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

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1. Residential exposure

RESIDENTIAL EXPOSURE TO ELECTRIC POWER TRANSMISSION LINES AND RISK OF LYMPHOPROLIFERATIVE AND MYELOPROLIFERATIVE DISORDERS: A CASE-CONTROL STUDY.

Lowenthal RM, Tuck DM, Bray IC.

Intern Med J. 2007; 37: 614-619.

Studies have shown an association between electromagnetic fields and childhood leukaemia. The aim of this study was to determine whether there is an increased risk of lymphoproliferative disorders (LPD) or myeloproliferative disorders (MPD) associated with residence < or =300 m from high-voltage power lines.
Case-control study of 854 patients diagnosed with LPD or MPD (including leukaemia, lymphoma and related conditions) aged 0-94 years comprising all cases diagnosed in Tasmania between 1972 and 1980. Controls were individually matched for sex and approximate age at the time of diagnosis.
Compared with those who had always lived >300 m from a power line, those who had ever lived within 50 m had an odds ratio (OR) of 2.06 (95% confidence interval 0.87-4.91) for developing LPD or MPD (based on 768 adult case-control pairs); those who had lived between 50 and 300 m had an OR of 1.30 (0.88-1.91). Adults who had lived within 300 m of a power line during the first 15 years of life had a threefold increase in risk (OR 3.23; 1.26-8.29); those who had lived within the same distance aged 0-5 years had a fivefold increase in risk (OR 4.74; 0.98-22.9). These associations were strengthened when analyses were repeated for 201 pairs with entirely Tasmanian residential histories.
Conclusion: Although recognizing that this study has limitations, the results raise the possibility that prolonged residence close to high-voltage power lines, especially early in life, may increase the risk of the development of MPD and LPD later.

2. Occupational exposure

RISK FOR LEUKAEMIA AND BRAIN AND BREAST CANCER AMONG DANISH UTILITY WORKERS: A SECOND FOLLOW-UP.

Johansen C, Raaschou Nielsen O, Olsen JH, Schüz J.

Occup Environ Med. 2007; 64:782-784.

The objective of this study was to update a study of risks for leukaemia, brain cancer and breast cancer in a Danish nationwide, population-based cohort of utility employees.
A multivariate statistical model including information on age, duration of employment, date of first employment and level of occupational exposure to electromagnetic fields was applied. RESULTS: No increased risk for these cancers was seen among 28,224 subjects with more than 3 months of employment in whom cancer had not been diagnosed before first employment.

Conclusion: The results do not support the hypothesis of an association between occupational exposure to magnetic fields in the electric utility industry and risks for leukaemia, brain cancer and breast cancer.

MORTALITY FROM ALZHEIMER'S, MOTOR NEURON AND PARKINSON'S DISEASE IN RELATION TO MAGNETIC FIELD EXPOSURE: FINDINGS FROM THE STUDY OF UK ELECTRICITY GENERATION AND TRANSMISSION WORKERS, 1973–2004

Sorahan T**,** Kheifets L.

Occup. Environ. Med. 2007; 64: 790-791.

There are a number of reports linking magnetic field exposure to increased risks of Alzheimer's disease and motor neuron disease.

The mortality experienced by a cohort of 83 997 employees of the former Central Electricity Generating Board of England and Wales was investigated for the period 1973–2004. All employees were employed for at least six months with some employment in the period 1973–82. Computerised work histories were available for 79 972 study subjects for the period 1971–93. Information on job and facility (location) were used to estimate exposures to magnetic fields. Two analytical approaches were used to evaluate risks, indirect standardisation (n = 83 997) and Poisson regression (n = 79 972).

Based on serial mortality rates for England and Wales, deaths from Alzheimer's disease and motor neuron disease were unexceptional. There was an excess of deaths from Parkinson's disease of borderline significance. No statistically significant trends were shown for risks of any of these diseases to increase with lifetime cumulative exposure to magnetic fields (RR per 10 µT-y: Alzheimer's disease 1.10 (95% CI 0.90 to 1.33); motor neuron disease 1.06 (95% CI 0.86 to 1.32); Parkinson's disease 0.88 (95% CI 0.74 to 1.05))

Conclusion: There is no convincing evidence that UK electricity generation and transmission workers have suffered increased risks from neurodegenerative diseases as a consequence of exposure to magnetic fields.

OCCUPATIONAL EXPOSURE TO IONIZING AND NON-IONIZING RADIATION AND RISK OF GLIOMA.

Karipidis KK, Benke G, Sim MR, Kauppinen T, Giles G.

Occup Med (Lond). 2007; 57: 518-524

Although the aetiology of glioma is poorly understood, the higher incidence in males has long suggested an occupational cause.

The aim of this study was to investigate possible associations between occupational exposure to ionizing, ultraviolet (UV), radiofrequency (RF) and extremely low frequency (ELF) radiation and adult glioma risk.

Case-control study using histologically confirmed cases of glioma first diagnosed between 1987 and 1991 in Melbourne, Australia, matched by age, sex and postcode of residence. A detailed occupational history was obtained for each subject. Exposure to radiation was assessed using a Finnish job exposure matrix (FINJEM) for all the radiation types as well as self-reports and expert hygienist review for RF and ionizing radiation. For ELF and UV, gender-specific FINJEM analysis was performed.

The study population consisted of 416 cases of glioma and 422 controls. The risk estimates given by FINJEM for ELF, RF and ionizing radiation were close to or below unity. Gender-specific analysis for UV showed odds ratios of 1.60 [95% confidence interval (CI) 0.95-2.69] and 0.54 (95% CI 0.27-1.07) for the highest exposed group of men and women, respectively (corresponding P value for trend was 0.03 and 0.04).

Conclusions: The authors did not find evidence of an association between glioma and occupational exposure to ELF, RF and ionizing radiation.

OCCUPATIONAL RISK FACTORS IN ALZHEIMER'S DISEASE: A REVIEW ASSESSING THE QUALITY OF PUBLISHED EPIDEMIOLOGICAL STUDIES.
Santibáñez M, Bolumar F, García AM.
Occup Environ Med. 2007 ;64: 723-732.

Epidemiological evidence of an association between Alzheimer's disease (AD) and the most frequently studied occupational exposures--pesticides, solvents, electromagnetic fields (EMF), lead and aluminium--is inconsistent. Epidemiological studies published up to June of 2003 were systematically searched through PubMed and Toxline. Twenty-four studies (21 case-control and 3 cohort studies) were included. Median GQI was 36.6% (range 19.5-62.9%). Most of the case-control studies had a GQI of <50%. The study with the highest score was a cohort study. Likelihood of exposure misclassification bias affected 18 of the 24 studies. Opportunity for bias arising from the use of surrogate informants affected 17 studies, followed by disease misclassification (11 studies) and selection bias (10 studies). Eleven studies explored the relationship of AD with solvents, seven with EMF, six with pesticides, six with lead and three with aluminium. For pesticides, studies of greater quality and prospective design found increased and statistically significant associations. For the remaining occupational agents, the evidence of association is less consistent (for solvents and EMF) or absent (for lead and aluminium).

3. Leukaemia studies

FAMILIAL HISTORY OF CANCER AND CHILDHOOD ACUTE LEUKEMIA: A FRENCH POPULATION-BASED CASE-CONTROL STUDY.
Ripert M, Menegaux F, Perel Y, Méchinaud F, Plouvier E, Gandemer V, Lutz P, Vannier JP, Lamagnére JP, Margueritte G, Boutard P, Robert A, Armari-Alla C, Munzer M, Millot F, de Lumley L, Berthou C, Rialland X, Pautard B, Clavel J.
Eur J Cancer Prev. 2007 ; 16: 466-470.

A case-control study was conducted to investigate the role of a familial history of cancer in the etiology of childhood acute leukemia. The history of cancer in the relatives of 472 cases was compared with that of 567 population-based controls. Recruitment was frequency matched on age, sex and region. The familial history of cancer in each child's relatives was reported by the mother in response to a standardized self-administered questionnaire. A familial history of solid tumor in first or second-degree relatives was associated with an increased risk of acute lymphoblastic leukemia (odds ratio (OR)=1.6 [95% confidence interval, 1.2-2.1]), while a familial history of hematopoietic malignancies in first or second-degree relatives was associated with an increased risk of acute myeloid leukemia (OR=4.3 [1.4-13]). The ORs for the histories of cancer increased with the number of relatives with cancer (OR=1.5 [1.1-2.0] for one relative and OR=2.3 [1.3-3.8] for two relatives or more; Ptrend<0.0001). Significant associations between childhood acute leukemia and familial history of genital cancers and brain tumor were also observed (OR=2.7 [1.2-5.8] and OR=10.7 [1.3-86], respectively).

Conclusion: This study supports the hypothesis that a familial history of cancer may play a role in the etiology of childhood acute leukemia. It also evidences some specific associations that require further investigation.

PARENTAL SOCIAL CONTACT IN THE WORK PLACE AND THE RISK OF CHILDHOOD ACUTE LYMPHOBLASTIC LEUKAEMIA.

Chang JS, Metayer C, Fear NT, Reinier K, Yin X, Urayama K, Russo C, Jolly KW, Buffler PA.

Br J Cancer. 2007; 97: 1315-1321.

To study the possible relation between parental social contact through occupation, a marker for a child's risk of infection, and childhood acute lymphoblastic leukaemia (ALL), the parents of 294 children with ALL aged 0-14.9 years and 376 matched controls were interviewed about their jobs after their child's birth up to the age of 3 years. Job titles were assigned to a level of social contact, and an index of occupational social contact months was created using the level and the job duration. Positive interactions between this index and rural residence associated with an increased risk of childhood ALL and common ALL (c-ALL) were observed (interaction P-value=0.02 for both, using tertiles of contact months; interaction P-value=0.05 and 0.02 for ALL and c-ALL, respectively, using continuous contact months); such findings were not observed when job durations were ignored.
Conclusion: These data suggest that duration of parental occupation may be important when examining the association between parental social contact in the workplace and childhood leukaemia.

SIGNIFICANCE OF GENETIC POLYMORPHISMS AT MULTIPLE LOCI OF CYP2E1 IN THE RISK OF DEVELOPMENT OF CHILDHOOD ACUTE LYMPHOBLASTIC LEUKEMIA.

Ulusoy G, Adali O, Tumer TB, Sahin G, Gozdasoglu S, Arinç E.

Oncology. 2007; 72: 125-131.

The molecular etiology of childhood acute lymphoblastic leukemia (ALL) is likely to involve interactions between environmental factors and genetic make up. Understanding these interactions between various predisposing genes for the risk of developing childhood leukemia is of considerable importance. CYP2E1 is a susceptible gene in this respect, especially for its capacity to bioactivate many procarcinogens including benzene and N-nitrosodimethylamine. The CYP2E1 gene possesses several polymorphisms in humans, and among them, CYP2E1*5B and *6 have been shown to be associated with increased risks of several chemical-induced diseases. There are limited and contradictory data on the association between the CYP2E1*5B variant allele and childhood ALL, and none on such associations of CYP2E1*6 and*7B variant alleles. The aim of this study was to investigate the possible association of CYP2E1*5B, *6 and *7B alleles, alone or in combination, with the risk of incidence of childhood ALL in a Turkish population.
The genotypes for both polymorphisms were determined by polymerase chain reaction/restriction fragment length polymorphism techniques on 207 healthy controls and 168 patients.
Neither locus was associated with the occurrence of childhood ALL. On the other hand, when both CYP2E1*5B and *6 alleles were considered together, the risk of childhood ALL increased significantly (2.9-fold; OR = 2.9, 95% CI 1.0-8.5; $p < 0.05$). Moreover, the presence of at least 2 variant alleles of any combination increased the risk significantly 3.9 times, suggesting a combined effect (OR = 3.9, 95% CI 1.4-11.0).

Conclusion: Individuals carrying combinations of CYP2E1*5B, *6 and *7B variants together are likely associated with the risk of developing childhood ALL.

EVIDENCE OF POPULATION MIXING BASED ON THE GEOGRAPHICAL DISTRIBUTION OF CHILDHOOD LEUKEMIA IN OHIO.

Clark BR, Ferketich AK, Fisher JL, Ruymann FB, Harris RE, Wilkins JR 3rd.

Pediatr Blood Cancer. 2007; 49: 797-802.

This ecologic study examined the geographic distribution of childhood leukemias in Ohio, 1996-2000, among children aged 0-19 for evidence that population mixing may be a factor. Procedure: (1) State incidence rates were compared to Surveillance, Epidemiology and End Results (SEER) rates for each year and for the 5-year period, 1996-2000; (2) incidence rates for each of Ohio's 88 counties were compared to statewide rates; and (3) county incidence rates were compared based on population density, population growth, and rural/urban locale. SEER*Stat version 5.0 was used to derive age-specific and 0-19 age-adjusted rates. Expected values, standardized incidence ratios (SIRs), and Poisson P-values were calculated with Excel using the indirect method of standardization.

Of the 585 cases, 73.3% were acute lymphocytic leukemia (ALL), 16.6% acute myelogenous leukemia (AML), 3.2% acute monocytic leukemia (AMoL), and 2.6% chronic myelogenous leukemia (CML). Rates for total leukemia burden were significantly below national levels for all races ($P = 0.00001$), likely due to poor ascertainment of cases. Yearly incidence rates for 1996-2000 were stable for ALL and AML; CML rates declined over the period. Based on 2000 Census and intercensal population estimates for 1996-2000, statistically higher rates for ALL were noted for counties experiencing >10% population change 1990-2000 ($P < 0.05$), especially for ages 1-4 ($P < 0.03$) in counties with 10-20% growth. Counties 67.9-99.2% urban experienced fewer than expected cases of AML + AMoL ($P < 0.06$).

Conclusion: Data support Kinlen's theory of population mixing and warrant further studies in Ohio, the US and other countries.