

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

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1. Reviews

CHANGES OVER TIME IN THE REPORTED RISK FOR CHILDHOOD LEUKEMIA AND MAGNETIC FIELDS.

Swanson J, Kheifets L, Vergara X.
J Radiol Prot. 2019 Feb 8;39(2):470-488.

There have been many studies from 1979 to the present reporting raised risks for childhood leukemia with exposure to power-frequency magnetic fields. There are also suggestions that the reported risk has been decreasing. The authors examine trends in the risk over time from all available studies. For 41 studies, reported risks were combined using inverse-variance weighting, drawing risk estimates from previous pooled analyses where possible for greater consistency. The cumulative risk for studies published up to each successive calendar year were examined for all studies and for various subsets, and tested for a trend over the period. The cumulative relative risk has indeed declined, for the most rigorous analysis from a maximum 2.44 in 1997 to 1.58 in 2017, but not statistically significantly when tested as a linear trend. Suggestions of higher risks were found in studies looking at higher exposures and in studies with better quality exposure assessment.

Conclusions: There is a decline in reported risk from the mid 1990s to now, which is unlikely to be solely explained by improving study quality but may be due to chance. An elevated risk remains.

OCCUPATIONAL EXPOSURES AND NEURODEGENERATIVE DISEASES - A SYSTEMATIC LITERATURE REVIEW AND META-ANALYSES.

Gunnarsson LG, Bodin L.
Int J Environ Res Public Health. 2019 Jan 26;16(3).

The objectives of this study are to carry out an integrated and stratified meta-analysis on occupational exposure to electromagnetic fields (EMFs), metals and pesticides and its effects on amyotrophic lateral sclerosis (ALS) and Parkinson's and Alzheimer's disease, and investigate the possibility of publication bias. The authors updated a recently published meta-analysis on occupational exposures in relation to ALS, Alzheimer's and Parkinson's disease. Based on 66 original publications of good scientific epidemiological standard, according to the Meta-analysis of Observational Studies in Epidemiology (MOOSE) and the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) guidelines, they analyzed subgroups by carrying out stratified meta-analyses on publication year, statistical precision of the relative risk (RR) estimates, inspection of the funnel plots and test of

bias. Based on 19 studies the weighted RR for occupational exposure to EMFs was 1.26 (95% confidence interval (CI) 1.07-1.50) for ALS, 1.33 (95% CI 1.07-1.64) for Alzheimer's disease and 1.02 (95% CI 0.83-1.26) for Parkinson's disease. Thirty-one studies concerned occupational exposure to pesticides and the weighted RR was 1.35 (95% CI 1.02-1.79) for ALS, 1.50 (95% CI 0.98-2.29) for Alzheimer's disease and 1.66 (95% CI 1.42-1.94) for Parkinson's disease. Finally, 14 studies concerned occupational exposure to metals and only exposure to lead (five studies) involved an elevated risk for ALS or Parkinson's disease and the weighted RR was 1.57 (95% CI 1.11-2.20). The weighted RR for all the non-lead exposures was 0.97 (95% CI 0.88-1.06).

Conclusions: Exposure to pesticides increased the risk of getting the mentioned neurodegenerative diseases by at least 50%. Exposure to lead was only studied for ALS and Parkinson's disease and involved 50% increased risk. Occupational exposure to EMFs seemed to involve some 30% increase in risk for ALS and Alzheimer's disease only.

2. Residential exposure

CHILDHOOD LEUKEMIA RISK IN THE CALIFORNIA POWER LINE STUDY: MAGNETIC FIELDS VERSUS DISTANCE FROM POWER LINES.

Crespi CM, Swanson J, Vergara XP, Kheifets L.
Environ Res. 2019 Apr;171:530-535.

Pooled analyses have suggested a small increased risk of childhood leukemia associated with distance and with exposure to high magnetic fields from power transmission lines. Because magnetic fields are correlated with distance from lines, the question of whether the risk is due to magnetic fields exposure or to some other factor associated with distance from lines is unresolved. The authors used data from a large records-based case-control study to examine several research questions formulated to disentangle the relationships among magnetic fields, distance from high voltage lines, and childhood leukemia risk. In models examining an interaction between distance and magnetic fields exposure, they found that neither close proximity to high voltage lines alone nor exposure to high calculated fields alone were associated with childhood leukemia risk. Rather, elevated risk was confined to the group that was both very close to high voltage lines (<50 m) and had high calculated fields ($\geq 0.4 \mu\text{T}$) (odds ratio 4.06, 95% CI 1.16, 14.3). Further, high calculated fields ($\geq 0.4 \mu\text{T}$) that were due solely to lower voltage lines (<200 kV) were not associated with elevated risk; rather, risk was confined to high fields attributable to high voltage lines.

Conclusions: Whilst other explanations are possible, these findings argue against magnetic fields as a sole explanation for the association between distance and childhood leukemia and in favor of some other explanation linked to characteristics of power lines.

PRENATAL EXPOSURE TO EXTREMELY LOW FREQUENCY MAGNETIC FIELD AND ITS IMPACT ON FETAL GROWTH.

Ren Y, Chen J, Miao M, Li DK, Liang H, Wang Z, Yang F, Sun X, Yuan W.
Environ Health. 2019 Jan 11;18(1):6.

This study aimed to examine the association between maternal extremely low frequency MF (ELF-MF) exposure during pregnancy and fetal growth in offspring. A total of 128 pregnant women were recruited at their 3rd trimester and asked to wear an EMDEX Lite meter for 24 h to capture daily ELF-MF exposure. Time-weighted average (TWA), P50, and P75 of personal 24-h measurements were used to evaluate prenatal ELF-MF exposure. The medians of these measurements were used as cut-off points of high and low prenatal ELF-MF exposure. Fetal growth was measured by infant's birth weight, skinfold thickness of triceps, abdomen, and back, and circumference of head, upper arm, and abdomen. These measures were conducted within 24-h after birth. Generalized Linear Model was used to examine the association between maternal ELF-MF level and fetal growth indices after potential confounders were adjusted for. Compared with girls with lower prenatal ELF-MF exposure, girls with higher exposure had a lower birth weight, thinner skinfold of triceps, abdomen and back, and smaller circumference of head, upper arm and abdomen in all three ELF-MF matrices. The differences were statistically significant for birth weight and most other growth measurements ($P < 0.05$). These measures had no significant difference between higher and lower prenatal ELF-MF exposure in boys except back skinfold thickness.

Conclusions: Prenatal exposure to higher ELF-MF levels was associated with decreased fetal growth in girls, but not in boys.

3. Occupational exposure

ASSOCIATIONS OF ELECTRIC SHOCK AND EXTREMELY LOW-FREQUENCY MAGNETIC FIELD EXPOSURE WITH THE RISK OF AMYOTROPHIC LATERAL SCLEROSIS.

Peters S, Visser AE, D'Ovidio F, Beghi E, Chiò A, Logroscino G, Hardiman O, Kromhout H, Huss A, Veldink J, Vermeulen R, van den Berg LH; Euro-MOTOR Consortium.

Am J Epidemiol. 2019 Apr 1;188(4):796-805.

The authors explored the associations of occupational exposure to extremely low-frequency magnetic fields (ELF-MF) and electric shocks with the risk of amyotrophic lateral sclerosis (ALS) in a pooled case-control study (European Multidisciplinary ALS Network Identification to Cure Motor Neuron Degeneration (Euro-MOTOR)) of data from 3 European countries. ALS patients and population-based controls were recruited in Ireland, Italy, and the Netherlands between 2010 and 2015. Lifetime occupational and lifestyle histories were obtained using structured questionnaires. Previously developed job exposure matrices assigning exposure levels to ELF-MF and potential for electric shocks were applied. Odds ratios and 95% confidence intervals were estimated by means of logistic regression for exposure to either ELF-MF or electric shocks, adjusted for age, sex, study center, education, smoking, and alcohol consumption and for the respective other exposure. Complete occupational

histories and information on confounding variables were available for 1,323 clinically confirmed ALS cases and 2,704 controls. Both ever having had exposure to ELF-MF above the background level (odds ratio = 1.16, 95% confidence interval: 1.01, 1.33) and ever having had potential exposure above background for electric shocks (odds ratio = 1.23, 95% confidence interval: 1.05, 1.43) were associated with ALS. Adjustment for the respective other exposure resulted in similar risk estimates. Heterogeneity in risks across study centers was significant for both exposures.

Conclusions: These findings support possible independent associations of occupational exposure to ELF-MF and electric shocks with the risk of ALS.

4. Human experimental studies

No publications

4. Exposure assessment

EVALUATING EXPOSURE FROM ELECTRIC FIELDS IN A HIGH VOLTAGE SWITCHYARD ACCORDING TO THE EU DIRECTIVE.

Hamnerius Y, Nilsson T, Friman E.

J Radiol Prot. 2019 Mar;39(1):150-160.

An assessment according to Directive 2013/35/EU of exposure in a 400 kV switchyard has been performed. Part of the body was exposed to electric field strength above the high action level. The authors therefore performed simulations of the electric fields induced in the body to assess these according to the exposure limit values (ELVs). The simulations show that as long as the body is not grounded nor touching any grounded metallic objects, worker exposure is compliant with the directive.

Conclusions: When grounded metallic objects are touched with hand or foot the ELV are exceeded. The ELV is exceeded already at very low contact currents (2-3 μ A) in the finger. If not appropriate measures are taken, this would lead to a severe limitation of the work tasks that can be performed in switchyards.

4. Leukemia studies

SPACE-TIME CLUSTERING OF CHILDHOOD CANCERS: A SYSTEMATIC REVIEW AND POOLED ANALYSIS.

Kreis C, Doessegger E, Lupatsch JE, Spycher BD.

Eur J Epidemiol. 2019 Jan;34(1):9-21.

The etiology of childhood cancers remains largely unknown. Space-time clustering of cases might imply an etiological role of infections. The authors aimed to review the evidence of space-time clustering of specific childhood cancers. They searched Medline and Embase for population-based studies that covered a pre-defined study

area, included cases under 20 years of age and were published before July 2016. They extracted all space-time clustering tests and calculated the proportion of positive tests per diagnostic group. In a pooled analysis, they performed a Knox test of the number of pairs of cases close to each other in time and space pooled across studies. 70 studies met the eligibility criteria, 32 of which reported Knox tests. For leukemia, the proportion of positive tests was higher than expected by chance at both time of diagnosis (26%) and birth (11%). The pooled analysis showed strong evidence of clustering at diagnosis for children aged 0-5 years for a spatial and temporal lag of 5 km and 6 months, respectively ($p < 0.001$). The evidence was mixed for lymphoma and tumors of the central nervous system.

Conclusions: The current study suggests that leukemia cases cluster in space-time due to an etiological factor affecting children under 5 years of age. The observed pattern of clustering of young children close to time of diagnosis is compatible with Greaves' delayed-infections-hypothesis.