

10076 - Health effects of light – the challenge to study an ubiquitous exposure

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The melatonin hypothesis links light-at-night (LAN) and extremely-low frequency electric and/or magnetic fields (ELF-EMF) to increased breast cancer risks via an impaired pineal secretion of melatonin. Of these distinct spectra of nonionizing radiation, exposures to light have been consistently linked with impaired melatonin secretion in humans, and experimental evidence suggests that melatonin can suppress mammary tumorigenesis in animals and possibly in humans.

To verify or falsify the notion that light can influence the development of internal cancers in man, epidemiological studies must seek sufficient differences in exposure patterns within the study population. To disentangle such gradients of ubiquitous exposures to natural and anthropogenic light, studies currently focus on three risk predictions [P] from the hypothesis [H] and its corollary [C], i.e., deficits of light enhance melatonin secretion and thus decrease cancer risks: P1|H: Female night shiftworkers have increased breast cancer risks; P2|C: Blind persons have lower hormone-dependent cancer risks; P3|C: Arctic residents have lower hormone-dependent cancer risks.

Regarding P1|H: Results of four studies of shiftworkers in Norway, Denmark and the USA are compatible with the prediction (up to 60 percent higher breast cancer risk). Regarding P2|C: Results of three studies in the USA, Sweden and Norway are compatible with the prediction (up to 30 percent reduced cancer risk). While a cohort study in Finland showed higher risks for some cancer sites, an embedded case-control study evinced that breast cancer risk decreased by degree of visual impairment. Regarding P3|C: Results of nine studies of healthy individuals living at or north of 60°N latitude are compatible with the assumption that the shorter photoperiods in winter significantly increase yearly averages of melatonin levels. Furthermore, large population-group data from the Arctic are strikingly consistent with the prediction. However, the problematic interpretation of ecologic observations disallows causal inferences.

Future studies of the three predictions should rigorously test their underlying assumptions regarding endocrine responses to light and darkness. Namely, shiftworkers are expected to have lower while blind people and Arctic residents would have higher melatonin levels. A systematic investigation of exposure-response relationships implied in the melatonin hypothesis could be based on “light dosimetry by geography”. Such study is envisaged by European researchers who aim to study “healthy general population samples” that are differentially exposed to light by virtue of varying ambient photoperiods. Provided that light can be identified as a potent endocrine modulator, comparing populations at distinct latitudes could offer novel opportunities to study biologically plausible relationships between melatonin and cancer, but also between hormones and aging, immune functions, sleep disorders, psychiatric disorders and reproduction.

10077 - A triage of scientific problems: ELF-EMF, Endocrine Disruptors, BSE and Light

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Triage in medicine is an effective means to maximize health benefits of limited resources. This paper suggests to use triage principles as one means to identify biomedical and epidemiological research priorities. The following questions are applied to four putative problems which receive different research and funding attention: (a) Does a suspected exposure render many humans at risk?, (b) Is a disease frequent, difficult to treat and expensive?, and (c) Is a causal link between (a) and (b) biologically plausible? A "yes" to all questions would define the highest priority for targeted investigations to achieve maximum community success. One, two or three "we do not know" will not do as sufficient answers to justify the same priority because in a triage decision process we have to consider what we know. Along this line of rationale, universal exposures which are linked to frequent and costly diseases via biological theory and empirical evidence should qualify for the most urgent research efforts to convincingly verify or falsify the possible relationship.

On the basis of answers to (a), (b) and (c) it is concluded that ELF-EMF and leukemia in infants would not qualify for further urgent investigations with all three answers to questions (a), (b) and (c) being "no". In view of the lack of a "yes" to all triage questions, endocrine disruptors and to be-identified end-points would not qualify for urgent investigations. A tentative "yes" to questions (a) and (c) would provide reasons to investigate the postulated link between BSE and the new variant form of Creutzfeldt-Jakob disease with priority. In view of the fact, that the answer to all triage questions is an unambiguous "yes", the suggestive link between light, endocrine systems and hormone-dependent cancers should become a higher priority research focus.

Without doubt, other criteria than the ones suggested in this paper can be used to identify research priorities and possible causal links between ELF-EMF and childhood leukaemia or other cancers, possible health implications of endocrine disruptors and the question whether BSE exposures can cause prion diseases in man need be studied. However, if answers to the outlined triage questions can be considered as a practical guide to urgent research and effective improvement of patient welfare, then investigations of the biologically plausible link between light, hormones and cancers should become a higher research priority.

10078 - OCCUPATIONAL EXPOSURE TO ELECTROMAGNETIC FIELDS IN RELATION TO THE RISK OF DEMENTIA: PRELIMINARY RESULTS FROM THE KUNGSHOLMEN PROJECT

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Objectives: Exposure to very-low frequency electromagnetic fields (EMF) is suspected to increase the risk of dementia. Such fields are present around electrical motors and other electric appliances containing coils. This study is aimed at evaluating whether the occupational exposure to EMF is related to an increased risk of dementia.

Methods: A dementia-free cohort of 931 individuals of 75 year of age or more at baseline was followed up clinically for dementia twice during 5 years. There were 265 incident dementia cases (50 men and 215 women), including 202 cases of Alzheimer's disease (AD; 31 men and 171 women). Lifetime occupational history was collected at baseline and processed to job codes used in the Nordic countries, and matched to a Swedish job-exposure matrix based on actual measurements of individual EMF. The matrix covered mainly current frequent male occupations (n=90) and missing recent occupations were estimated as combinations of occupations in the matrix. All historical exposures were assessed subjectively by an occupational hygienist (TB). The assessment was supported by simple EMF measurements on historical telephone switchboards, and sewing machines from a museum of technology. All exposure assessment was performed blind to disease status. Age and education were used for adjustment of all risk estimates.

Results: The average assessed occupational EMF exposure level for the longest job held ranged 0.10-1.90 μT (median 0.18 μT for men and 0.15 μT for women). Women with low average exposure ($<0.2\mu\text{T}$) in the longest job held had a higher risk to become demented than had men with low exposure (adjusted RR=2.6, 95% CI: 1.4-4.8). Having worked in a high-exposed job increased the risk of AD (adjusted RR=2.4, CI: 1.1-5.1) and all dementia (adjusted RR=1.8, CI: 1.0-3.2) for men, but not for women. A similar pattern of gender differences was seen for estimated cumulative lifetime occupational exposure, that ranged 0.7-80 $\mu\text{T}\cdot\text{year}$ (median 8.6 $\mu\text{T}\cdot\text{year}$ for men and 7.0 $\mu\text{T}\cdot\text{year}$ for women). For men, there was a tendency of a dose-response relation, with a relative risk of 1.6 (CI: 0.6-4.4) for AD and 2.0 (CI: 0.8-4.6) for all dementia, in the highest dose tertile ($>8.4\mu\text{T}\cdot\text{years}$). No effect was seen in women.

Conclusions: This study provides limited evidence that long-term occupational exposure to very-low frequency electromagnetic fields increases the risk of AD and dementia. The observed effect is strong, but the interpretation is restricted by the small numbers, and the fact that the retrospective exposure assessment had subjective parts that could not be validated. The reason why the effect is seen in men only is not clear. Possible explanations may be that men were more exposed than women, and that exposure misclassification was higher for women, because the job-exposure matrix had been developed for typical male occupations.

10189 - Occupational Magnetic-Field Exposures of Garment Workers Results of Personal and Survey Measurements and a Pilot Interview Study

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Background

To explore the feasibility of performing an epidemiological study of female breast cancer and magnetic-field (MF) exposures, we chose to study garment workers who reportedly have some of the highest MF exposures.

Methods

To develop exposure assessment protocols and to assess magnetic field (MF) exposures of sewing-machine operators, we measured MF at a variety of work locations. We collected personal exposure (PE) (n=48) and survey measurements (n=77) at three garment facilities (a used sewing-machine shop, a small sample facility, and a pant-making facility) and conducted a pilot interview among 25 garment workers asking about exposure duration, activities, and machine characteristics.

Results

Average PE (n=48) at the waist with the machine sewing or idling ranged from 0.07 to 3.7 microtesla (μT) and were higher at the sewing-machine shop where the machines were

predominantly older than at the sample and pant-making facilities. MF levels were higher for machines with alternating-current (AC) than direct-current (DC) motors, but were comparable for both idling and sewing activities. The field intensity increased moving down from the head, to chest, to waist, to knees. Mean 60-hertz (Hz) survey measurements for AC machines at all body positions were 1.71, 1.22 and 0.46 μT at the sewing-machine shop, the sample facility, and the pant-making facility, respectively. A pilot interview study among 25 Chinese-speaking garment workers indicated that on average workers worked 37 hours per week and had been employed in a sewing-related job for 13 years. Most workers could distinguish between automatic and manual machines (a proxy for DC or AC technology), but could not describe other machine characteristics related to MF exposure.

Conclusions

Measurements were lower than previously reported for garment workers but were higher than exposures to most women at home or at work. We conclude that a historical exposure assessment can be conducted by linking duration of exposure and use of sewing-machines with reconstructed or current exposure measurements; however, this exposure reconstruction may be limited due to the dependency on the accuracy of work history data and worker recall.

10201 - Comparison of Measurements and Calculations of Electromagnetic Radiation from GSM Mobile Phone Base Stations

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Possible adverse health consequences due to exposure to radiation from mobile phone base stations may be investigated by means of epidemiological studies. The validity of an epidemiological study is in large part determined by the quality of the exposure assessment. However, generally only simple procedures can be used to estimate the individual exposure in a large study population. Thus, the exposure assessment may be either based on spot measurements or model calculations. The objective of this study was to compare two simple approaches to assess exposure to radiation from GSM mobile phone base station at different sites in the city of Basel, Switzerland. One approach was based on broadband measurements (100 kHz - 3 GHz), and the other approach was based on model calculations taking into account the power as well as the geometric radiation pattern of the base station, the distance between base station and measurement site and for indoor sites the attenuation factor of the building. Calculations and spot measurements (5-10 min) were performed at 96 different sites, which were chosen with regard to minimise the possible impact of other radiofrequency sources on the measurement results. Additionally, long term measurements (2-24 h) were performed at 5 sites. The long term measurements showed that the mean radiation levels were mainly determined by the power of the broadcast control channels (BCCH). Additional traffic channels increased the levels temporary by maximum 30 percent. However, average levels were only slightly above the base levels. For all sites the correlation between measured values and distance to the base station was -0.04, for the 39 sites in the main radiation beam it was -0.36, and for the 57 indoor sites it was 0.03. The correlation factors between measured and computed levels were 0.63 (all sites), 0.52 (main beam), and 0.64 (indoor). However, the measured values were on average 3.0 times lower than the calculated values. Thus, using fixed values to discriminate between different exposure classes yielded totally different results for a given site depending whether measurements or calculated values were considered. Hence, we classified the 96 sites into the three tertile high, medium and low exposed based on the measurements as well as based on the calculated values and examined the accordance of these classification procedures for each site. It was found that 47 percent of all sites were classified into the same category. Reducing this analysis to the indoor sites resulted in an accordance of 57 percent. From this study was concluded that the distance to the base station is not associated with the radiation level. The accordance of an exposure assessment either based on simple measurement or calculation techniques is modest. At present none of these methods can be recommended as gold standard for exposure assessment in epidemiological studies.

OCCUPATIONAL EXPOSURE TO EXTREMELY LOW FREQUENCY MAGNETIC FIELDS AND POSTMENOPAUSAL BREAST CANCER.

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In 1987, Stevens suggested that exposure to extremely low frequency electromagnetic fields decreases production of melatonin by the pineal gland, thus indirectly increasing the risk of breast cancer. We assessed this putative association using data from a case-control study of postmenopausal breast cancer conducted in Montreal. Case subjects included all new histologically confirmed cases of malignant breast cancer (ICD-9 174) detected in all major hospitals of the city. Only postmenopausal women (according to the WHO definition) who were 50-75 years of age at time of diagnosis during the period 1996 to 1997 were included. Control subjects were selected randomly from other histologically confirmed sites of cancer, but excluding cancers of the liver and intrahepatic bile ducts, pancreas, lung, bronchus and trachea, brain and central nervous system, leukaemias, and non-melanoma skin cancer. Face-to-face or telephone interviews were used to elicit detailed information on nonoccupational risk factors and to obtain information on each occupation that the subject had had in her working lifetime. A team of industrial hygienists and chemists then attributed occupational exposures to these occupations using the methodology developed by Siemiatycki and colleagues. Briefly, for each job that the subject had had, each substance on an exposure checklist was coded as present or absent. For those agents coded as present, the team assigned route of exposure (e.g., respiratory) and average frequency of exposure (in hours) in a working day at specific intensities of exposure (on a 4-point ordinal scale). The confidence that the hygienists had in their assessment of exposure was also attributed using a 4-point ordinal scale. For magnetic fields, intensity was ranked as: background ("no exposure"): 0.2- <0.5 μ T; "low", 0.5- <1.0 μ T; "medium", 1- <10 μ T; "high", \geq 10 μ T. Unconditional logistic regression was used to estimate odds ratios (OR) and associated 95% confidence intervals (95% CI). We interviewed 608 cases and 667 controls (81.1% and 75.7% response rates, respectively). We observed the usual risk factors for breast cancer and, adjusting for these, we found an OR of 1.95 (95%CI: 1.16-3.28) for ever occupationally exposed to magnetic fields at medium or high levels of intensity (medium or high levels of confidence). We also found monotonically increases in risk by duration of exposure and by cumulative exposure. Cumulative exposures before the age of 35, the age in which breast cells stop proliferating, showed the highest risks. Some of the highest exposures occurred for women working in textiles, but we did not find that the above associations were confounded by occupation (e.g., OR for EMF among textile workers was 2.58 and among non-textile workers it was 1.46). We conclude that there is an apparent increase in risk among postmenopausal women exposed occupationally to extremely low frequency magnetic fields, and it is likely that our estimates of risk were underestimated because of nondifferential misclassification in assigning exposure.

10590 - entral nervous systemsymptoms associated with mobile phone use: an objective method for evaluation

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Introduction The explosive growth of mobile communications has been matched by concern about the potential links between cellular phones to health problems. We have previously reported on a cross-sectional investigation on the prevalence of specific central nervous system (CNS) symptoms among NMT and GSM cellular telephone users compared to nonusers (n=759). As a part of the evaluation study of the impact of cellphones radiofrequency fields on users health, the authors conducted a clinical investigation to provide an objective characteristic of CNS symptoms associated with the use of digital and analogue mobile phones. For these purposes a method of reography has been used. The rationale of conducting this test was that a frontier psychical dysfunction is practically always accompanied by a vegetative dysfunction with a cardiovascular disturbance.

Methods 17 cell phone users and 15 nonusers (20-39 years old) who experienced one or more CNS symptoms were examined. There were defined some parameters of heart pumping function using a tetrapolar breast reography, as well as indices of cerebral hemodynamics using a bipolar reoencephalography.

Results On the basis of our data it has been found that among people exposed to radiofrequency fields produced by NMT-450i and GSM-900 cellular phones, the hypercynetic type of central hemodynamics following by the functional overstrains was dominated. The degrees of hypercynetic overstrain in the exposed and unexposed groups were significantly different that indicates a tension of sympathetic regulatory mechanisms. A study of cerebral hemodynamics has shown that people exposed to cellphones radiofrequency fields developed a cerebral vascular dystonic syndrome, that reveals by difficulties in venous circulation and arterioles spasm. The sensitivity to radiofrequency fields differs from person to person. There is slight indication that femails are more affected by the EMF radiation that males. Such reoencephalographic changes are clinically revealed by headaches, dizziness and some other CNS symptoms.

Conclusion The results showed an association between CNS symptoms and cellular phones exposure. These subjective symptoms among NMT and GSM mobile phones users were verified reographically. The cellphones radiofrequency fields cause changes in functional state of central and cerebral hemodynamics. Further studies with larger materials and more detailed data on physical examination, as well as follow-up investigations may provide more valid risk assessment.

IS RESIDING NEAR RADIO BROADCAST TOWERS A RISK FACTOR OF LEUKEMIA AND BRAIN CANCER IN CHILDREN? : A CASE CONTROL STUDY IN KOREA

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Background: Public concern about the health effects of radiofrequency radiation exposure have been increased. This study was performed to investigate the association between residing near AM radio broadcasting towers and childhood leukemia and brain cancer in Korea with case control design.

Methods: We selected the cases using the data of Korea Medical Insurance Corporation during 1993-1996. Cases were defined by ICD-9 or ICD-10 codes which covered leukemia and brain cancer. The controls were selected from the pool of respiratory patients using the same KMIC data and were matched (1: 4) with age, sex and year of diagnosis. All study subjects were less than 15 years old at the time of diagnosis. For the convenience of survey and the quality of diagnosis, among all eligible cases and controls, only subjects who were diagnosed at the university hospitals were included. All study subjects (case 1,575, control 5,099 persons) were investigated with their medical charts at each hospital for validation of diagnosis and acquiring their residing addresses. Exposure to radiofrequency radiation of radio broadcasting towers was defined by residing within 2 km from the point of the towers whose electric power were more than 100kW (total 11 areas in Korea). As confounders, the level of industrialization (large city/medium city/rural area), the local gross products per capita (for adjustment of socioeconomic status) and the local electric consumption were considered. Unmatched and matched analyses with logistic regression were used for estimation of crude and adjusted odds ratios.

Results: There were one patient who resided in the exposed areas for leukemia and three patients for brain cancer. Among control children, two persons for leukemia and one person for brain cancer were resided in the exposed areas. The crude and adjusted ORs for leukemia were 1.76(95% CI 0.16-19.42) and 1.64(0.15-18.56) in unmatched analyses and 1.78(0.16-19.59) and 1.71(0.15-19.34) in conditional logistic regression. For brain cancer, those were 8.46(0.88-81.60) and 5.29(0.49-56.96) in unmatched analyses and 8.61(0.89-82.82) and 5.51(0.52-58.43).

Conclusion: This study results showed the increased risks of childhood leukemia and brain cancer without statistical significances in the vicinity of radio broadcast towers. For some limitations of present study, which have been done with crude exposure assessment and small number of study cases, further study should be needed.