in swiss albino mice. Toxicol Ind Health. 2016 Oct 13. pii: 0748233716671206.

Abstract

Even though there are contradictory reports regarding the cellular and molecular changes induced by mobile phone emitted radiofrequency radiation (RFR), the possibility of any biological effect cannot be ruled out. In view of a widespread and extensive use of mobile phones, this study evaluates alterations in male germ cell transformation kinetics following RFR exposure and after recovery. Swiss albino mice were exposed to RFR (900 MHz) for 4 h and 8 h duration per day for 35 days. One group of animals was terminated after the exposure period, while others were kept for an additional 35 days post-exposure. RFR exposure caused depolarization of mitochondrial membranes resulting in destabilized cellular redox homeostasis. Statistically significant increases in the damage index in germ cells and sperm head defects were noted in RFR-exposed animals. Flow cytometric estimation of germ cell subtypes in mice testis revealed 2.5-fold increases in spermatogonial populations with significant decreases in spermatids. Almost fourfold reduction in spermatogonia to spermatid turnover (1C:2C) and three times reduction in primary spermatocyte to spermatid turnover (1C:4C) was found indicating arrest in the premeiotic stage of spermatogenesis, which resulted in loss of post-meiotic germ cells apparent from testis histology and low sperm count in RFR-exposed animals. Histological alterations such as sloughing of immature germ cells into the seminiferous tubule lumen, epithelium depletion and maturation arrest were also observed. However, all these changes showed recovery to varied degrees following the post-exposure period indicating that the adverse effects of RFR on mice germ cells are detrimental but reversible. To conclude, RFR exposure-induced oxidative stress causes DNA damage in germ cells, which alters cell cycle progression leading to low sperm count in mice.

https://www.ncbi.nlm.nih.gov/pubmed/27738269?dopt=Abstract

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Effects of long-term exposure to 900 MHz EMF on heart morphology and biochemistry of male adolescent rats

Kerimoğlu G, Mercantepe T, Erol HS, Turgut A, Kaya H, Çolakoğlu S, Odacı E. Effects of long-term exposure to 900 megahertz electromagnetic field on heart morphology and biochemistry of male adolescent rats. Biotech Histochem. 2016 Aug 11:1-10.

Abstract

The pathological effects of exposure to an electromagnetic field (EMF) during adolescence may be greater than those in adulthood. We investigated the effects of exposure to 900 MHz EMF during adolescence on male

adult rats. Twenty-four 21-day-old male rats were divided into three equal groups: control (Cont-Gr), sham (Shm-Gr) and EMF-exposed (EMF-Gr). EMF-Gr rats were placed in an EMF exposure cage (Plexiglas cage) for 1 h/day between postnatal days 21 and 59 and exposed to 900 MHz EMF. Shm-Gr rats were placed inside the Plexiglas cage under the same conditions and for the same duration, but were not exposed to EMF. All animals were sacrificed on postnatal day 60 and the hearts were extracted for microscopic and biochemical analyses. Biochemical analysis showed increased levels of malondialdehyde and superoxide dismutase, and reduced glutathione and catalase levels in EMF-Gr compared to Cont-Gr animals. Hematoxylin and eosin stained sections from EMF-Gr animals exhibited structural changes and capillary congestion in the myocardium. The percentage of apoptotic myocardial cells in EMF-Gr was higher than in either Shm-Gr or Cont-Gr animals. Transmission electron microscopy of myocardial cells of EMF-Gr animals showed altered structure of Z bands, decreased myofilaments and pronounced vacuolization. We found that exposure of male rats to 900 MHz EMF for 1 h/day during adolescence caused oxidative stress, which caused structural alteration of male adolescent rat heart tissue.

https://www.ncbi.nlm.nih.gov/pubmed/27715326?dopt=Abstract

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Effect of Radiofrequency Radiation on Human Hematopoietic Stem Cells

Gläser K, Rohland M, Kleine-Ostmann T, Schrader T, Stopper H, Hintzsche H. Effect of Radiofrequency Radiation on Human Hematopoietic Stem Cells. Radiat Res. 2016 Oct 6.

Abstract

Exposure to electromagnetic fields in the radiofrequency range is ubiquitous, mainly due to the worldwide use of mobile communication devices. With improving technologies and affordability, the number of cell phone subscriptions continues to increase. Therefore, the potential effect on biological systems at low-intensity radiation levels is of great interest. While a number of studies have been performed to investigate this issue, there has been no consensus reached based on the results. The goal of this study was to elucidate the extent to which cells of the hematopoietic system, particularly human hematopoietic stem cells (HSC), were affected by mobile phone radiation. We irradiated HSC and HL-60 cells at frequencies used in the major technologies, GSM (900 MHz), UMTS (1,950 MHz) and LTE (2,535 MHz) for a short period (4 h) and a long period (20 h/66 h), and with five different intensities ranging from 0 to 4 W/kg specific absorption rate (SAR). Studied end points included apoptosis, oxidative stress, cell cycle, DNA damage and DNA repair. In all but one of these end points, we detected no clear effect of mobile phone radiation; the only alteration was found when quantifying DNA damage. Exposure of HSC to the GSM modulation for 4 h caused a small but statistically significant decrease in DNA damage compared to sham exposure. To our knowledge, this is the first published study in which putative effects (e.g., genotoxicity or influence on apoptosis rate) of radiofrequency radiation were investigated in HSC. Radiofrequency electromagnetic fields did not affect cells of the hematopoietic system, in particular HSC, under the given experimental conditions.

https://www.ncbi.nlm.nih.gov/pubmed/27710704?dopt=Abstract

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Effects of ELF EMF and cisplatin on mRNA levels of some DNA repair genes.

Sanie-Jahromi F, Saadat 2, Saadat M. Effects of extremely low frequency electromagnetic field and cisplatin on mRNA levels of some DNA repair genes. Life Sci. 2016 Oct 6. pii: S0024-3205(16)30588-4. doi: 10.1016/j.lfs.2016.10.006.

Highlights

• Extremely-low frequency electromagnetic field (ELF-EMF) can affect gene expression.
• mRNA levels of seven genes involved in DNA repair pathways were evaluated.
• The examined genes had tendency to be down-regulated in the cells treated with EMF.
• *GADD45A* mRNA levels in cells co-treated with cisplatin (CDDP) + EMF were increased.
• Co-treatment of CDDP + EMF enhances down-regulation of the genes of NHEJ pathway.
• Elevation in IC_{50} of CDDP when cells co-treated with CDDP + EMF was observed.

Abstract

AIMS: It has been shown that exposure to extremely-low frequency (<300Hz) oscillating electromagnetic field (EMF) can affect gene expression. The effects of different exposure patterns of 50-Hz EMF and co-treatment of EMF plus cisplatin (CDDP) on mRNA levels of seven genes involved in DNA repair pathways (GADD45A, XRCC1, XRCC4, Ku70, Ku80, DNA-PKcs and LIG4) were evaluated.

MAIN METHODS: Two 50-Hz EMF intensities (0.25 and 0.50mT), three exposure patterns (5min field-on/5min field-off, 15min field-on/15min field-off, 30min field-on continuously) and two cell lines (MCF-7 and SH-SY5Y) were used. The mRNA levels were measured using quantitative real-time PCR.

KEY FINDINGS: The examined genes had tendency to be down-regulated in MCF-7 cells treated with EMF. In the pattern of 15min field-on/15min field-off of the 0.50mT EMF, no increase in mRNA levels were observed, but the mRNA levels of GADD45A, XRCC1, XRCC4, Ku80, Ku70, and LIG4 were down-regulated. A significant elevation in IC50 of CDDP was observed when MCF-7 and SH-SY5Y cells were co-treated with CDDP+EMF in comparison with the cells treated with CDDP alone. GADD45A mRNA levels in MCF-7 and SH-SY5Y cells co-treated with CDDP+EMF were increased and at the same time the mRNA levels of XRCC4, Ku80, Ku70 and DNA-PKcs were down-regulated.

SIGNIFICANCE: Present study provides evidence that co-treatment of CDDP+EMF can enhance down-regulation of the genes involved in non-homologous end-joining pathway. It might be suggested that co-treatment of CDDP+EMF could be more promising for sensitizing cancer cells to DNA double strand breaks.

https://www.ncbi.nlm.nih.gov/pubmed/27721000?dopt=Abstract