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28/04/2015 - April 2015 - 2nd 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. **Ayrapetyan S, De J**, (2014) *Cell hydration as a biomarker for estimation of biological effects of nonionizing radiation on cells and organisms*, ScientificWorldJournal. 2014;2014:890518. doi: 10.1155/2014/890518. Epub 2014 Dec 18 [View Author's abstract conclusions] [View on Pubmed]

"Changes in cell hydration" have been hypothesized as an input signal for intracellular metabolic cascade responsible for biological effects of nonionizing radiation (NIR). To test this hypothesis a comparative study on the impacts of different temperature and NIR (infrasound frequency mechanical vibration (MV), static magnetic field (SMF), extremely low frequency electromagnetic field (ELF EMF), and microwave (MW)) pretreated water on the hydration of barley seeds in its dormant and germination periods was performed. In dormant state temperature sensitivity (Q 10) of seed hydration in distilled water (DW) was less than 2, and it was nonsensitive to NIR treated DW, whereas during the germination period (48-72 hours) seeds hydration exhibited temperature sensitivity Q 10 > 2 and higher sensitivity to NIR treated DW. Obtained data allow us to suggest that the metabolic driving of intracellular water dynamics accompanied by hydrogen bonding and breaking is more sensitive to NIR-induced water structure changes in seed bathing aqua medium than the simple thermodynamic processes such as osmotic gradient driven water absorption by seeds in dormant state. Therefore, cell hydration is suggested to be a universal and extrasensitive biomarker for detection of biological effects of NIR on cells and organisms.

2. **Todorovic D** *et al*, (February 2015) *Effects of two different waveforms of ELF MF on bioelectrical activity of antennal lobe neurons of Morimus funereus (Insecta, Coleoptera)*, Int J Radiat Biol. 2015 Feb 10:1-8. [Epub ahead of print] [View Author's abstract conclusions] [View on Pubmed]

External magnetic fields (MF) interact with organisms at all levels, including the nervous system. Bioelectrical activity of antennal lobe neurons of adult Morimus funereus was analyzed under the influence of extremely low frequency MF (ELF MF, 50 Hz, 2 mT) of different characteristics (exposure duration and waveform). Neuronal activity (background/neuronal population and those nearest to the recording electrode) in adult longhorn beetles was registered through several phases of exposure to the sine wave and square wave MF for 5, 10 and 15 min. The sine wave MF, regardless of the exposure duration, did not change the reversibility factor of antennal lobe neuronal activity in adult M. funereus. In contrast, reversibility factors of the nearest neurons were significantly changed after the exposure to square wave MF for 10 and 15 min. M. funereus individuals are sensitive to both sine wave and square wave ELF MF (50 Hz, 2 mT) of different duration, whereby their reactions depend on the characteristics of the applied MF and specificity of each individual.

3. **Chung YH** *et al*, (January 2015) *Extremely low frequency magnetic field modulates the level of neurotransmitters*, Korean J Physiol Pharmacol. 2015 Jan;19(1):15-20. doi: 10.4196/kjpp.2015.19.1.15. Epub 2014 Dec 31 [View Author's abstract conclusions] [View on Pubmed]

This study was aimed to observe that extremely low frequency magnetic field (ELF-MF) may be relevant to changes of major neurotransmitters in rat brain. After the exposure to ELF-MF (60 Hz, 2.0 mT) for 2 or 5 days, we measured the levels of biogenic amines and their metabolites, amino acid neurotransmitters and nitric oxide (NO) in the cortex, striatum, thalamus, cerebellum

and hippocampus. The exposure of ELF-MF for 2 or 5 days produced significant differences in norepinephrine and vanillyl mandelic acid in the striatum, thalamus, cerebellum and hippocampus. Significant increases in the levels of serotonin and 5-hydroxyindoleacetic acid were also observed in the striatum, thalamus or hippocampus. ELF-MF significantly increased the concentration of dopamine in the thalamus. ELF-MF tended to increase the levels of amino acid neurotransmitters such as glutamine, glycine and ? -aminobutyric acid in the striatum and thalamus, whereas it decreased the levels in the cortex, cerebellum and hippocampus. ELF-MF significantly increased NO concentration in the striatum, thalamus and hippocampus. The present study has demonstrated that exposure to ELF-MFs may evoke the changes in the levels of biogenic amines, amino acid and NO in the brain although the extent and property vary with the brain areas. However, the mechanisms remain further to be characterized.

4. - **Christopoulou M** *et al*, (January 2015) *Evaluation of occupational exposure to ELF magnetic fields at power plants in Greece in the context of European directives*, Radiat Prot Dosimetry. 2015 Jan 21. pii: ncu373. [Epub ahead of print] [View Author's abstract conclusions] [View on Pubmed]

The scope of this paper is to comparatively present the extremely low-frequency (ELF) measurements performed at four power plants in Greece, focusing on: (a) the worst-case exposure conditions, (b) the existence of magnetic field harmonic components, (c) the technical similarities among the power plants and (d) comparison of the measured percentages of reference levels at typical working areas in the power plants. A detailed measurement methodology is proposed, including broadband on-site inspection of the working areas, weighted averaged root-mean-square and peak values of magnetic flux density, percentage of reference levels, according to 1998 ICNIRP guidelines and harmonic analysis of the multi-frequency magnetic fields. During the analysis of the occupational exposure in all power plants, the new Directive 2013/35/EU has been taken into account. The study concludes by proposing a mapping procedure of working areas into certain zones, in order to take measures for workers safety.

5. - **Freudenstein F** *et al*, (January 2015) *Exposure Knowledge and Risk Perception of RF EMF*, Front Public Health. 2015 Jan 13;2:289. doi: 10.3389/fpubh.2014.00289. eCollection 2014 [View Author's abstract conclusions] [View on Pubmed]

The presented study is part of the EU-Project Low EMF Exposure Future Networks (LEXNET), which deals among other things with the issue of whether a reduction of the radiofrequency (RF) electro-magnetic fields (EMF) exposure will result in more acceptance of wireless communication networks in the public sphere. We assume that the effects of any reduction of EMF exposure will depend on the subjective link between exposure perception and risk perception (RP). Therefore we evaluated respondents' RP of different RF EMF sources and their subjective knowledge about various exposure characteristics with regard to their impact on potential health risks. The results show that participants are more concerned about base stations than about all other RF EMF sources. Concerning the subjective exposure knowledge the results suggest that people have a quite appropriate impact model. The question how RF EMF RP is actually affected by the knowledge about the various exposure characteristics was tested in a linear regression analysis. The regression indicates that these features - except distance - do influence people's general RF EMF RP. In addition, we analyzed the effect of the quality of exposure knowledge on RF EMF RP of various sources. The results show a tendency that better exposure knowledge leads to higher RP, especially for mobile phones. The study provides empirical support for models of the relationships between exposure perception and RP. It is not the aim to extrapolate these findings to the whole population because the samples are not exactly representative for the general public in the participating countries.

6. N **Eltiti S** *et al*, (February 2015) *Aggregated data from two double-blind base station provocation studies comparing individuals with idiopathic environmental intolerance with attribution to electromagnetic fields and controls*, Bioelectromagnetics. 2015 Feb;36(2):96-107. doi: 10.1002/bem.21892. Epub 2015 Jan 30 [View Author's abstract conclusions] [View on Pubmed]

Data from two previous studies were aggregated to provide a statistically powerful test of whether exposure to electromagnetic fields (EMFs) produced by telecommunication base stations negatively affects well-being in individuals who report idiopathic environmental illness with attribution to electromagnetic fields (IEI-EMF) and control participants. A total of 102 IEI-EMF and 237 controls participated in open provocation trials and 88 IEI-EMF and 231 controls went on to complete double-blind trials in which they were exposed to EMFs from a base station emitting either a Global System for Mobile Communication and Universal Mobile Telecommunications System or a Terrestrial Trunked Radio Telecommunications System signal. Both experiments included a comparison sham condition. Visual analog and symptom scales measured subjective well-being. Results showed that IEI-EMF participants reported lower levels of well-being during real compared to sham exposure during open provocation, but not during double-blind trials. Additionally, participants reported lower levels of well-being during high compared to low load trials and this did not interact with radiofrequency-EMF exposure. These findings are consistent with a growing body of literature indicating there is no causal relationship between short-term exposure to EMFs and subjective well-being in members of the public whether or not they report perceived sensitivity to EMFs.

7. [P] **Halgamuge MN** *et al*, (February 2015) *Reduced growth of soybean seedlings after exposure to weak microwave radiation from GSM 900 mobile phone and base station*, Bioelectromagnetics. 2015 Feb;36(2):87-95. doi: 10.1002/BEM.21890. Epub 2015 Jan 21 [View Author's abstract conclusions] [View on Pubmed]

The aim of this work was to study possible effects of environmental radiation pollution on plants. The association between cellular telephone (short duration, higher amplitude) and base station (long duration, very low amplitude) radiation exposure and the growth rate of soybean (Glycine max) seedlings was investigated. Soybean seedlings, pre-grown for 4 days, were exposed in a gigahertz transverse electromagnetic cell for 2 h to global system for mobile communication (GSM) mobile phone pulsed radiation or continuous wave (CW) radiation at 900 MHz with amplitudes of 5.7 and 41 Vm(-1) , and outgrowth was studied one week after exposure. The exposure to higher amplitude (41?V?m(-1)) GSM radiation resulted in diminished outgrowth of the epicotyl. The exposure to lower amplitude (5.7 Vm(-1)) GSM radiation did not influence outgrowth of epicotyl, hypocotyls, or roots. The exposure to higher amplitude CW radiation resulted in reduced outgrowth of the roots whereas lower CW exposure resulted in a reduced outgrowth of the hypocotyl. Soybean seedlings were also exposed for 5 days to an extremely low level of radiation (GSM 900 MHz, 0.56 Vm(-1)) and outgrowth was studied 2 days later. Growth of epicotyl and hypocotyl was found to be reduced, whereas the outgrowth of roots was stimulated. Our findings indicate that the observed effects were significantly dependent on field strength as well as amplitude modulation of the applied field.

8. [-] **Hareuveny R** *et al*, (January 2015) *Characterization of extremely low frequency magnetic fields from diesel, gasoline and hybrid cars under controlled conditions*, Int J Environ Res Public Health. 2015 Jan 30;12(2):1651-66. doi: 10.3390/ijerph120201651 [View Author's abstract conclusions] [View on Pubmed]

This study characterizes extremely low frequency (ELF) magnetic field (MF) levels in 10 car models. Extensive measurements were conducted in three diesel, four gasoline, and three hybrid cars, under similar controlled conditions and negligible background fields. Averaged over all four seats under various driving scenarios the fields were lowest in diesel cars (0.02 μT), higher for gasoline (0.04-0.05 μT) and highest in hybrids (0.06-0.09 μT), but all were in-line with daily exposures from other sources. Hybrid cars had the highest mean and 95th percentile MF levels, and an especially large percentage of measurements above 0.2 μT. These parameters were also higher for moving conditions compared to standing while idling or revving at 2500 RPM and higher still at 80 km/h compared to 40 km/h. Fields in non-hybrid cars were higher at the front seats, while in hybrid cars they were higher at the back seats, particularly the back right seat where 16%-69% of measurements were greater than 0.2 μT. As our results do not include low frequency fields (below 30 Hz) that might be generated by tire rotation, we suggest that net currents flowing through the cars' metallic chassis may be a possible source of MF. Larger surveys in standardized and well-described settings should be conducted with different types of

vehicles and with spectral analysis of fields including lower frequencies due to magnetization of tires.

9. [N] **Li L** *et al*, (February 2015) *A cross-sectional study on oxidative stress in workers exposed to extremely low frequency electromagnetic fields*, Int J Radiat Biol. 2015 Feb 4:1-23. [Epub ahead of print] [View Author's abstract conclusions] [View on Pubmed]

To investigate whether extremely low frequency electromagnetic field (ELF-EMF) exposure could induce oxidative stress in workers performing tour-inspection near transformers and distribution power lines. Occupational short-term "spot" measurements were performed. In total, 310 inspection workers exposed to ELF-EMF were selected as the exposure group and 300 logistical staff as the control group. Plasma total antioxidant capacity (T-AOC) and glutathione peroxidase (GPx) activity were tested by the colorimetric method. Superoxide dismutase (SOD) activity was tested using the xanthine oxidase method. Plasma malodialdehyde (MDA) concentration was determined with a thiobarbituric acid assay. The micronucleus cell frequency (MCF) and Micronuclei frequency (MN) were also tested for genotoxic assessment. No significant changes of enzyme activities or MDA concentration were found. Neither the frequency of micronucleus lymphocytes nor micronuclei frequency changes were statistically significant. Continual ELF-EMF exposure might not induce oxidative stress in workers from a power supply bureau.

10. [P] **Cao H** *et al*, (February 2015) *Circadian rhythmicity of antioxidant markers in rats exposed to 1.8 GHz radiofrequency fields*, Int J Environ Res Public Health. 2015 Feb 12;12(2):2071-87. doi: 10.3390/ijerph120202071. [View Author's abstract conclusions] [View on Pubmed]

The potential health risks of exposure to Radiofrequency Fields (RF) emitted by mobile phones are currently of considerable public interest, such as the adverse effects on the circadian rhythmicities of biological systems. To determine whether circadian rhythms of the plasma antioxidants (Mel, GSH-Px and SOD) are affected by RF, we performed a study on male Sprague Dawley rats exposed to the 1.8 GHz RF. All animals were divided into seven groups. The animals in six groups were exposed to 1.8 GHz RF (201.7 μ/cm^2 power density, 0.05653 W/kg specific absorption rate) at a specific period of the day (3, 7, 11, 15, 19 and 23 h GMT, respectively), for 2 h/day for 32 consecutive days. The rats in the seventh group were used as sham-exposed controls. At the end of last RF exposure, blood samples were collected from each rat every 4 h (total period of 24 h) and also at similar times from sham-exposed animals. The concentrations of three antioxidants (Mel, GSH-Px and SOD) were determined. The data in RF-exposed rats were compared with those in sham-exposed animals. Circadian rhythms in the synthesis of Mel and antioxidant enzymes, GSH-Px and SOD, were shifted in RF-exposed rats compared to sham-exposed animals: the Mel, GSH-Px and SOD levels were significantly decreased when RF exposure was given at 23 and 3 h GMT. The overall results indicate that there may be adverse effects of RF exposure on antioxidant function, in terms of both the daily antioxidative levels, as well as the circadian rhythmicity.

11. [P] **Duan W** *et al*, (March 2015) *Comparison of the Genotoxic Effects Induced by 50 Hz Extremely Low-Frequency Electromagnetic Fields and 1800 MHz Radiofrequency Electromagnetic Fields in GC-2 Cells*, Radiat Res. 2015 Mar;183(3):305-14. doi: 10.1667/RR13851.1. Epub 2015 Feb 17 [View Author's abstract conclusions] [View on Pubmed]

Extremely low-frequency electromagnetic fields (ELF-EMF) and radiofrequency electromagnetic fields (RF-EMF) have been considered to be possibly carcinogenic to humans. However, their genotoxic effects remain controversial. To make experiments controllable and results comparable, we standardized exposure conditions and explored the potential genotoxicity of 50 Hz ELF-EMF and 1800 MHz RF-EMF. A mouse spermatocyte-derived GC-2 cell line was intermittently (5 min on and 10 min off) exposed to 50 Hz ELF-EMF at an intensity of 1, 2 or 3 mT or to RF-EMF in GSM-Talk mode at the specific absorption rates (SAR) of 1, 2 or 4 W/kg. After exposure for 24 h, we found that neither ELF-EMF nor RF-EMF affected cell viability using Cell Counting Kit-8. Through the use of an alkaline comet assay and immunofluorescence against γ-H2AX foci, we found that ELF-EMF exposure resulted in a significant increase of DNA strand

breaks at 3 mT, whereas RF-EMF exposure had insufficient energy to induce such effects. Using a formamidopyrimidine DNA glycosylase (FPG)-modified alkaline comet assay, we observed that RF-EMF exposure significantly induced oxidative DNA base damage at a SAR value of 4 W/kg, whereas ELF-EMF exposure did not. Our results suggest that both ELF-EMF and RF-EMF under the same experimental conditions may produce genotoxicity at relative high intensities, but they create different patterns of DNA damage. Therefore, the potential mechanisms underlying the genotoxicity of different frequency electromagnetic fields may be different.

12. [N] **Lustenberger C** *et al*, (April 2015) *Inter-individual and intra-individual variation of the effects of pulsed RF EMF exposure on the human sleep EEG*, Bioelectromagnetics. 2015 Apr;36(3):169-77. doi: 10.1002/bem.21893. Epub 2015 Feb 17 [View Author's abstract conclusions] [View on Pubmed]

Pulse-modulated radiofrequency electromagnetic fields (RF EMF) can alter brain activity during sleep; increases of electroencephalographic (EEG) power in the sleep spindle (13.75-15.25?Hz) and delta-theta (1.25-9?Hz) frequency range have been reported. These field effects show striking inter-individual differences. However, it is still unknown whether individual subjects react in a similar way when repeatedly exposed. Thus, our study aimed to investigate inter-individual variation and intra-individual stability of field effects. To do so, we exposed 20 young male subjects twice for 30?min prior to sleep to the same amplitude modulated 900?MHz (2?Hz pulse, 20?Hz Gaussian low-pass filter and a ratio of peak-to-average of 4) RF EMF (spatial peak absorption of 2?W/kg averaged over 10?g) 2 weeks apart. The topographical analysis of EEG power during all-night non-rapid eye movement sleep revealed: (1) exposure-related increases in delta-theta frequency range in several fronto-central electrodes; and (2) no differences in spindle frequency range. We did not observe reproducible within-subject RF EMF effects on sleep spindle and delta-theta activity in the sleep EEG and it remains unclear whether a biological trait of how the subjects' brains react to RF EMF exists.

13. [P] **Ghosn R** *et al*, (February 2015) *Radiofrequency signal affects alpha band in resting electroencephalogram*, J Neurophysiol. 2015 Feb 18:jn.00765.2014. doi: 10.1152/jn.00765.2014. [Epub ahead of print] [View Author's abstract conclusions] [View on Pubmed]

The aim of the present work was to investigate the effects of the radiofrequency (RF) electromagnetic fields (EMFs) on human resting EEG with a control of some parameters that are known to affect alpha band such as electrode impedance, salivary cortisol and caffeine. Eyes open and eyes-closed resting EEG data were recorded in 26 healthy young subjects under two conditions: sham exposure and real exposure in double-blind, counterbalanced, crossover design. Spectral power of EEG rhythms was calculated for the alpha band (8-12Hz). Saliva samples were collected before and after the study. Salivary cortisol and caffeine were assessed respectively by Enzyme linked immunosorbent assay (ELISA) and high performance liquid chromatography (HPLC). The electrode impedance was recorded at the beginning of each run. Compared with sham session, the exposure session showed a statistically significant ($p < 0.0001$) decrease of the alpha band spectral power during closed eyes condition. This effect persisted in the post-exposure session ($p < 0.0001$). No significant changes were detected in electrode impedance, salivary cortisol and caffeine in the sham session when compared to the exposure one. These results suggest that GSM-EMFs of a mobile phone affect alpha band within spectral power of resting human EEG.

14. [-] **Porsius JT** *et al*, (April 2015) *Symptom reporting after the introduction of a new high-voltage power line: A prospective field study*, Environ Res. 2015 Apr;138:112-7. doi: 10.1016/j.envres.2015.02.009. Epub 2015 Feb 20 [View Author's abstract conclusions] [View on Pubmed]

There is public concern about the potential health effects of exposure to extremely low frequency electromagnetic fields (ELF-EMF) of high-voltage power lines (HVPLs). Some residents living near HVPLs believe ELF-EMF might cause non-specific health complaints. The present study is the first to prospectively investigate whether self-reported health complaints and causal beliefs increase

after the construction of a new power line. We used a quasi-experimental design with two pretests before and two posttests after a new HVPL was put into operation. Residents living near (0-300m, n=229; 300-500m, n=489) and farther away (500-2000m, n=536) participated in the study. Linear mixed models were fitted to test whether symptom reports and beliefs that power lines caused health complaints increased more in residents living close to the new line compared to residents living farther away. A significantly ($p<.05$) larger increase from baseline in symptom reports and causal beliefs was found in residents living within 300m from the new power line when compared to residents living farther away. While symptom reports did not differ at baseline, the belief that a power line could cause these symptoms was at baseline already stronger for residents living close compared to residents living farther away. We found a negative impact of a new HVPL on health perceptions of nearby residents, even before the line was put into operation.

15. N **Baliatsas C** *et al*, (May 2015) *Actual and perceived exposure to electromagnetic fields and non-specific physical symptoms: An epidemiological study based on self-reported data and electronic medical records.*, Int J Hyg Environ Health. 2015 May;218(3):331-44. doi: 10.1016/j.ijheh.2015.02.001. Epub 2015 Feb 7 [View Author's abstract conclusions] [View on Pubmed]

There is continuing scientific debate and increasing public concern regarding the possible effects of electromagnetic fields (EMF) on general population's health. To date, no epidemiological study has investigated the possible association between actual and perceived EMF exposure and non-specific physical symptoms (NSPS) and sleep quality, using both self-reported and general practice (GP)-registered data. A health survey of adult (=18) participants (n=5933) in the Netherlands was combined with the electronic medical records (EMRs) of NSPS as registered by general practitioners. Characterization of actual exposure was based on several proxies, such as prediction models of radiofrequency (RF)-EMF exposure, geo-coded distance to high-voltage overhead power lines and self-reported use/distance of/to indoor electrical appliances. Perceived exposure and the role of psychological variables were also examined. Perceived exposure had a poor correlation with the actual exposure estimates. No significant association was found between modeled RF-EMF exposure and the investigated outcomes. Associations with NSPS were observed for use of an electric blanket and close distance to an electric charger during sleep. Perceived exposure, perceived control and avoidance behavior were associated with the examined outcomes. The association between perceived exposure was stronger for self-reported than for GP-registered NSPS. There was some indication, but no consistent pattern for an interaction between idiopathic environmental intolerance (IEI-EMF) and the association between actual exposure and NSPS. In conclusion, there is no convincing evidence for an association between everyday life RF-EMF exposure and NSPS and sleep quality in the population. Better exposure characterization, in particular with respect to sources of extremely low frequency magnetic fields (ELF-MF) is needed to draw more solid conclusions. We argue that perceived exposure is an independent determinant of NSPS.

16. – **Lopez-Iturri P** *et al*, (February 2015) *Estimation of radiofrequency power leakage from microwave ovens for dosimetric assessment at nonionizing radiation exposure levels*, Biomed Res Int. 2015;2015:603260. doi: 10.1155/2015/603260. Epub 2015 Feb 1 [View Author's abstract conclusions] [View on Pubmed]

The electromagnetic field leakage levels of nonionizing radiation from a microwave oven have been estimated within a complex indoor scenario. By employing a hybrid simulation technique, based on coupling full wave simulation with an in-house developed deterministic 3D ray launching code, estimations of the observed electric field values can be obtained for the complete indoor scenario. The microwave oven can be modeled as a time- and frequency-dependent radiating source, in which leakage, basically from the microwave oven door, is propagated along the complete indoor scenario interacting with all of the elements present in it. This method can be of aid in order to assess the impact of such devices on expected exposure levels, allowing adequate minimization strategies such as optimal location to be applied.

17. N **Court-Kowalski S** *et al*, (April 2015) *Effect of long-term (2 years) exposure of mouse*

brains to global system for mobile communication (GSM) radiofrequency fields on astrocytic immunoreactivity., Bioelectromagnetics. 2015 Apr;36(3):245-50. doi: 10.1002/bem.21891. Epub 2015 Feb 20 [View Author's abstract conclusions] [View on Pubmed]

This study was designed to determine whether long-term (2 years) brain exposure to mobile telephone radiofrequency (RF) fields produces any astrocytic activation as these glia react to a wide range of neural perturbations by astrogliosis. Using a purpose-designed exposure system at 900?MHz, mice were given a single, far-field whole body exposure at a specific absorption rate of 4?W/kg on five successive days per week for 104 weeks. Control mice were sham-exposed or freely mobile in a cage to control any stress caused by immobilization in the exposure module. Brains were perfusion-fixed with 4% paraformaldehyde and three coronal levels immunostained for glial fibrillary acidic protein (GFAP). These brain slices were then examined by light microscopy and the amount of this immunomarker quantified using a color deconvolution method. There was no change in astrocytic GFAP immunostaining in brains after long-term exposure to mobile telephony microwaves compared to control (sham-exposed or freely moving caged mice). It was concluded that long-term (2 years) exposure of murine brains to mobile telephone RF fields did not produce any astrocytic reaction (astrogliosis) detectable by GFAP immunostaining.

18. P **Brouwer M** *et al*, (February 2015) *Occupational exposures and Parkinson's disease mortality in a prospective Dutch cohort*, Occup Environ Med. 2015 Feb 23. pii: oemed-2014-102209. doi: 10.1136/oemed-2014-102209. [Epub ahead of print] [View Author's abstract conclusions] [View on Pubmed]

We investigated the association between six occupational exposures (ie, pesticides, solvents, metals, diesel motor emissions (DME), extremely low frequency magnetic fields (ELF-MF) and electric shocks) and Parkinson's disease (PD) mortality in a large population-based prospective cohort study. The Netherlands Cohort Study on diet and cancer enrolled 58 279 men and 62 573 women aged 55-69 years in 1986. Participants were followed up for cause-specific mortality over 17.3 years, until December 2003, resulting in 402 male and 207 female PD deaths. Following a case-cohort design, a subcohort of 5 000 participants was randomly sampled from the complete cohort. Information on occupational history and potential confounders was collected at baseline. Job-exposure matrices were applied to assign occupational exposures. Associations with PD mortality were evaluated using Cox regression. Among men, elevated HRs were observed for exposure to pesticides (eg, ever high exposed, HR 1.27, 95% CI 0.86 to 1.88) and ever high exposed to ELF-MF (HR 1.54, 95% CI 1.00 to 2.36). No association with exposure duration or trend in cumulative exposure was observed for any of the occupational exposures. Results among women were unstable due to small numbers of high-exposed women. Associations with PD mortality were observed for occupational exposure to pesticides and ELF-MF. However, the weight given to these findings is limited by the absence of a monotonic trend with either duration or cumulative exposure. No associations were found between PD mortality and occupational exposure to solvents, metals, DME or electric shocks.

19. P **Mohammed HS** *et al*, (March 2013) *Non-thermal continuous and modulated electromagnetic radiation fields effects on sleep EEG of rats*, J Adv Res. 2013 Mar;4(2):181-7. doi: 10.1016/j.jare.2012.05.005. Epub 2012 Jun 25 [View Author's abstract conclusions] [View on Pubmed]

In the present study, the alteration in the sleep EEG in rats due to chronic exposure to low-level non-thermal electromagnetic radiation was investigated. Two types of radiation fields were used; 900 MHz unmodulated wave and 900 MHz modulated at 8 and 16 Hz waves. Animals has exposed to radiation fields for 1 month (1 h/day). EEG power spectral analyses of exposed and control animals during slow wave sleep (SWS) and rapid eye movement sleep (REM sleep) revealed that the REM sleep is more susceptible to modulated radiofrequency radiation fields (RFR) than the SWS. The latency of REM sleep increased due to radiation exposure indicating a change in the ultradian rhythm of normal sleep cycles. The cumulative and irreversible effect of radiation exposure was proposed and the interaction of the extremely low frequency radiation with the similar EEG frequencies was suggested.

20. P **Aerts S** *et al*, (February 2015) *Impact of a small cell on the RF-EMF exposure in a train*, Int J Environ Res Public Health. 2015 Feb 27;12(3):2639-52. doi: 10.3390/ijerph120302639. [View Author's abstract conclusions] [View on Pubmed]

The deployment of a miniature mobile-phone base station or small cell in a train car significantly improves the coverage and the capacity of a mobile network service on the train. However, the impact of the small cell on the passengers' exposure to radio-frequency electromagnetic fields (RF-EMF) is unknown. In this study, we assessed experimentally the RF-EMF exposure of a mobile-phone user who is either connected to the outdoor macrocell network or to an in-train small cell, while traveling on the train, by means of the absorbed-dose concept, which combines the base station downlink exposure with the mobile-phone uplink exposure. For Global System for Mobile Communications (GSM) technology at 1800 MHz, we found that by connecting to a small cell, the brain exposure of the user could realistically be reduced by a factor 35 and the whole-body exposure by a factor 11.