Overview of the epidemiologic studies on the health effects of ELF magnetic and electric fields published in the first trimester of 2011

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1. Residential exposure

THE RELATIONSHIP BETWEEN RESIDENTIAL PROXIMITY TO EXTREMELY LOW FREQUENCY POWER TRANSMISSION LINES AND ADVERSE BIRTH OUTCOMES.

Auger N, Joseph D, Goneau M, Daniel M.
J Epidemiol Community Health. 2011; 65: 83-85.

Occupational exposure to electromagnetic fields has been linked to adverse birth outcomes. This study evaluated whether maternal residential proximity to power transmission lines was associated with adverse birth outcomes.

Live singleton births in the Montréal and Québec census metropolitan areas from 1990 to 2004 were extracted from the Québec birth file (N=707,215). Proximity was defined as residing within 400 m of a transmission line. Generalised estimating equations were used to evaluate associations between residential proximity to transmission lines and preterm birth (PTB), low birth weight (LBW), small-for-gestational age (SGA) birth and infant sex, accounting for maternal age, education, marital status, ethnicity, parity, period of birth, and neighbourhood median household income.

There was no association between residential proximity to transmission lines and PTB, LBW and infant sex in unadjusted and adjusted models. A lower likelihood of SGA birth was present for some distance categories (eg, adjusted OR 0.88, 95% CI 0.81 to 0.95 for 50-75 m relative to ≥400 m).

Conclusion: Residential proximity to transmission lines is not associated with adverse births outcomes

EXPOSURE TO ELECTRICAL CONTACT CURRENTS AND THE RISK OF CHILDHOOD LEUKEMIA.

Does M, Scélo G, Metayer C, Selvin S, Kavet R, Buffler P.
Radiat Res. 2011;175: 390-396.

The objectives of this study were to examine the association between contact current exposure and the risk of childhood leukemia and to investigate the relationship between residential contact currents and magnetic fields. Indoor and outdoor contact voltage and magnetic-field measurements were collected for the diagnosis residence of 245 cases and 269 controls recruited in the Northern California Childhood Leukemia Study (2000-2007). Logistic regression techniques produced odds ratios (OR) adjusted for age, sex, Hispanic ethnicity, mother's race and household income. No statistically significant associations were seen between childhood leukemia and indoor contact voltage level [exposure ≥90th percentile (10.5 mV): OR = 0.83, 95% confidence interval (CI): 0.45, 1.54], outdoor contact voltage level [exposure ≥90th percentile (291.2 mV): OR =0.89,

95% CI: 0.48, 1.63], or indoor magnetic-field levels (>0.20 μT: OR = 0.76, 95% CI: 0.30, 1.93). Contact voltage was weakly correlated with magnetic field; correlation coefficients were r = 0.10 (P = 0.02) for indoor contact voltage and r = 0.15 (P = 0.001) for outdoor contact voltage.

Conclusion: In this California population, there was no evidence of an association between childhood leukemia and exposure to contact currents or magnetic fields and a weak correlation between measures of contact current and magnetic fields.

2. Human experiment

THE RESPONSE OF THE HUMAN CIRCULATORY SYSTEM TO AN ACUTE 200-μT, 60-HZ MAGNETIC FIELD EXPOSURE.

McNamee DA, Corbacio M, Weller JK, Brown S, Stodilka RZ, Prato FS, Bureau Y, Thomas AW, Legros AG.

Int Arch Occup Environ Health 2011; 84: 267-277.

Recent research by the authors on the effects of extremely low-frequency (ELF) magnetic field (MF) exposure on human heart rate (HR), heart rate variability (HRV), and skin blood perfusion found no cardiovascular effects of exposure to an 1,800-μT, 60-Hz MF. Research from the group using rats, however, has suggested a microcirculatory response to a 200-μT, 60-Hz MF exposure. The present pilot study investigated the effects of 1 h of exposure to a 200-μT, 60-Hz MF on the human circulation. Microcirculation (as skin blood perfusion) and HR were measured using laser Doppler flowmetry. Mean arterial pressure was monitored with a non-invasive blood pressure system.

Ten volunteers were recruited to partake in a counterbalanced, single-blinded study consisting of two testing sessions (real and sham exposure) administered on separate days. Each session included four consecutive measurement periods separated by rest, allowing assessment of cumulative and residual MF effects.

A within-subjects analysis of variance did not reveal session by time period interactions for any of the parameters which would have been suggestive of a MF effect ($p > 0.05$). Perfusion, HR, and skin surface temperature decreased over the course of the experiment ($p < 0.05$).

Conclusions: The MF used in this experiment did not affect perfusion, HR, or mean arterial pressure. Decreasing perfusion and HR trends over time were similar to previous results and appear to be associated with a combination of inactivity (resulting in decreasing body temperatures) and reduced physiological arousal.

3. Occupational exposure

IMPLANTABLE CARDIOVERTER DEFIBRILLATOR AND 50-HZ ELECTRIC AND MAGNETIC FIELDS EXPOSURE IN THE WORKPLACE.

Souques M, Magne I, Lambrozo J.

Int Arch Occup Environ Health 2011; 84: 1-6.

The operation of implantable cardioverter defibrillators (ICD) can be disrupted by exposure to electromagnetic fields (EMF). In the workplace, some workers can be exposed to EMF higher than in daily life. The authors present an approach aimed at assessing fitness for work in this type of situation, based on in situ case studies in the absence of clinical and in vivo studies.

A risk assessment protocol was developed to measure the 50-Hz electric and magnetic fields in the various places where the worker is likely to be present. These measures are taken in the worker's presence, while monitoring the ICD operation.

All cases of implanted ICD workers in EDF, the French electricity company (around 130,000 employees), and potentially exposed to high electric and/or magnetic fields, between 2004 and 2009 are presented. These three cases involved different work circumstances, with exposure to 50-Hz electric and/or magnetic fields. No interference of the ICD was observed.

Conclusions: This information provides the basis for the occupational physician to make a decision about fitness for work. This procedure can be extended to other medical implants and to electromagnetic fields frequencies other than 50-Hz.

4. Exposure assessment

OCCUPATIONAL EXPOSURE TO ELECTRIC FIELDS AND INDUCED CURRENTS ASSOCIATED WITH 400 KV SUBSTATION TASKS FROM DIFFERENT SERVICE PLATFORMS.

Korpinen LH, Elovaara JA, Kuisti HA.

Bioelectromagnetics 2011; 32: 79-83.

The aim of the study was to investigate the occupational exposure to electric fields, average current densities, and average total contact currents at 400 kV substation tasks from different service platforms (main transformer inspection, maintenance of operating device of disconnector, maintenance of operating device of circuit breaker). The average values are calculated over measured periods (about 2.5 min). In many work tasks, the maximum electric field strengths exceeded the action values proposed in the EU Directive 2004/40/EC, but the average electric fields (0.2-24.5 kV/m) were at least 40% lower than the maximum values. The average current densities were 0.1-2.3 mA/m² and the average total contact currents 2.0-143.2 µA, that is, clearly less than the limit values of the EU Directive. The average values of the currents in head and contact currents were 16-68% lower than the maximum values when we compared the average value from all cases in the same substation.

In the future it is important to pay attention to the fact that the action and limit values of the EU Directive differ significantly. It is also important to take into account that generally, the workers' exposure to the electric fields, current densities, and total contact currents are obviously lower if we use the average values from a certain measured time period (e.g., 2.5 min) than in the case where exposure is defined with only the help of the maximum values.

5. Childhood leukaemia studies

RESIDENTIAL EXPOSURE TO PESTICIDES AND CHILDHOOD LEUKAEMIA: A SYSTEMATIC REVIEW AND META-ANALYSIS.

Van Maele-Fabry G, Lantin AC, Hoet P, Lison D.

Environ Int. 2011; 37: 280-291.

The objective of this study is to conduct a systematic review of published studies on the association between residential/household/domestic exposure to pesticides and childhood leukaemia, and to provide a quantitative estimate of the risk.

Publications in English were searched in MEDLINE (1966-31 December 2009) and from the reference list of identified publications. Extraction of relative risk (RR) estimates was performed independently by 2 authors using predefined inclusion criteria. Meta-rate ratio estimates (mRR) were calculated according to fixed and random-effect models. Separate analyses were conducted after stratification for exposure time windows, residential exposure location, biocide category and type of leukaemia.

RR estimates were extracted from 13 case-control studies published between 1987 and 2009. Statistically significant associations with childhood leukaemia were observed when combining all studies (mRR: 1.74, 95% CI: 1.37-2.21). Exposure during and after pregnancy was positively associated with childhood leukaemia, with the strongest risk for exposure during pregnancy (mRR: 2.19, 95% CI: 1.92-2.50). Other stratifications showed the greatest risk estimates for indoor exposure (mRR: 1.74, 95% CI: 1.45-2.09), for exposure to insecticides (mRR: 1.73, 95% CI: 1.33-2.26) as well as for acute non-lymphocytic leukaemia (ANLL) (mRR: 2.30, 95% CI: 1.53-3.45). Outdoor exposure and exposure of children to herbicides (after pregnancy) were not significantly associated with childhood leukaemia (mRR: 1.21, 95% CI: 0.97-1.52; mRR: 1.16, 95% CI: 0.76-1.76, respectively).

Conclusions: These findings support the assumption that residential pesticide exposure may be a contributing risk factor for childhood leukaemia but available data were too scarce for causality ascertainment. It may be opportune to consider preventive actions, including educational measures, to decrease the use of pesticides for residential purposes and particularly the use of indoor insecticides during pregnancy.

CHILDHOOD LEUKAEMIA, NUCLEAR SITES, AND POPULATION MIXING.
Kinlen L.
Br J Cancer 2011;104: 12-18.

The excess of childhood leukaemia (CL) in Seascale, near the Sellafield nuclear reprocessing site in rural NW England, suggested that an epidemic of an underlying infection, to which CL is a rare response, is promoted by marked population mixing (PM) in rural areas, in which the prevalence of susceptibles is higher than average. This hypothesis has been confirmed by 12 studies in non-radiation situations. Of the five established CL excesses near nuclear sites, four are associated with significant PM; in the fifth, the Krummel power station in Germany, the subject has not been thoroughly investigated.

EARLY LIFE EXPOSURE TO DIAGNOSTIC RADIATION AND ULTRASOUND SCANS AND RISK OF CHILDHOOD CANCER: CASE-CONTROL STUDY.
Rajaraman P, Simpson J, Neta G, Berrington de Gonzalez A, Ansell P, Linet MS, Ron E, Roman E.
BMJ. 2011; 342:d472.

The objective of this study is to examine childhood cancer risks associated with exposure to diagnostic radiation and ultrasound scans in utero and in early infancy (age 0-100 days).

2690 childhood cancer cases and 4858 age, sex, and region matched controls from the United Kingdom Childhood Cancer Study (UKCCS), born 1976-96 participated in this case-control study.

Logistic regression models conditioned on matching factors, with adjustment for maternal age and child's birth weight, showed no evidence of increased risk of childhood cancer with in utero exposure to ultrasound scans. Some indication existed of a slight increase in

risk after in utero exposure to x rays for all cancers (odds ratio 1.14, 95% confidence interval 0.90 to 1.45) and leukaemia (1.36, 0.91 to 2.02), but this was not statistically significant. Exposure to diagnostic x rays in early infancy (0-100 days) was associated with small, non-significant excess risks for all cancers and leukaemia, as well as increased risk of lymphoma (odds ratio 5.14, 1.27 to 20.78) on the basis of small numbers.

Conclusions: Although the results for lymphoma need to be replicated, all of the findings indicate possible risks of cancer from radiation at doses lower than those associated with commonly used procedures such as computed tomography scans, suggesting the need for cautious use of diagnostic radiation imaging procedures to the abdomen/pelvis of the mother during pregnancy and in children at very young ages.