

Overview of the epidemiologic studies on the health effects of ELF magnetic and electric fields published in the third trimester of 2019

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1. Reviews

PARENTAL OCCUPATIONAL EXPOSURE TO LOW-FREQUENCY MAGNETIC FIELDS AND RISK OF LEUKAEMIA IN THE OFFSPRING: FINDINGS FROM THE CHILDHOOD LEUKAEMIA INTERNATIONAL CONSORTIUM (CLIC).

Talibov M, Olsson A, Bailey H, Erdmann F, Metayer C, Magnani C, Petridou E, Auvinen A, Spector L, Clavel J, Roman E, Dockerty J, Nikkilä A, Lohi O, Kang A, Psaltopoulou T, Miligi L, Vila J, Cardis E, Schüz J.

Occup Environ Med. 2019 Oct;76(10):746-753.

Previously published studies on parental occupational exposure to extremely low-frequency magnetic fields (ELF-MF) and risk of acute lymphoblastic leukaemia (ALL) and acute myeloid leukaemia (AML) in their offspring were inconsistent. The authors therefore evaluated this question within the Childhood Leukemia International Consortium. They pooled 11 case-control studies including 9723 childhood leukaemia cases and 17 099 controls. Parental occupational ELF-MF exposure was estimated by linking jobs to an ELF-MF job-exposure matrix (JEM). Logistic regression models were used to estimate ORs and 95% CIs in pooled analyses and meta-analyses. ORs from pooled analyses for paternal ELF-MF exposure >0.2 microtesla (μT) at conception were 1.04 (95% CI 0.95 to 1.13) for ALL and 1.06 (95% CI 0.87 to 1.29) for AML, compared with $\leq 0.2 \mu\text{T}$. Corresponding ORs for maternal ELF-MF exposure during pregnancy were 1.00 (95% CI 0.89 to 1.12) for ALL and 0.85 (95% CI 0.61 to 1.16) for AML. No trends of increasing ORs with increasing exposure level were evident. Furthermore, no associations were observed in the meta-analyses.

Conclusions: In this large international dataset applying a comprehensive quantitative JEM, the authors did not find any associations between parental occupational ELF-MF exposure and childhood leukaemia.

2. Residential exposure

RESIDENTIAL DISTANCE FROM HIGH-VOLTAGE OVERHEAD POWER LINES AND RISK OF ALZHEIMER'S DEMENTIA AND PARKINSON'S DISEASE: A POPULATION-BASED CASE-CONTROL STUDY IN A METROPOLITAN AREA OF NORTHERN ITALY.

Gervasi F, Murtas R, Decarli A, Giampiero Russo A.

Int J Epidemiol. 2019 Jul 6.

The association between the extremely low-frequency magnetic field generated by overhead power lines and neurodegenerative disease is still a matter of debate. A population-based case-control study was carried out on the residents in the Milan metropolitan area between 2011 and 2016 to evaluate the possible association between exposure to extremely low-frequency magnetic fields generated by high-voltage overhead power lines and Alzheimer's dementia and Parkinson's disease. A statistical analysis was performed on cases and controls matched by sex, year of birth and municipality of residence (with a case to controls ratio of 1 : 4) using conditional logistic regression models adjusted for socio-economic deprivation and distance from the major road network as potential confounders. Odds ratios for residents <50 m from the source of exposure compared with residents at ≥600 m turned out to be 1.11 (95% confidence interval: 0.95-1.30) for Alzheimer's dementia and 1.09 (95% confidence interval: 0.92-1.30) for Parkinson's disease.

Conclusions: The finding of a weak association between exposure to the extremely low-frequency magnetic field and neurodegenerative diseases suggests the continuation of research on this topic. Moreover, the low consistency between the results of the already existing studies emphasises the importance of increasingly refined study designs.

3. Occupational exposure

EFFECT OF LONG-TERM OCCUPATIONAL EXPOSURE TO EXTREMELY LOW-FREQUENCY ELECTROMAGNETIC FIELDS ON PROINFLAMMATORY CYTOKINE AND HEMATOLOGICAL PARAMETERS.

Hosseiniabadi MB, Khanjani N, Samaei SE, Nazarkhani F.

Int J Radiat Biol. 2019 Aug 5:1-8.

The purpose of the present study aimed to investigate the effect of extremely low-frequency electromagnetic fields (ELF-EMFs) on proinflammatory cytokines and hematological parameters, among the employees of a power plant, which are one of the most important occupational groups exposed to ELF-EMFs extensively. The studied population included 112 employees of a power plant as the exposed group and 138 unexposed employees who were enrolled based on inclusion and exclusion criteria. The magnetic flux density and the strength of the electric field were determined by spot measurements and according to the IEEE C95.3.1 standard. Proinflammatory cytokines including serum interleukin-1 β (IL-1 β), interleukin-6 (IL-6), and tumor necrosis factor- α (TNF- α); and hematologic parameters of all subjects were measured. The mean level of IL-1 β and IL-6, white blood cell count (WBC) and red blood cell count (RBC), lymphocyte percentage (Lym%), mean corpuscular volume (MCV), platelet count (PLT) and procalcitonin (PCT) were significantly more in the exposed group, than the unexposed group. The mean serum levels of IL-6, IL-1 β and some of the hematological parameters including WBC, lymphocyte, RBC and hematocrit were higher in technicians which had the highest level of exposure to magnetic fields compared to other groups and these relations were linear.

Conclusions: Long-term exposure to ELF-EMFs probably affects immune responses, by stimulating the production of proinflammatory cytokines, and increasing some hematological parameters.

4. Human experimental studies

MELATONIN LEVELS AND LOW-FREQUENCY MAGNETIC FIELDS IN HUMANS AND RATS: NEW INSIGHTS FROM A BAYESIAN LOGISTIC REGRESSION.

Bouché NF, McConway K.

Bioelectromagnetics. 2019 Sep 29.

The present analysis revisits the impact of extremely low-frequency magnetic fields (ELF-MF) on melatonin (MLT) levels in human and rat subjects using both a parametric and non-parametric approach. In this analysis, 62 studies from review articles were used. The parametric approach consists of a Bayesian logistic regression (LR) analysis and the non-parametric approach consists of a Support Vector analysis, both of which are robust against spurious/false results. Both approaches reveal a unique well-ordered pattern, and show that human and rat studies are consistent with each other once the MF strength is restricted to cover the same range (with $B \lesssim 50 \mu\text{T}$). In addition, the data reveal that chronic exposure (longer than ~ 22 days) to ELF-MF appears to decrease MLT levels only when the MF strength is below a threshold of $\sim 30 \mu\text{T}$, i.e., when the man-made ELF-MF intensity is below that of the static geomagnetic field.

Conclusions: Studies reporting an association between ELF-MF and changes to MLT levels and the opposite (no association with ELF-MF) can be reconciled under a single framework.

5. Exposure assessment

CHARACTERIZATION OF LEVELS OF EXTREMELY LOW FREQUENCY MAGNETIC FIELDS EMITTED FROM PORTABLE HAND-HELD FANS.

Choi S, Kim S, Bae S, Kim W, Park JH, Chung E, Park J, Park DU.

Bioelectromagnetics. 2019 Aug 2.

This study aims to assess the levels of extremely low frequency magnetic fields (ELF-MF) emitted from portable hand-held fans (HHFs) and their principal frequency and to identify factors influencing these levels. The authors collected a total of eleven models of HHF and monitored the ELF-MF as a function of fan speed and distance from the fan. EMDEX II was used to monitor the ELF-MF. An SMP2 EMF-meter equipped with a P400 field probe was used to determine the levels of ELF-MF and the frequency spectrum. Ten of the fans, excluding only one bladeless-fan model, emitted a high level of ELF-MF near the source of the HHF direct-current motor. The maximum measured level of ELF-MF ranged from 14.07 to 218.7 μT .

Conclusions: All measurements of the ELF-MF taken within 10 cm from the HHFs showed values higher than 1.0 μT . ELF-MF levels were found to decrease markedly with distance, regardless of the HHF product. The level of ELF-MF rose noticeably

with increased fan speed. The speed of and distance from the HHF significantly influenced the level of ELF-MF. All principal frequencies ranged from 1 to 300 Hz, which falls in the typical range of ELF.

6. Leukemia studies

RISK OF ACUTE LYMPHOBLASTIC LEUKEMIA: RESULTS OF A CASE-CONTROL STUDY.

Rafieemehr H, Calhor F, Esfahani H, Ghorbani Gholiabad S.

Asian Pac J Cancer Prev. 2019 Aug 1;20(8):2477-2483.

Acute lymphoblastic leukemia (ALL) is the most common malignancy in children. Different environmental factors might be effective in the occurrence of this malignancy during childhood. The aim of this study was to find environmental risk factors in childhood ALL in Hamadan, Iran. This case-control study was done in 2015-2018 on 125 children younger than 15 years of age suffering from ALL. Patients were matched with 130 controls with respect to age, gender, and residence location. The identification of risk factors for ALL was sought based on the comparison of studied variables between case and control individuals. A statistically significant increased risk for ALL was found with regard to type of delivery (OR: 0.43, 95% CI: 0.20 - 0.92, $p < 0.02$), childcare (OR: 4.58, 95% CI: 0.95 - 22.20, $p < 0.04$), birth weight (OR: 1.44, 95% CI: 1.53 - 2.21, $p < 0.006$), father's education level (OR: 2.67, 95% CI: 1.10 - 6.45, $p < 0.02$), and father's job (OR: 0.2 95% CI: 0.08 - 0.51, $p < 0.001$). Also observed were increased odds for ALL regarding male gender, mother's high education level, mother's freelance job, and medium or high family income. No association with ALL incidence was observed for age, gender, breastfeeding, mother's age at pregnancy, malignancy in first- or second-degree relatives, or mother's use of hair dye during pregnancy ($p > 0.05$).

Conclusions: This study showed that father's education level, father's job, delivery type, birth weight, and childcare can play a role in the incidence of childhood ALL.

HIGH PARENTAL OCCUPATIONAL SOCIAL CONTACT AND RISK OF CHILDHOOD HEMATOPOIETIC, BRAIN AND BONE CANCERS.

Omidakhsh N, Hansen J, Ritz B, Olsen J, Heck JE.

Cancer Epidemiol. 2019 Oct;62:101575.

The etiology of childhood cancer is largely unknown, though some research suggests an infectious origin of hematopoietic, central nervous system (CNS) and bone cancers. The authors examined parental occupational social contact as a proxy for exposure to infectious agents and risk of childhood cancer. This population-based case-control study utilized a linkage of four Danish data-registries, and included 3581 cases (<17 years, diagnosed 1973-2012) and 358,100 age-matched controls. The authors examined the risks of leukemia, lymphoma, CNS and bone cancer related to high occupational social contact from (1) conception to birth and (2) birth to diagnosis. Acute lymphoblastic leukemia (ALL) and bone cancer were inversely associated with high maternal social contact from conception to birth (OR: 0.86, 95% CI: 0.67-1.10) and birth to diagnosis (OR: 0.54, 95% CI: 0.34-0.86). Children of fathers with high social contact from birth to diagnosis had an increased risk of bone

cancers, particularly in rural areas (OR: 1.65, 95% CI: 1.03-2.63). Parental social contact was associated with increased risk of astrocytoma, with strongest associations found in first-born children (maternal: OR: 1.54, 95% CI: 1.02-2.32; paternal: OR: 1.82, 95% CI: 1.05-3.17).

Conclusions: These results support the notion of a role of infections for some cancer types.