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13/04/2015 - April 2015 - Science Update


The following is a quick summary of another twenty papers that have come out over the last few months related to effects of electromagnetic radiation. All papers with a green background are highlighted as being particularly important or relevant.

1.  **Pettersson D et al**, (January 2015) *Validation of self-reported start year of mobile phone use in a Swedish case-control study on radiofrequency fields and acoustic neuroma risk*, *J Expo Sci Environ Epidemiol*. 2015 Jan;25(1):72-9. doi: 10.1038/jes.2014.76. Epub 2014 Nov 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

The possible effect of radiofrequency exposure from mobile phones on tumor risk has been studied since the late 1990s. Yet, empirical information about recall of the start of mobile phone use among adult cases and controls has never been reported. Limited knowledge about recall errors hampers interpretations of the epidemiological evidence. We used network operator data to validate the self-reported start year of mobile phone use in a case-control study of mobile phone use and acoustic neuroma risk. The answers of 96 (29%) cases and 111 (22%) controls could be included in the validation. The larger proportion of cases reflects a more complete and detailed reporting of subscription history. Misclassification was substantial, with large random errors, small systematic errors, and no significant differences between cases and controls. The average difference between self-reported and operator start year was -0.62 (95% confidence interval: -1.42, 0.17) years for cases and -0.71 (-1.50, 0.07) years for controls, standard deviations were 3.92 and 4.17 years, respectively. Agreement between self-reported and operator-recorded data categorized into short, intermediate and long-term use was moderate (kappa statistic: 0.42). Should an association exist, dilution of risk estimates and distortion of exposure-response patterns for time since first mobile phone use could result from the large random errors in self-reported start year. Retrospective collection of operator data likely leads to a selection of "good reporters", with a higher proportion of cases. Thus, differential recall cannot be entirely excluded.

2.  **Adibzadeh F et al**, (January 2015) *Impact of head morphology on local brain specific absorption rate from exposure to mobile phone radiation*, *Bioelectromagnetics*. 2015 Jan;36(1):66-76. doi: 10.1002/bem.21885. Epub 2014 Nov 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

Among various possible health effects of mobile phone radiation, the risk of inducing cancer has the strongest interest of laymen and health organizations. Recently, the Interphone epidemiological study investigated the association between the estimated Radio Frequency (RF) dose from mobile phones and the risk of developing a brain tumor. Their dosimetric analysis included over 100 phone models but only two homogeneous head phantoms. So, the potential impact of individual morphological features on global and local RF absorption in the brain was not investigated. In this study, we performed detailed dosimetric simulations for 20 head models and quantified the variation of RF dose in different brain regions as a function of head morphology. Head models were exposed to RF fields from generic mobile phones at 835 and 1900 MHz in the "tilted" and "cheek" positions. To evaluate the local RF dose variation, we used and compared two different post-processing methods, that is, averaging specific absorption rate (SAR) over Talairach regions and over sixteen predefined 1 cm(3) cube-shaped field-sensors. The results show that the variation in the averaged SAR among the heads can reach up to 16.4 dB at a 1 cm(3) cube inside the brain (field-sensor method) and alternatively up to 15.8 dB in the medulla region (Talairach method). In conclusion, we show head morphology as an important uncertainty source for dosimetric studies of mobile phones. Therefore, any dosimetric analysis dealing with RF dose at a specific region in the brain (e.g., tumor risk analysis) should be based upon real morphology.

3.  **Geronikolou S et al**, (November 2014) *Diverse radiofrequency sensitivity and*

radiofrequency effects of mobile or cordless phone near fields exposure in Drosophila melanogaster, PLoS One. 2014 Nov 17;9(11):e112139. doi: 10.1371/journal.pone.0112139. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

The impact of electromagnetic fields on health is of increasing scientific interest. The aim of this study was to examine how the *Drosophila melanogaster* animal model is affected when exposed to portable or mobile phone fields. Two experiments have been designed and performed in the same laboratory conditions. Insect cultures were exposed to the near field of a 2G mobile phone (the GSM 2G networks support and complement in parallel the 3G wide band or in other words the transmission of information via voice signals is served by the 2G technology in both mobile phones generations) and a 1880 MHz cordless phone both digitally modulated by human voice. Comparison with advanced statistics of the egg laying of the second generation exposed and non-exposed cultures showed limited statistical significance for the cordless phone exposed culture and statistical significance for the 900 MHz exposed insects. We calculated by physics, simulated and illustrated in three dimensional figures the calculated near fields of radiation inside the experimenting vials and their difference. Comparison of the power of the two fields showed that the difference between them becomes null when the experimental cylinder radius and the height of the antenna increase. Our results suggest a possible radiofrequency sensitivity difference in insects which may be due to the distance from the antenna or to unexplored intimate factors. Comparing the near fields of the two frequencies bands, we see similar not identical geometry in length and height from the antenna and that lower frequencies tend to drive to increased radiofrequency effects.

4. [P](#) **Huang CY** *et al*, (November 2014) *Distinct epidermal keratinocytes respond to extremely low-frequency electromagnetic fields differently*, PLoS One. 2014 Nov 19;9(11):e113424. doi: 10.1371/journal.pone.0113424. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

Following an increase in the use of electric appliances that can generate 50 or 60 Hz electromagnetic fields, concerns have intensified regarding the biological effects of extremely low-frequency electromagnetic fields (ELF-EMFs) on human health. Previous epidemiological studies have suggested the carcinogenic potential of environmental exposure to ELF-EMFs, specifically at 50 or 60 Hz. However, the biological mechanism facilitating the effects of ELF-EMFs remains unclear. Cellular studies have yielded inconsistent results regarding the biological effects of ELF-EMFs. The inconsistent results might have been due to diverse cell types. In our previous study, we indicated that 1.5 mT, 60 Hz ELF-EMFs will cause G1 arrest through the activation of the ATM-Chk2-p21 pathway in human keratinocyte HaCaT cells. The aim of the current study was to investigate whether ELF-EMFs cause similar effects in a distinct epidermal keratinocyte, primary normal human epidermal keratinocytes (NHEK), by using the same ELF-EMF exposure system and experimental design. We observed that ELF-EMFs exerted no effects on cell growth, cell proliferation, cell cycle distribution, and the activation of ATM signaling pathway in NHEK cells. We demonstrated that the 2 epidermal keratinocytes responded to ELF-EMFs differently. To further validate this finding, we simultaneously exposed the NHEK and HaCaT cells to ELF-EMFs in the same incubator for 168 h and observed the cell growths. The simultaneous exposure of the two cell types results showed that the NHEK and HaCaT cells exhibited distinct responses to ELF-EMFs. Thus, we confirmed that the biological effects of ELF-EMFs in epidermal keratinocytes are cell type specific. Our findings may partially explain the inconsistent results of previous studies when comparing results across various experimental models.

5. [P](#) **Gorpinchenko I** *et al*, (2014) *The influence of direct mobile phone radiation on sperm quality*, Cent European J Urol. 2014;67(1):65-71. doi: 10.5173/ceju.2014.01.art14. Epub 2014 Apr 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

It is impossible to imagine a modern socially-active man who does not use mobile devices and/or computers with Wi-Fi function. The effect of mobile phone radiation on male fertility is the subject of recent interest and investigations. The aim of this study was to investigate the direct in vitro influence of mobile phone radiation on sperm DNA fragmentation and motility parameters

in healthy subjects with normozoospermia. 32 healthy men with normal semen parameters were selected for the study. Each sperm sample was divided into two equal portions (A and B). Portions A of all involved men were placed for 5 hours in a thermostat, and portions B were placed into a second thermostat for the same period of time, where a mobile phone in standby/talk mode was placed. After 5 hours of incubation the sperm samples from both thermostats were re-evaluated regarding basic motility parameters. The presence of DNA fragmentation in both A and B portions of each sample was determined each hour using a standard sperm chromatin dispersion test. The number of spermatozoa with progressive movement in the group, influenced by electromagnetic radiation, is statistically lower than the number of spermatozoa with progressive movement in the group under no effect of the mobile phone. The number of non-progressive movement spermatozoa was significantly higher in the group, which was influenced by cell phone radiation. The DNA fragmentation was also significantly higher in this group. correlation exists between mobile phone radiation exposure, DNA-fragmentation level and decreased sperm motility.

6. [] Tomitsch J, Dechant E et al, (January 2015) *Exposure to electromagnetic fields in households--trends from 2006 to 2012*, Bioelectromagnetics. 2015 Jan;36(1):77-85. doi: 10.1002/bem.21887. Epub 2014 Nov 24 [View Author's abstract conclusions] [View on Pubmed]

This article is a follow-up study of extremely low-frequency electric and magnetic fields (ELF-EFs, ELF-MFs) and radiofrequency electromagnetic fields (RF-EMFs) using data collected in 2012 following earlier data sets from 2006 and 2009. Measurements were conducted in 219 bedrooms in Lower Austria. Out of these rooms 113 measurements were done in the same households in 2006, 2009 and 2012, and 106 were conducted in neighbouring buildings added in 2009 and newly recruited buildings in mainly urban areas in 2012. In revisited places the median of the ELF-EFs decreased from 23.20 V/m in 2006 to 13.90 V/m in 2012. The median of all-night measurements of ELF-MFs at 50 Hz decreased from 13.50 to 11.37 nT. The median of total RF-EMFs increased from 28.13 to 52.16 $\mu\text{W}/\text{m}^2$. Highest increases were found for universal mobile telecommunication system (UMTS) and wireless local area networks (WLAN). The analysis of all households showed higher total RF-EMFs in urban (median = 117.73 $\mu\text{W}/\text{m}^2$) than in rural (median = 34.52 $\mu\text{W}/\text{m}^2$) areas. Long-term evolution (LTE) in the 2600 MHz frequency range was detected at 17 locations with a maximum of 38.20 $\mu\text{W}/\text{m}^2$. Indoor RF-EMF sources resulted in decreased exposure in the frequency range of digital enhanced cordless telecommunications telephones (DECT) and increased exposure in the frequency range of WLAN.

7. [N] Giorgi G et al, (December 2014) *An evaluation of genotoxicity in human neuronal-type cells subjected to oxidative stress under an extremely low frequency pulsed magnetic field*, Mutat Res Genet Toxicol Environ Mutagen. 2014 Dec;775-776:31-7. doi: 10.1016/j.mrgentox.2014.10.003. Epub 2014 Oct 22 [View Author's abstract conclusions] [View on Pubmed]

The possible genotoxicity of extremely low frequency magnetic field (ELF-MF) exposure is still a controversial topic. The most of the reported data suggests that it alone does not affect DNA integrity, but several recent reports have suggested that sinusoidal ELF-MF may increase the effect of known genotoxic agents. Only a few studies deal with non sinusoidal ELF-MF, including pulsed magnetic field (PMF), which are produced by several devices. The aim of this study is to investigate whether PMF exposure can interfere with DNA damage and repair in the presence of a genotoxic oxidative agent in neuronal type cells. To this purpose gamma-H2AX foci formation, which is a sensitive marker of DNA double strand breaks (DSB), was investigated at different points of time (1, 24, 48, 72h) after the H2O2 treatment (300 μM for 1h) under PMF exposure (1mT, 50Hz) in human neuroblastoma BE(2)C cells. Moreover, cytotoxicity evaluation, by MTT assay and cell cycle analysis, was performed at various points of time after the treatment. Taken together, results suggest that PMF exposure does not interfere with genotoxicity and cytotoxicity induced by oxidative stress.

8. [P] Agarwal A, Durairajanayagam D, (November 2014) *Are men talking their reproductive health away?*, Asian J Androl. 2014 Nov 18. doi: 10.4103/1008-682X.140963. [Epub ahead of print] [View Author's abstract conclusions] [View on Pubmed]

The advent of mobile phones has revolutionized communication trends across the globe. As the popularity of mobile phone usage continues to escalate, there is now growing concern about the effects of radiofrequency electromagnetic waves (RF-EMW) exposure on biological tissues, such as the brain and testes. Researchers have sought to link the much debated decline in human sperm quality in the last decade, with increased exposure to RF-EMW, particularly through mobile phone usage. In a recent systematic review and meta-analysis on the effect of mobile phone RF-EMW radiation on sperm quality, Adams et al. [1] demonstrated an association between mobile phone exposure and reduced sperm motility and viability, with inconsistent effects on sperm concentration. [1] Results from 10 pooled experimental (in vitro) and observational (in vivo) human studies (n = 1492) led these researchers to suggest that exposure to RF-EMW radiation from carrying a mobile phone in the trouser pocket negatively impacts sperm quality.

9. [P] Aydogan F et al, (January 2015) *The effect of 2100 MHz radiofrequency radiation of a 3G mobile phone on the parotid gland of rats*, Am J Otolaryngol. 2015 Jan-Feb;36(1):39-46. doi: 10.1016/j.amjoto.2014.10.001. Epub 2014 Oct 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

We aimed to evaluate the effect of 2100 MHz radiofrequency radiation on the parotid gland of rats in short and relatively long terms. Thirty Wistar albino rats were divided into four groups. Groups A and B served as the control groups (for 10 days and 40 days, respectively), and each group included six rats. Groups C and D were composed of nine rats each, and they were the exposure groups. The rats were exposed to 2100 MHz radiofrequency radiation emitted by a generator, simulating a third generation mobile phone for 6 hours/day, 5 days/week, for 10 or 40 days. Following exposure, the rats were sacrificed and parotid glands were removed. Histopathological and biochemical examinations were performed. Although there were no histopathological changes in the control groups except for two animals in group A and three animals in group B, the exposure groups C (10 days) and D (40 days) showed numerous histopathological changes regarding salivary gland damage including acinar epithelial cells, interstitial space, ductal system, vascular system, nucleus, amount of cytoplasm and variations in cell size. The histopathological changes were more prominent in group D compared to group C. There was statistically significant different parameter regarding variation in cell size between the groups B and D ($p=0.036$). The parotid gland of rats showed numerous histopathological changes after exposure to 2100 MHz radiofrequency radiation, both in the short and relatively long terms. Increased exposure duration led to an increase in the histopathological changes.

10. [P] Bolte JF et al, (January 2015) *Everyday exposure to power frequency magnetic fields and associations with non-specific physical symptoms*, Environ Pollut. 2015 Jan;196:224-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

The aim of this study was to investigate the association between exposure to extremely low frequency magnetic fields (ELF MF), or power frequency fields, and non-specific physical symptoms (NSPS). In across-sectional study, personal exposure to ELF MF was measured for 99 adults selected in and around Amsterdam, the Netherlands in 2009-2010. They were scored on 16 NSPS. As a cut-off point for the individual 24-h time weighted average exposure the 80-percentile (0.09 mT) was chosen. As only one man scored "moderately high" on the somatisation scale against nine women, we decided to proceed analyses only with the 48 women. The crude odds ratio (OR) for women was 8.50 (CI 95%: 1.73-46.75), suggesting that for women environmental exposure to ELF MF is associated with an increased score on NSPS. As this is an exploratory cross-sectional study in a relatively small sample, no conclusions regarding causality can be drawn.

11. [P] Grant DN et al, (December 2014) *In vitro electromagnetic stimulation to enhance cell proliferation in extracellular matrix constructs with and without metallic nanoparticles*, J Biomed Mater Res B Appl Biomater. 2014 Dec 2. doi: 10.1002/jbm.b.33338. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

Extremely low frequency electromagnetic fields (ELF-EMFs) can induce beneficial effects including enhanced protein synthesis and cell proliferation on healing bone and skin wounds. This study investigated the effects of ELF-EMFs on acellular tissue constructs with and without gold nanoparticles (AuNPs) to determine if cell proliferation could be increased and thus provide an enhanced mechanism for in vitro cell seeding on tissue engineered constructs. Different sized AuNPs, 20 and 100 nm, were conjugated to acellular porcine tissue, seeded with L929 murine fibroblasts and exposed to a continuous 12 gauss, 60 Hz electromagnetic field for 2 hours each day up to 10 days. Scanning electron microscopy and cell culture assays were performed to ascertain cell proliferation and viability before and after exposure. Results indicate the ELF-EMF stimulation significantly increased cell proliferation. The presence of AuNPs did not boost the stimulatory effects, but they did demonstrate higher rates of proliferation from day 3 to day 10. In addition, unstimulated 100 nm AuNPs constructs resulted in significant increases in proliferation as compared to unstimulated crosslinked constructs. In conclusion, ELF-EMF stimulation enhanced cellular proliferation and while the presence of AuNPs did not significantly enhance this effect, AuNPs resulted in increased proliferation rates from day 3 to day 10.

12. [P](#) **Carpenter DO**, (November 2014) *Excessive exposure to radiofrequency electromagnetic fields may cause the development of electrohypersensitivity*, *Altern Ther Health Med*. 2014 Nov-Dec;20(6):40-2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

No abstract provided

13. [P](#) **Lamech F**, (November 2014) *Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in victoria, australia: a case series*, *Altern Ther Health Med*. 2014 Nov-Dec;20(6):28-39 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

In 2006, the government in the state of Victoria, Australia, mandated the rollout of smart meters in Victoria, which effectively removed a whole population's ability to avoid exposure to human-made high-frequency nonionizing radiation. This issue appears to constitute an unprecedented public health challenge for Victoria. By August 2013, 142 people had reported adverse health effects from wireless smart meters by submitting information on an Australian public Web site using its health and legal registers. The study evaluated the information in the registers to determine the types of symptoms that Victorian residents were developing from exposure to wireless smart meters. In this case series, the registers' managers eliminated those cases that did not clearly identify the people providing information by name, surname, postal address, and/or e-mail to make sure that they were genuine registrants. Then they obtained consent from participants to have their deidentified data used to compile the data for the case series. The author later removed any individual from outside of Victoria. The study included 92 residents of Victoria, Australia. The author used her medical experience and judgment to group symptoms into clinically relevant clusters (eg, pain in the head was grouped with headache, tinnitus was grouped with ringing in the ears). The author stayed quite close to the wording used in the original entries. She then calculated total numbers and percentages for each symptom cluster. Percentages were rounded to the nearest whole number. The most frequently reported symptoms from exposure to smart meters were (1) insomnia, (2) headaches, (3) tinnitus, (4) fatigue, (5) cognitive disturbances, (6) dysesthesias (abnormal sensation), and (7) dizziness. The effects of these symptoms on people's lives were significant. Review of some key studies, both recent and old (1971), reveals that the participants' symptoms were the same as those reported by people exposed to radiofrequency fields emitted by devices other than smart meters. Interestingly, the vast majority of Victorian cases did not state that they had been sufferers of electromagnetic hypersensitivity syndrome (EHS) prior to exposure to the wireless meters, which points to the possibility that smart meters may have unique characteristics that lower people's threshold for symptom development.

14. [P](#) **Patruno A et al**, (January 2015) *Effects of extremely low frequency electromagnetic field (ELF-EMF) on catalase, cytochrome P450 and nitric oxide synthase in erythro-leukemic cells*, *Life Sci*. 2015 Jan 15;121:117-23. doi: 10.1016/j.lfs.2014.12.003. Epub 2014 Dec 11 [[View Author's](#)

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Extremely low frequency electromagnetic fields (ELF-EMFs) are widely employed in electrical appliances and different equipment such as television sets, mobile phones, computers and microwaves. The molecular mechanism through which ELF-EMFs can influence cellular behavior is still unclear. A hypothesis is that ELF-EMFs could interfere with chemical reactions involving free radical production. Under physiologic conditions, cells maintain redox balance through production of ROS/RNS and antioxidant molecules. The altered balance between ROS generation and elimination plays a critical role in a variety of pathologic conditions including neurodegenerative diseases, aging and cancer. Actually, there is a disagreement as to whether there is a causal or coincidental relationship between ELF-EMF exposure and leukemia development. Increased ROS levels have been observed in several hematopoietic malignancies including acute and chronic myeloid leukemias. In our study, the effect of ELF-EMF exposure on catalase, cytochrome P450 and inducible nitric oxide synthase activity and their expression by Western blot analysis in myelogenous leukemia cell line K562 was evaluated. A significant modulation of iNOS, CAT and Cyt P450 protein expression was recorded as a result of ELF-EMF exposure in both phorbol 12-myristate 13-acetate (PMA)-stimulated and non-stimulated cell lines. Modulation in kinetic parameters of CAT, CYP-450 and iNOS enzymes in response to ELF-EMF indicates an interaction between the ELF-EMF and the enzymological system. These new insights might be important in establishing a mechanistic framework at the molecular level within which the possible effects of ELF-EMF on health can be understood.


15. [P] **Gok DK et al**, (December 2014) *The developmental effects of extremely low frequency electric fields on visual and somatosensory evoked potentials in adult rats*, *Electromagn Biol Med.* 2014 Dec 11:1-10. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

The purpose of our study was to investigate the developmental effects of extremely low frequency electric fields (ELF-EFs) on visual evoked potentials (VEPs) and somatosensory-evoked potentials (SEPs) and to examine the relationship between lipid peroxidation and changes of these potentials. In this context, thiobarbituric acid reactive substances (TBARS) levels were determined as an indicator of lipid peroxidation. Wistar albino female rats were divided into four groups; Control (C), gestational (prenatal) exposure (Pr), gestational+ postnatal exposure (PP) and postnatal exposure (Po) groups. Pregnant rats of Pr and PP groups were exposed to 50 Hz electric field (EF) (12 kV/m; 1 h/day), while those of C and Po groups were placed in an inactive system during pregnancy. Following parturition, rats of PP and Po groups were exposed to ELF-EFs whereas rats of C and Pr groups were kept under the same experimental conditions without being exposed to any EF during 68 days. On postnatal day 90, rats were prepared for VEP and SEP recordings. The latencies of VEP components in all experimental groups were significantly prolonged versus C group. For SEPs, all components of PP group, P2, N2 components of Pr group and P1, P2, N2 components of Po group were delayed versus C group. As brain TBARS levels were significantly increased in Pr and Po groups, retina TBARS levels were significantly elevated in all experimental groups versus C group. In conclusion, alterations seen in evoked potentials, at least partly, could be explained by lipid peroxidation in the retina and brain.


16. [P] **Mortazavi S et al**, (September 2014) *Electromagnetic Radiofrequency Radiation Emitted from GSM Mobile Phones Decreases the Accuracy of Home Blood Glucose Monitors*, *J Biomed Phys Eng.* 2014 Sep 1;4(3):111-6. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

Mobile phones are two-way radios that emit electromagnetic radiation in microwave range. As the number of mobile phone users has reached 6 billion, the bioeffects of exposure to mobile phone radiation and mobile phone electromagnetic interference with electronic equipment have received more attention, globally. As self-monitoring of blood glucose can be a beneficial part of diabetes control, home blood glucose testing kits are very popular. The main goal of this study was to investigate if radiofrequency radiation emitted from a common GSM mobile phone can alter the accuracy of home blood glucose monitors. Forty five female nondiabetic students aged 17-20 years old participated in this study. For Control-EMF group (30 students), blood glucose concentration for each individual was measured in presence and absence of radiofrequency

radiation emitted by a common GSM mobile phone (HTC touch, Diamond 2) while the phone was ringing. For Control- Repeat group (15 students), two repeated measurements were performed for each participant in the absence of electromagnetic fields. The magnitude of the changes between glucose levels in two repeated measurements ($^{\circ}\text{C}$) in Control-Repeat group was 1.07 ± 0.88 mg/dl while this magnitude for Control-EMF group was 7.53 ± 4.76 mg/dl ($P < 0.001$, two-tailed test). To the best of our knowledge, this is the first study to assess the electromagnetic interference in home blood glucose monitors. It can be concluded that electromagnetic interference from mobile phones has an adverse effect on the accuracy of home blood glucose monitors. We suggest that mobile phones should be used at least 50 cm away from home blood glucose monitors.

17.  **Gryz K et al**, (December 2014) *Evaluation of exposure to electromagnetic radiofrequency radiation in the indoor workplace accessible to the public by the use of frequency-selective exposimeters*, Int J Occup Med Environ Health. 2014 Dec;27(6):1043-54. doi: 10.2478/s13382-014-0334-0. Epub 2014 Dec 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

The aim of the study was to identify and assess electromagnetic radiofrequency radiation (EMRR) exposure in a workplace located in a publicly accessible environment, and represented by offices (where exposure is caused by various transmitters of local fixed indoor and outdoor wireless communication systems). The investigations were performed in 45 buildings (in urban and rural areas in various regions of Poland), using frequency-selective electric field strength (E-field) exposimeters sensitive to the EMRR with a frequency range of 88-2500 MHz, split into 12 sub-bands corresponding to the operating frequencies of typical EMRR sources. The variability of the E-field was analyzed for each frequency range and the total level of exposure by statistical parameters of recorded exposimetric profiles: minimum, maximum, median values and 25-75th - percentiles. The main sources of exposure to EMRR are mobile phone base transceiver stations (BTS) and radio-television transmitters (RTV). The frequency composition in a particular office depends on the building's location. The E-field recorded in buildings in urban and rural areas from the outdoor BTS did not exceed respectively: medians - 0.19 and 0.05 V/m, 75th percentiles - 0.25 and 0.09 V/m. In buildings equipped with the indoor BTS antennas the E-field did not exceed: medians - 1 V/m, 75th percentiles - 1.8 V/m. Whereas in urban and rural areas, the median and 75th percentile values of the E-field recorded in buildings located near the RTV (within 1 km) did not exceed: 1.5 and 3.8 V/m or 0.4 and 0.8 V/m, for radio FM band or for TV bands, respectively. Investigations confirmed the practical applicability of the exposimetric measurements technique for evaluating parameters of worker's exposure in both frequency- and time-domain. The presented results show EMRR exposure of workers or general public in locations comparable to offices to be well below international limits.

18.  **Dasdag S et al**, (April 2015) *Long term and excessive use of 900 MHz radiofrequency radiation alter microRNA expression in brain*, Int J Radiat Biol. 2015 Apr;91(4):306-11. doi: 10.3109/09553002.2015.997896. Epub 2015 Jan 2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

We still do not have any information on the interaction between radiofrequency radiation (RF) and miRNA, which play paramount role in growth, differentiation, proliferation and cell death by suppressing one or more target genes. The purpose of this study was to bridge this gap by investigating effects of long-term 900 MHz mobile phone exposure on some of the miRNA in brain tissue. The study was carried out on 14 Wistar Albino adult male rats by dividing them into two groups: Sham ($n = 7$) and exposure ($n = 7$). Rats in the exposure group were exposed to 900 MHz RF radiation for 3 h per day (7 days a week) for 12 months (one year). The same procedure was applied to the rats in the sham group except the generator was turned off. Immediately after the last exposure, rats were sacrificed and their brains were removed. rno-miR-9-5p, rno-miR-29a-3p, rno-miR-106b-5p, rno-miR-107 and rno-miR-125a-3p in brain were investigated in detail. Results revealed that long-term exposure of 900 MHz RF radiation only decreased rno-miR107 (adjP* = 0.045) value where the whole body (rms) SAR value was 0.0369 W/kg. However, our results indicated that other microRNA evaluated in this study was not altered by 900 MHz RF radiation. 900 MHz RF radiation can alter some of the miRNA, which, in turn, may lead to adverse effects. Therefore, further studies should be performed.

19. [P](#) **Boga A et al**, (March 2015) *The effect of 900 and 1800 MHz GSM-like radiofrequency irradiation and nicotine sulfate administration on the embryonic development of Xenopus laevis*, *Ecotoxicol Environ Saf.* 2015 Mar;113:378-90. doi: 10.1016/j.ecoenv.2014.12.020. Epub 2014 Dec 20. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

The aim of this study was to investigate the effects of GSM-like radiofrequency electromagnetic radiation (RF EMR) and nicotine sulfate (NS) exposure on *Xenopus* embryonic development. The developmental effects of GSM-like RF-EMR (900-1800 MHz, at a SAR value of 1W/kg and NS on *Xenopus laevis* embryos were investigated). Following the application of radiofrequency radiation and/or NS administration, the embryos were closely examined in order to determine their possible teratogenic effects. *Xenopus* frogs obtained from the Department of Physiology of the Cukurova University, in accordance described by the Standard Guide of the American Society for Testing and Materials (ASTM). Following the exposure of *Xenopus* embryos to RF-EMR at 900 and 1800 MHz (1.0W/kg) for 4, 6 and 8h; the whole body specific energy absorption rate (SAR) of the embryos was calculated. With the exception of irradiation at 1800 MHz no dramatic developmental anomalies were observed in the *Xenopus* embryos in association with RF-EMR applications. Combined RF-EMR and NS applications resulted in dramatic abnormalities and death among the *Xenopus* embryos. The study results indicated that GSM-like RF-EMR (e.g. radiation from cell phones) was not as harmful to *Xenopus* embryos as might have been expected. However, the combined effects of GSM-like RF-EMR and NS on *Xenopus* embryos were more severe than the effect of RF-EMR or NS alone. In conclusion, the study results appear to suggest that the combined use of nicotine and cell phones might result in more pronounced detrimental effects on the health of smokers.

20. [P](#) **D'Angelo C et al**, (January 2015) *Experimental model for ELF-EMF exposure: Concern for human health*, *Saudi J Biol Sci.* 2015 Jan;22(1):75-84. doi: 10.1016/j.sjbs.2014.07.006. Epub 2014 Aug 6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

Low frequency (LF) electromagnetic fields (EMFs) are abundantly present in modern society and in the last 20 years the interest about the possible effect of extremely low frequency (ELF) EMFs on human health has increased progressively. Epidemiological studies, designed to verify whether EMF exposure may be a potential risk factor for health, have led to controversial results. The possible association between EMFs and an increased incidence of childhood leukemia, brain tumors or neurodegenerative diseases was not fully elucidated. On the other hand, EMFs are widely used, in neurology, psychiatry, rheumatology, orthopedics and dermatology, both in diagnosis and in therapy. In vitro studies may help to evaluate the mechanism by which LF-EMFs affect biological systems. In vitro model of wound healing used keratinocytes (HaCaT), neuroblastoma cell line (SH-SY5Y) as a model for analysis of differentiation, metabolism and functions related to neurodegenerative processes, and monocytic cell line (THP-1) was used as a model for inflammation and cytokines production, while leukemic cell line (K562) was used as a model for hematopoietic differentiation. MCP-1, a chemokine that regulates the migration and infiltration of memory T cells, natural killer (NK), monocytes and epithelial cells, has been demonstrated to be induced and involved in various diseases. Since, varying the parameters of EMFs different effects may be observed, we have studied MCP-1 expression in HaCaT, SH-SY5Y, THP-1 and K562 exposed to a sinusoidal EMF at 50 Hz frequency with a flux density of 1 mT (rms). Our preliminary results showed that EMF-exposure differently modifies the expression of MCP-1 in different cell types. Thus, the MCP-1 expression needs to be better determined, with additional studies, with different parameters and times of exposure to ELF-EMF.