

Overview of the epidemiologic studies on the health effects of ELF magnetic and electric fields published in the third trimester of 2007.

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1. Residential exposure

NIGHTTIME EXPOSURE TO ELECTROMAGNETIC FIELDS AND CHILDHOOD LEUKEMIA: AN EXTENDED POOLED ANALYSIS.

Schüz J, Svendsen AL, Linet MS, McBride ML, Roman E, Feychting M, Kheifets L, Lightfoot T, Mezei G, Simpson J, Ahlbom A.

Am J Epidemiol. 2007; 166: 263-269.

It has been hypothesized that nighttime bedroom measurements of extremely low frequency electromagnetic fields (ELF EMF) may represent a more accurate reflection of exposure and have greater biologic relevance than previously used 24-/48-hour measurements. Accordingly, the authors extended a pooled analysis of case-control studies on ELF EMF exposure and risk of childhood leukemia to examine nighttime residential exposures. Data from four countries (Canada, Germany, the United Kingdom, and the United States) were included in the analysis, comprising 1,842 children diagnosed with leukemia and 3,099 controls (diagnosis dates ranged from 1988 to 1996). The odds ratios for nighttime ELF EMF exposure for categories of 0.1-<0.2 microT, 0.2-<0.4 microT, and \geq 0.4 microT as compared with <0.1 microT were 1.11 (95% confidence interval (CI): 0.91, 1.36), 1.37 (95% CI: 0.99, 1.90), and 1.93 (95% CI: 1.11, 3.35), respectively. The fact that these estimates were similar to those derived using 24-/48-hour geometric mean values (odds ratios of 1.09, 1.20, and 1.98, respectively) indicates that the nighttime component cannot, on its own, account for the pattern observed.

Conclusion: These results do not support the hypotheses that nighttime measures are more appropriate; hence, the observed association between ELF EMF and childhood leukemia still lacks a plausible explanation.

ASSESSMENT OF NON-RESPONSE BIAS IN A SURVEY OF RESIDENTIAL MAGNETIC FIELD EXPOSURE IN TAIWAN.

Li CY, Mezei G, Sung FC, Silva M, Lee PC, Chen PC, Chen LM.

Bioelectromagnetics. 2007; 28: 340-348.

The authors assessed potential non-response bias in obtaining information on residential extremely low-frequency power frequency magnetic field (MF) in Taiwan. All households occupied by children aged less than 7 years in two study districts, one in an urban town and the other in a rural town, were visited and solicited for on-site measurements in late 2003. The initial response rate was only 32% (33/104, urban) and 60% (61/101, rural). In the same season 1 year later, they performed a second survey of those who declined to be measured at the initial survey and successfully measured another 77 residences (50 and 27 for urban and rural districts, respectively). The two districts were selected mainly because the local public health officers were quite willing to assist the initial survey and to inform residents of the second survey. Except for meteorological conditions, the two surveys came up with very similar findings regarding residential characteristics and power facilities surrounding the houses. The mean residential MF for the urban residences was .121 and .140 micro-Tesla (microT) ($P = .620$) for the two surveys.

The corresponding figures for the rural residences were .119 and .115 microT (P = .802).

Conclusion: Although limited in its scope, this study tends to indicate that measurement studies of residential MF are less likely to suffer from serious selection bias if sampling is confined within a small district where people have similar socioeconomic characteristics.

2. Occupational exposure

PATERNAL OCCUPATIONAL EXPOSURE TO ELECTRO-MAGNETIC FIELDS AS A RISK FACTOR FOR CANCER IN CHILDREN AND YOUNG ADULTS: A CASE-CONTROL STUDY FROM THE NORTH OF ENGLAND.

Pearce MS, Hammal DM, Dorak MT, McNally RJ, Parker L.
Pediatr Blood Cancer. 2007; 49: 280-286.

Numerous studies have implied that paternal occupational exposures, in particular electromagnetic fields (EMF) and ionizing radiation, may be involved in the etiology of childhood cancers. The authors investigated whether an association exists between paternal occupations at birth involving such exposures and cancer risk in offspring, using data from the Northern Region Young Persons' Malignant Disease Registry (NRYPM DR).

Cases (n=4,723) were matched, on sex and year of birth, to controls from two independent sources: (i) all other patients from the NRYPM DR with a different cancer, (ii) 100 cancer-free individuals per case from the Cumbrian Births Database. An occupational exposure matrix was used to assign individuals to exposure groups. There was an increased risk of leukemia among the offspring of men employed in occupations likely to be associated with EMF or radiation exposures (OR 1.31, 95% CI 1.02-1.69), particularly in males aged less than 6 years (OR 1.81, 95% 1.19-2.75). No significant association was seen in females. Increased risks were also seen for chondrosarcoma (OR 8.7, 95% CI 1.55-49.4) and renal carcinoma (OR 6.75, 95% CI 1.73-26.0). These associations were consistent between control groups and remained after adjustment for socio-economic status.

Conclusions: This large case-control study identified a significantly increased risk of leukemia among the offspring of men likely to have been occupationally exposed to EMF, with differing associations between males and females. Increased risks of chondrosarcoma and renal carcinoma were also seen, although based on smaller numbers. Further detailed investigations in this area are required to understand this association.

MORTALITY FROM NEURODEGENERATIVE DISEASE AND EXPOSURE TO EXTREMELY LOW-FREQUENCY MAGNETIC FIELDS: 31 YEARS OF OBSERVATIONS ON SWISS RAILWAY EMPLOYEES.

Roosli M, Lortscher M, Egger M, Pfluger D, Schreier N, Lortscher E, Locher P, Spoerri A, Minder C.
Neuroepidemiology. 2007; 28: 197-206

The objective of this study was to investigate the relationship between extremely low-frequency magnetic field (ELF-MF) exposure and mortality from several neurodegenerative conditions in Swiss railway employees. The authors studied a cohort of 20,141 Swiss railway employees with 464,129 person-years of follow-up between 1972 and 2002. For each individual, cumulative exposure was calculated from on-site measurements and modelling of past exposure. Cause-specific mortality in highly exposed train drivers (mean exposure: 21 μ T) was compared with less exposed occupational groups (for example station masters: 1 μ T).

The hazard ratio for train drivers compared to station masters was 1.96 [95% confidence interval (CI) = 0.98-3.92] for senile dementia and 3.15 (95% CI = 0.90-11.04) for Alzheimer's disease. For every 10 μ T years of cumulative exposure senile dementia mortality increased by 5.7% (95% CI = 1.3-10.4), Alzheimer's disease by 9.4% (95% CI = 2.7-16.4) and amyotrophic lateral sclerosis by 2.1% (95% CI = -6.8 to 11.7). There was no evidence for an increase in mortality from Parkinson's disease and multiple sclerosis.

Conclusions: This study suggests a link between exposure to ELF-MF and Alzheimer's disease and indicates that ELF-MF might act in later stages of the disease process.

LEUKAEMIA, BRAIN TUMOURS AND EXPOSURE TO EXTREMELY LOW FREQUENCY MAGNETIC FIELDS: COHORT STUDY OF SWISS RAILWAY EMPLOYEES.

Röösli M, Lörtscher M, Egger M, Pfluger D, Schreier N, Lörtscher E, Locher P, Spoerri A, Minder C.

Occup Environ Med. 2007; 64 :553-559.

The aim of this study was to investigate the relationship between extremely low frequency magnetic field (ELF-MF) exposure and mortality from leukaemia and brain tumour in a cohort of Swiss railway workers.

20,141 Swiss railway employees with 464,129 person-years of follow-up between 1972 and 2002 were studied. Mortality rates for leukaemia and brain tumour of highly exposed train drivers (21 μ T average annual exposure) were compared with medium and low exposed occupational groups (i.e. station masters with an average exposure of 1 μ T). In addition, individual cumulative exposure was calculated from on-site measurements and modelling of past exposures.

The hazard ratio (HR) for leukaemia mortality of train drivers was 1.43 (95% CI 0.74 to 2.77) compared with station masters. For myeloid leukaemia the HR of train drivers was 4.74 (95% CI 1.04 to 21.60) and for Hodgkin's disease 3.29 (95% CI 0.69 to 15.63). Lymphoid leukaemia, non-Hodgkin's disease and brain tumour mortality were not associated with magnetic field exposure. Concordant results were obtained from analyses based on individual cumulative exposure.

Conclusions: Some evidence of an exposure-response association was found for myeloid leukaemia and Hodgkin's disease, but not for other haematopoietic and lymphatic malignancies and brain tumours.

OCCUPATIONAL EXPOSURE TO IONIZING AND NON-IONIZING RADIATION AND RISK OF NON-HODGKIN LYMPHOMA.

Karipidis KK, Benke G, Sim MR, Kauppinen T, Krickler A, Hughes AM, Grulich AE, Vajdic CM, Kaldor J, Armstrong B, Fritschi L.

Int Arch Occup Environ Health. 2007; 80: 663-670.

The aim of this study was to investigate the association between occupational exposure to ionizing, ultraviolet (UV), radiofrequency (RF) and extremely low frequency (ELF) radiation and risk of developing non-Hodgkin lymphoma (NHL) in a population-based case-control study.

The study population consisted of 694 NHL cases, first diagnosed between 1 January 2000 and 31 August 2001, and 694 controls from two regions in Australia, matched by age, sex and region of residence. A detailed occupation history was first obtained using a lifetime calendar and a telephone interview. Exposure to radiation was then assessed using a Finnish job-exposure matrix (FINJEM). Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated from logistic regression models that included the matching variables as covariates.

For ionizing radiation, the ORs were close to unity. For UV and ELF radiation, the highest exposed group of workers had ORs of 1.32 (95% CI=0.96-1.81) and 1.25

(95% CI=0.91-1.72), respectively. For UV radiation there was a positive dose-response when exposure was lagged by 5 and 10 years (P for trend 0.04 for both lag periods). Workers in the upper tertile of exposure for RF radiation had an OR of 3.15 (95% CI=0.63-15.87), but the estimate was based on very small numbers. Conclusions: These results do not provide support for an association between NHL and occupational exposure to ionizing or ELF radiation. For UV radiation, our findings are consistent with a weak positive association. Further investigation focusing on UV and RF radiation and NHL is required.

3. Leukaemia studies

FETAL GROWTH AND ACUTE CHILDHOOD LEUKEMIA: LOOKING BEYOND BIRTH WEIGHT.

Milne E, Laurvick CL, Blair E, Bower C, de Klerk N.

Am J Epidemiol. 2007; 166: 151-159.

The authors examined the relation between birth weight, intrauterine growth, and risk of childhood leukemia using population-based linked health data from Western Australia. A cohort of 576,593 infants born in 1980-2004 were followed from birth to diagnosis of acute lymphoblastic leukemia (ALL) (n = 243) or acute myeloid leukemia (AML) (n = 36) before their 15th birthday, death, or the end of follow-up (December 31, 2005). Data were analyzed using Cox regression. Risk of ALL was positively associated with the proportion of optimal birth weight--a measure of the appropriateness of fetal growth--particularly among children younger than 5 years; the hazard ratio for a 1-standard-deviation increase in proportion of optimal birth weight was 1.25 (95% confidence interval: 1.07, 1.47). Among children younger than 5 years not classified as having high birth weight (defined as >3,500 g, >3,800 g, and >4,000 g), a 1-unit increase in proportion of optimal birth weight was associated with an approximately 40% increase in ALL risk. This suggests that accelerated growth, rather than high birth weight per se, is involved in the etiology of ALL. These findings are consistent with a role for insulin-like growth factor I in the causal pathway. Findings for AML were inconclusive, probably because of small numbers.

PARENTAL OCCUPATIONAL EXPOSURE TO PESTICIDES AND THE RISK OF CHILDHOOD LEUKEMIA IN COSTA RICA.

Monge P, Wesseling C, Guardado J, Lundberg I, Ahlbom A, Cantor KP, Weiderpass E, Partanen T.

Scand J Work Environ Health. 2007; 33: 293-303.

Parental exposure to pesticides and the risk of leukemia in offspring were examined in a population-based case-control study in Costa Rica.

All cases of childhood leukemia (N=334), in 1995-2000, were identified at the Cancer Registry and the Children's Hospital. Population controls (N=579) were drawn from the National Birth Registry. Interviews of parents were conducted using conventional and icon-based calendar forms. An exposure model was constructed for 25 pesticides in five time periods.

Mothers' exposures to any pesticides during the year before conception and during the first and second trimesters were associated with the risk [odds ratio (OR) 2.4, 95% confidence interval (95% CI) 1.0-5.9; OR 2.2, 95% CI 1.0-4.8; OR 4.5, 95% CI 1.4-14.7, respectively] and during anytime (OR 2.2, 95% CI 1.0-4.8). An association was found for fathers' exposures to any pesticides during the second trimester (OR 1.5, 95% CI 1.0-2.3). An increased risk with respect to organophosphates was found for mothers during the first trimester (OR 3.5, 95% CI 1.0-12.2) and for fathers during the year before conception and the first trimester (OR 1.5, 95% CI 1.0-2.2 and OR 1.6, 95% CI 1.0-2.6, respectively), and benzimidazoles during the first, second, and third

trimesters of pregnancy (OR 2.2, 95% CI 1.0-4.4; OR 2.2, 95% CI 1.0-5.0; OR 2.2, 95% CI 1.0-5.2, respectively). There was a suggestion of an exposure-response gradient for fathers as regards picloram, benomyl, and paraquat. Age at diagnosis was positively associated with fathers' exposures and inversely associated with mothers' exposures.

Conclusions: The results suggest that parental exposure to certain pesticides may increase the risk of leukemia in offspring.