

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

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## 1. Reviews

### **EXTREMELY LOW-FREQUENCY MAGNETIC FIELDS AND HEART DISEASE.**

Kheifets L, Ahlbom A, Johansen C, Feychting M, Sahl J, Savitz D.

*Scand J Work Environ Health. 2007; 33 : 5-12.*

The biologically based hypothesis that magnetic fields increase the risk of conditions related to cardiac arrhythmia and acute myocardial infarction but not chronic cardiovascular disease was initially supported by the results of an epidemiologic study. High rates of cardiovascular disease and relatively common exposure to magnetic fields made it an important public health question. Most of the epidemiologic studies that followed showed no effect. In this paper the basis for both this hypothesis and the epidemiologic studies that tested it are presented.

Conclusion: It was concluded that the evidence speaks against an etiologic relation between exposure to electric and magnetic fields and cardiovascular disease. This effort represents an interesting case study of a scientific inquiry that has been successfully resolved despite numerous methodological difficulties inherent in research on low-level environmental exposures.

### **POWER-FREQUENCY ELECTRIC AND MAGNETIC FIELDS IN THE LIGHT OF DRAPER ET AL. 2005.**

Swanson J, Vincent T, Kroll M, Draper G.

*Ann N Y Acad Sci. 2006;1076 : 318-330.*

Power-frequency electric and magnetic fields are produced wherever electricity is used; exposure is ubiquitous. Epidemiologic studies find an association between children living in homes with the highest magnetic fields and childhood leukemia, but bias is a possible alternative to a causal explanation. A new study, Draper et al., looks at residence close to high-voltage power lines, one source of exposure to such fields, and its design avoids any obvious bias. It finds elevated childhood leukemia rates, but extending too far from the power lines to be straightforwardly compatible with the existing literature. This leads to an examination of alternative explanations: magnetic fields, other physical factors, such as corona ions, the characteristics of the areas power lines pass through, bias, and chance.

The conclusion is that there is currently no single preferred explanation, but that this is a serious body of science that needs further work until an explanation is found.

## **HEALTH EFFECTS OF ELECTROMAGNETIC FIELDS.**

Expert Group on Health Effects of Electromagnetic Fields, Ireland  
*Department of Communications, Marine and Natural Resources, Ireland.*

Extremely low frequency (ELF) fields induce electric fields and currents in tissues that can result in involuntary nerve and muscle stimulation, but only at very high field strengths. These acute effects form the basis of international guidelines that limit exposure. However, fields found in our environment are so low that no acute effects result from them, except for small electric shocks that can occur from touching large conductive objects charged by these fields. No adverse health effects have been established below the limits suggested by international guidelines.

There is limited scientific evidence of an association between ELF magnetic fields and childhood leukaemia. This does not mean that ELF magnetic fields cause cancer, but the possibility cannot be excluded. However considerable research carried out in laboratories has not supported this possibility, and overall the evidence is considered weak, suggesting it is unlikely that ELF magnetic fields cause leukaemia in children. Nevertheless the evidence should not be discounted and so no or low cost precautionary measures to lower people's exposure to these fields have been suggested.

As a precautionary measure future power lines and power installations should be sited away from heavily populated areas to keep exposures to people low. The evidence for 50 Hz magnetic fields causing childhood leukaemia is too weak to require re-routing of existing lines, and so these measures should only apply to new lines.

Conclusion: The conclusions of the Expert Group are consistent with those of similar reviews conducted by authoritative national and international agencies.

## **2. Residential exposure**

### **MAGNETIC FIELDS AND ACUTE LEUKEMIA IN CHILDREN WITH DOWN SYNDROME.**

Mejia-Arangure JM, Fajardo-Gutierrez A, Perez-Saldivar ML, Gorodezky C, Martinez-Avalos A, Romero-uzman L, Campo-Martinez MA, Flores-Lujano J, Salamanca-Gomez F, Velasquez-Perez L.

*Epidemiology. 2007; 18 : 158-161.*

The authors analyzed effects of exposure to magnetic fields on the expression of acute leukemia in children with Down syndrome (who have a 20-fold higher risk of leukemia). They performed a case-control study that included 42 children with both acute leukemia and Down syndrome as cases and 124 healthy children with Down syndrome as controls. They obtained demographic information concerning the children and took spot measurements of magnetic fields at each residence. The odds ratio for direct measurements of magnetic fields  $\geq 6.00$  mG was 3.7 (95% confidence interval = 1.05-13.1).

Conclusion: The association between magnetic fields and leukemia in children with Down syndrome suggests the possibility of a causal role for magnetic fields in the etiology of leukemia among a genetically susceptible subgroup of children.

**RESIDENTIAL MAGNETIC FIELDS, MEDICATION USE, AND THE RISK OF BREAST CANCER.**

Davis S, Mirick DK.

*Epidemiology. 2007; 18 : 266-269.*

Exposure to 60-Hz magnetic fields may increase breast cancer risk by suppressing the nocturnal production of melatonin. The use of medications associated with reduced melatonin levels could modify this relationship. The authors recontacted participants in a population-based case-control study of residential magnetic field exposure and breast cancer risk and interviewed them regarding medication use during the 10 years before diagnosis. Cases were diagnosed between November 1992 and March 1995, and magnetic field levels were measured in the home at diagnosis. Medication use information was obtained by telephone interview from 558 cases and 588 controls. Breast cancer risk was not associated with exposure to residential magnetic fields, regardless of medication use.

Conclusion: These results support previous findings that magnetic field exposure does not increase breast cancer risk.

**INVESTIGATION OF THE SOURCES OF RESIDENTIAL POWER FREQUENCY MAGNETIC FIELD EXPOSURE IN THE UK CHILDHOOD CANCER STUDY.**

Maslanyj MP, Mee TJ, Renew DC, Simpson J, Ansell P, Allen SG, Roman E.

*J Radiol Prot. 2007; 27 : 41-58.*

There is an unexplained association between exposure to the magnetic fields arising from the supply and use of electricity, and increase in risk of childhood leukaemia. The UK Childhood Cancer Study (UKCCS) provides a large and unique source of information on residential magnetic field exposure in the UK. The purpose of this supplementary study was to investigate a sample of UKCCS homes in order to identify the particular sources that contribute to elevated time-averaged exposure. In all, 196 homes have been investigated, 102 with exposures estimated on the basis of the original study to be above 0.2 microT, and 21 higher than 0.4 microT, a threshold above which a raised risk has been observed. First, surveys were carried out outside the property boundaries of all 196 study homes, and then, where informed consent had been obtained, assessments were conducted inside the properties of 19 homes. The study found that low-voltage (LV) sources associated with the final electricity supply accounted together for 77% of exposures above 0.2 microT, and 57% of those above 0.4 microT. Most of these exposures were linked to net currents in circuits inside and/or around the home. High-voltage (HV) sources, including the HV overhead power lines that are the focus of public concern, accounted for 23% of the exposures above 0.2 microT, and 43% of those above 0.4 microT. Public health interest has focused on the consideration of precautionary measures that would reduce exposure to power frequency magnetic fields.

Conclusion: This study provides a basis for considering the options for exposure mitigation in the UK. For instance, in elevated-exposure homes where net currents are higher than usual, if it is possible to reduce the net currents, then the exposure could be reduced for a sizeable proportion of these homes. Further investigations would be necessary to determine whether this is feasible.

### **MAGNETIC FIELD EXPOSURE AND PROGNOSTIC FACTORS IN CHILDHOOD LEUKEMIA.**

Foliart DE, Mezei G, Iriye R, Silva JM, Ebi KL, Kheifets L, Link MP, Kavet R, Pollock BH.

*Bioelectromagnetics. 2007; 28 : 69-71.*

The authors examined the association between magnetic field (MF) exposure and the presence of prognostic risk factors among 482 children diagnosed with acute lymphoblastic leukemia (ALL) between 1996 and 2001. Personal 24-h MF measurements were obtained for 412 children; 386 children were included in analyses. There were no trends seen between increasing exposure to MF and the presence of adverse clinical and tumor-specific prognostic factors.

Conclusion: The results suggest that exposure to MF is not associated with the presence of unfavorable cytogenetic abnormalities in leukemic blast cells or with clinical factors at the time of diagnosis that predict poor survival.

### **TRANSMISSION LINES, EMF AND POPULATION MIXING.**

Jeffers D.

*Radiat Prot Dosimetry. 2006, Nov 15 Epub.*

Draper et al. found that the incidence of childhood leukaemia was slightly elevated for children living at distances of 200-600 m from high-voltage transmission lines. This elevation cannot be explained by EMF exposure and it is suggested that it may be due to population mixing in housing developments which followed the construction of the lines.

Conclusion: Population mixing may explain the slightly increased risk of leukaemia for children living 200 – 600 m from transmission lines.

### **SURVEY OF RESIDENTIAL EXTREMELY-LOW-FREQUENCY MAGNETIC FIELD EXPOSURE AMONG CHILDREN IN TAIWAN.**

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

*Environment International 2007; 33 : 233-238..*

This survey estimated the extremely-low-frequency magnetic field (ELF-MF) exposure in households with children under the age of 7 years in Taiwan. To select a representative sample, we used the probability proportional to size sampling technique and simple random cluster sampling technique to select study districts in each city/county of Taiwan. A total of 40 districts were selected and all households with children aged less than 7 (n=4184) were visited and solicited for in-home measurements. Four trained interviewers carried out spot-measurements in rooms of each selected household during a two-year period. A questionnaire inquiring residential characteristics and nearby power facilities was also administered to a parent or caregiver. ELF-MF measurements were performed in a total of 2214 households (53% participation rate). Controlling for participation rate, the weighted overall mean magnetic field exposure was estimated at 0.121 (standard deviation 0.185) micro-Tesla (microT) (range 0.010-3.304 microT). Mean exposures were higher than 0.3 and 0.4 microT in an estimated 7.3% (n=159) and 5.4% (n=115) of the households, respectively. There was a substantial agreement between overall mean residential exposure and exposure measured in children's bedrooms. In a multivariate logistic regression model, we noted that buildings with advanced age, buildings for both residential and commercial uses, and buildings close to power facilities were more likely a to have mean exposure above 0.4 microT.

Conclusion: This survey results indicate that residential ELF-MF exposure is likely to be higher for children in Taiwan than for children in Europe and North America.

### **3. Occupational exposure**

#### **OCCUPATIONAL EXPOSURE TO LOW FREQUENCY MAGNETIC FIELDS AND DEMENTIA: A CASE-CONTROL STUDY.**

Seidler A, Geller P, Nienhaus A, Bernhardt T, Ruppe I, Eggert S, Hietanen M, Kauppinen T, Frolich L.

*Occup Environ Med. 2007; 64 : 108-114.*

Several studies point to a potential aetiological relevance to dementia of exposure to low-frequency magnetic fields, but the evidence is inconclusive. From 23 general practices, 195 patients with dementia were recruited. Of these, 108 had possible Alzheimer's disease, 59 had possible vascular dementia and 28 had secondary or unclassified dementia. A total of 229 controls were recruited: 122 population controls and 107 ambulatory patients free from dementia. Data were gathered in a structured personal interview; in cases, the interview was administered to the next of kin. Exposure to low-frequency electromagnetic fields was assessed by expert rating. To identify occupations suspected to be associated with dementia, major occupations were a priori formed. Odds ratios were calculated using logistic regression, to control for age, region, sex, dementia in parents and smoking. Exposure to magnetic fields was not significantly associated with dementia; restriction of the analysis to cases with possible Alzheimer's disease or possible vascular dementia did not lead to statistically significant results. We found an increased risk of dementia in blue-collar occupations (electrical and electronics workers, metal workers, construction workers, food and beverage processors and labourers).

Conclusion: This study does not support a strong association between occupational exposure to low-frequency magnetic fields and dementia. Further studies should consider the relationship between blue-collar work and the late development of dementia.

#### **OCCUPATIONAL EXPOSURE TO POWER FREQUENCY MAGNETIC FIELDS AND RISK OF NON-HODGKIN LYMPHOMA.**

Karipidis K, Benke G, Sim M, Fritschi L, Yost M, Armstrong B, Hughes AM, Grulich A, Vajdic CM, Kaldor J, Kricker A.

*Occup Environ Med. 2007; 64 : 25-29.*

The objectives of this study are to investigate the risk of non-Hodgkin lymphoma (NHL) using a job-exposure matrix (JEM) to assess exposure to occupational magnetic fields at the power frequencies of 50/60 Hz. The study population consisted of 694 cases of NHL, 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 occupational history was given by each subject. Exposure to power frequency magnetic fields was estimated using a population-based JEM which was specifically developed in the United States to assess occupational magnetic field exposure. The cumulative exposure distribution was divided into quartiles and adjusted odds ratios were calculated using the lowest quartile as the referent group. For the total work history, the odds ratio (OR) for

workers in the upper quartile of exposure was 1.48 (95% CI 1.02 to 2.16) compared to the referent (p value for trend was 0.006). When the exposure was lagged by 5 years the OR was 1.59 (95% CI 1.07 to 2.36) (p value for trend was 0.003). Adjusting for other occupational exposures did not significantly alter the results. Conclusion: These findings provide weak support for the hypothesis that occupational exposure to 50/60 Hz magnetic fields increases the risk of NHL.

**OCCUPATION AND BREAST CANCER RISK IN POLISH WOMEN: A POPULATION-BASED CASE-CONTROL STUDY.**

Peplonska B, Stewart P, Szeszenia-Dabrowska N, Rusiecki J, Garcia-Closas M, Lissowska J, Bardin-ikolajczak A, Zatonski W, Gromiec J, Brzezniacki S, Brinton LA, Blair A.

*Am J Ind Med. 2007; 50 : 97-111.*

This population-based case-control study included 2,386 incident breast cancer cases diagnosed in 2000-2003, and 2,502 controls. Lifetime occupational histories and information on other potential breast cancer risk factors were obtained through personal interviews. Conditional logistic regression analyses calculated odds ratios (ORs) associated with various occupations and industries after control for potential confounders. The authors found statistically significant excesses of breast cancer among engineers (OR=2.0; 95% CI: 1.0-3.8), economists (2.1; 1.1-3.8), sales occupations-retail (1.2; 1.0-1.5), and other sales occupations (1.2; 1.0-1.5). Industries showing significantly elevated risks included special trade contractors (2.2; 1.2-4.3), electronic and electric equipment manufacturers (1.7; 1.1-2.7); and public administration/general government n.e.c. (2.7; 1.3-5.7). Each of these findings was supported by a statistically significant positive trend for duration of employment (P<0.05). A decreased breast cancer risk was observed in janitors and cleaners (0.7; 0.5-0.8).

Conclusion: In this study, few associations for breast cancer and occupations or industries were found. The suggestive findings for the electronic and electric equipment manufacturing industry and for the occupations with potential exposure to magnetic fields deserve further evaluation.

**OCCUPATIONAL EXPOSURE TO ELECTROMAGNETIC FIELD AND BREAST CANCER RISK IN A LARGE, POPULATION-BASED, CASE-CONTROL STUDY IN THE UNITED STATES.**

McElroy JA, Egan KM, Titus-Ernstoff L, Anderson HA, Trentham-Dietz A, Hampton JM, Newcomb PA.

*J Occup Environ Med. 2007;49 : 266-274.*

The objective of this study was to evaluate women who were occupationally exposed to electromagnetic fields (EMF) and breast cancer risk. Women diagnosed with breast cancer (n=6213) and randomly selected age-matched control subjects (n=7390) provided breast cancer risk factor information and occupational history. A qualified industrial hygienist classified each job for EMF exposure as background, low, medium, or high. When compared with the referent of background exposure, the odds ratio adjusted for age and state of residence was 1.06 (95% CI=0.99-1.14) for low exposure, 1.09 (95% CI=0.96-1.23) for medium exposure, and 1.16 (95% CI=0.90-1.50) for high exposure.

Conclusion: These findings suggest that exposure to EMF in the workplace may be associated with a slight elevation in breast cancer risk.

#### **4. Childhood leukaemia studies**

##### **RISK FACTORS FOR ACUTE LEUKEMIA IN CHILDREN: A REVIEW.**

BELSON M, KINGSLEY B, HOLMES A.

*Environ Health Perspect.* 2007; 115 : 138–145.

Although overall incidence is rare, leukemia is the most common type of childhood cancer. It accounts for 30% of all cancers diagnosed in children younger than 15 years. Within this population, acute lymphocytic leukemia (ALL) occurs approximately five times more frequently than acute myelogenous leukemia (AML) and accounts for approximately 78% of all childhood leukemia diagnoses. Epidemiologic studies of acute leukemias in children have examined possible risk factors, including genetic, infectious, and environmental, in an attempt to determine etiology. Only one environmental risk factor (ionizing radiation) has been significantly linked to ALL or AML. Most environmental risk factors have been found to be weakly and inconsistently associated with either form of acute childhood leukemia. This review focuses on the demographics of childhood leukemia and the risk factors that have been associated with the development of childhood ALL or AML. The environmental risk factors discussed include ionizing radiation, non-ionizing radiation, hydrocarbons, pesticides, alcohol use, cigarette smoking, and illicit drug use. Knowledge of these particular risk factors can be used to support measures to reduce potentially harmful exposures and decrease the risk of disease. The authors also review genetic and infectious risk factors and other variables, including maternal reproductive history and birth characteristics.

##### **INFECTIOUS ETIOLOGIES OF CHILDHOOD LEUKEMIA: PLAUSIBILITY AND CHALLENGES TO PROOF**

O'Connor SM, Boneva RS.

*Environ Health Perspect.* 2007; 115 : 146–150.

Infections as well as environmental exposures are proposed determinants of childhood acute lymphoblastic leukemia (ALL), particularly common precursor B-cell ALL (cALL). Lines of investigation test hypotheses that cALL is a rarer result of common infection, that it results from uncommon infection, or that it ensues from abnormal immune development; perhaps it requires a preceding prenatal or early childhood insult. Ideally, studies should document that particular infections precede leukemia and induce malignant transformation. However, limited detection studies have not directly linked specific human or nonhuman infectious agents with ALL or cALL. Primarily based on surrogate markers of infectious exposure, indirect evidence from ecologic and epidemiologic studies varies widely, but some suggest that infancy or early childhood infectious exposures might protect against childhood ALL or cALL. Several others suggest that maternal infection during pregnancy might increase risk or that certain breast-feeding practices decrease risk. To date, evidence cannot confirm or refute whether at least one infection induces or is a major co-factor for developing ALL or cALL, or perhaps actually protects against disease. Differences in methodology and populations studied may explain some inconsistencies. Other challenges to proof include the likely time lag between infection and diagnosis, the ubiquity of many infections, the influence of age at infection, and the limitations in laboratory assays; small numbers of cases, inaccurate background leukemia rates, and difficulty tracking mobile populations further affect cluster investigations. Nevertheless, existing evidence partially supports plausibility and warrants further investigation into potential infectious determinants of ALL and cALL, particularly in the context of multifactorial or complex systems.

**ACTIVATION OF MATERNAL EPSTEIN-BARR VIRUS INFECTION AND RISK OF ACUTE LEUKEMIA IN THE OFFSPRING.**

Tedeschi R, Bloigu A, Ogmundsdottir HM, Marus A, Dillner J, dePaoli P, Gudnadottir M, Koskela P, Pukkala E, Lehtinen T, Lehtinen M.  
*Am J Epidemiol.* 2007; 165 : 134-137.

After identifying an association between maternal Epstein-Barr virus (EBV) reactivation and acute lymphoblastic leukemia (ALL), the authors analyzed a nested case-control study within Finnish and Icelandic maternity cohorts with 7 million years of follow-up to confirm EBV's role in ALL. Offspring of 550,000 mothers were followed up to age 15 years during 1975-1997 by national cancer registries to identify leukemia cases. Mothers of cases and three quarters of matched mothers of controls were identified by national population registers. First-trimester sera from mothers of 304 ALL cases and 39 non-ALL cases and from 943 mothers of controls were analyzed for antibodies to viral capsid antigen, early antigen, and EBV transactivator protein ZEBRA. Relative risk, estimated as odds ratio (95% confidence interval), was adjusted for birth order and sibship size. Combining early antigen and/or ZEBRA immunoglobulin G antibodies with the presence of viral capsid antigen immunoglobulin M antibodies did not increase the estimate for ALL risk for viral capsid antigen immunoglobulin M alone (odds ratio = 1.9, 95% confidence interval: 1.2, 3.0). Both ZEBRA immunoglobulin G antibodies and viral capsid antigen immunoglobulin M antibodies were associated with an increased risk of non-ALL in the offspring (odds ratio = 4.5, 95% confidence interval: 1.3, 16; odds ratio = 5.6, 95% confidence interval: 1.1, 29, respectively), suggesting EBV reactivation in the mothers of non-ALL cases. Conclusion: EBV reactivation may be associated with a proportion of childhood leukemia.

**MATERNAL ILLNESS AND DRUG/MEDICATION USE DURING THE PERIOD SURROUNDING PREGNANCY AND RISK OF CHILDHOOD LEUKEMIA AMONG OFFSPRING.**

Kwan ML, Metayer C, Crouse V, Buffler PA.  
*Am J Epidemiol.* 2007; 165 : 27-35.

Maternal illness and drug/medication use (prescription, over-the-counter, and illicit) during pregnancy might be related to childhood leukemia risk. These issues were evaluated using data (1995-2002) from the Northern California Childhood Leukemia Study. The authors selected 365 children under age 15 years who had been diagnosed with incident leukemia and birth certificate controls who were matched to them on age, sex, Hispanic ethnicity, and maternal race. Data on maternal illnesses and drug use from before pregnancy through breastfeeding were obtained by interview with the biologic mother and were analyzed by conditional logistic regression. Maternal history of influenza/pneumonia was associated with a statistically significant increased risk of acute lymphoblastic leukemia (ALL) in the offspring (odds ratio (OR) = 1.89, 95% confidence interval (CI): 1.24, 2.89), although the risk was nonsignificant for common ALL (OR = 1.41, 95% CI: 0.75, 2.63). A similar pattern of increased risk was found for history of sexually transmitted disease. Use of iron supplements was indicative of decreased ALL risk (OR = 0.67, 95% CI: 0.47, 0.94).

Conclusion: Observing an increased risk of leukemia in children of mothers reporting a history of influenza/pneumonia and sexually transmitted disease around the time of pregnancy suggests that maternal infection might contribute to the etiology of leukemia. Furthermore, maternal iron supplement use may be protective against childhood leukemia.

**CHILDHOOD ACUTE LYMPHOBLASTIC LEUKEMIA AND INFECTIONS IN THE FIRST YEAR OF LIFE: A REPORT FROM THE UNITED KINGDOM CHILDHOOD CANCER STUDY.**

Roman E, Simpson J, Ansell P, Kinsey S, Mitchell CD, McKinney PA, Birch JM, Greaves M, Eden T; United Kingdom Childhood Cancer Study Investigators.  
*Am J Epidemiol.* 2007; 165 : 496-504.

The United Kingdom Childhood Cancer Study was designed to examine the relation between childhood cancer and preceding exposure to infectious diseases. The authors analyzed the relation between diagnosis (1991-1996) of acute lymphoblastic leukemia (ALL) at ages 2-5 years and clinically diagnosed infections in infancy. Almost all study children (96% of both cases and controls) were taken to a general practitioner for a non-immunization-associated visit at least once before their first birthday. Children diagnosed with ALL had significantly more clinically diagnosed infectious episodes in infancy than did controls; the average number of episodes was 3.6 (95% confidence interval (CI): 3.3, 3.9) versus 3.1 (95% CI: 2.9, 3.2). This case-control difference was most apparent in the neonatal period (< or =1 month); 18% of controls and 24% of ALL cases were diagnosed with at least one infection (odds ratio = 1.4, 95% CI: 1.1, 1.9;  $p < 0.05$ ). Cases who had more than one neonatal infectious episode tended to be diagnosed with ALL at a comparatively young age; the mean age at ALL diagnosis was 37.7 months for cases with two or more episodes versus 45.3 months for cases with only one episode or none ( $p < 0.01$ ).

Conclusion: These findings support the hypothesis that a dysregulated immune response to infection in the first few months of life promotes transition to overt ALL later in childhood.

**ROADS, RAILWAYS, AND CHILDHOOD CANCERS.**

Knox EG.

*Journal of Epidemiology and Community Health* 2006; 60 :136-141.

The objectives of this study are to locate geographical sources of engine exhaust emissions in Great Britain and to link them with the birth addresses of children dying from cancer. To estimate the cancer initiating roles of nearby roads and railways and to measure effective ranges. Birth and death addresses of all children born between 1955 and 1980 in Great Britain, and dying from leukaemia or other cancer during those years, were linked to locations of railway stations, bus stations, ferry terminals, railways, roads, canals, and rivers. Nearest distances to births and deaths were measured, and migration data relating to children who had moved house were analysed. Excesses of close to hazard birth addresses, compared with close to hazard death addresses, indicate a high prenatal or early postnatal risk of cancer initiation. Child cancer birth and death addresses and their map references were extracted from an earlier inquiry. Map references of putative hazards were downloaded from the Ordnance Survey national digital map of Great Britain. These data are recorded to a precision of one metre and have ground accuracies around 20 metres. Significant birth excesses were found within short distances of bus stations, railway stations, ferries, railways, and A,B class roads, with a relative risk of 2.1 within 100 m, tapering to neutral after 3.0 km. About 24% of child cancers were attributable to these joint birth proximities. Roads exerted the major effect.

Conclusion: Child cancer initiations are strongly determined by prenatal or early postnatal exposures to engine exhaust gases, probably through maternal inhalation and accumulation of carcinogens over many months. The main active substance is probably 1,3-butadiene.

## 5. Experimental research

### **FETAL EXPOSURE TO LOW FREQUENCY ELECTRIC AND MAGNETIC FIELDS.**

Cech R, Leitgeb N, Pediaditis M.

*Phys Med Biol.* 2007; 52 : 879-888.

To investigate the interaction of low frequency electric and magnetic fields with pregnant women and in particular with the fetus, an anatomical voxel model of an 89 kg woman at week 30 of pregnancy was developed. Intracorporal electric current density distributions due to exposure to homogeneous 50 Hz electric and magnetic fields were calculated and results were compared with basic restrictions recommended by ICNIRP guidelines. It could be shown that the basic restriction is met within the central nervous system (CNS) of the mother at exposure to reference level of either electric or magnetic fields. However, within the fetus the basic restriction is considerably exceeded. Revision of reference levels might be necessary.