

# Overview of the epidemiologic studies on the health effects of ELF magnetic and electric fields published in the third trimester of 2020.

---

Dr. Maurits De Ridder  
Public Health Department  
Ghent University

---

## 1. Reviews

**Scientific advisory report nr. 9431 from the Superior Health Council of Belgium regarding the impact of exposure to magnetic fields from the electricity supply on the health of the population.** Superior Health Council of Belgium, 08/09/2020.

<https://www.health.belgium.be/en/report-9431-exposure-magnetic-fields>

The recent research and renewed analyzes of all research data on the exposure to magnetic fields of the electricity supply in the residential environment in relation to health do not change the general conclusion of the 2008 advice of the Superior Health Council. When exposed to field strengths greater than 0.3 to 0.4 microtesla, an increase in the incidence of childhood leukemia of the order of a factor of 2 is found. Foreign data, correspond to about one additional case of illness every two years. Whether the magnetic fields are the cause of the increased incidence of childhood leukemia is uncertain, but cannot be excluded. It is known that magnetic fields, at least with relatively short-term and relatively high exposure, can make changes in body cells. But how those changes play a role in a mechanism that could help understand causation is unclear. Incidentally, the exposure of the population in general is significantly lower than the stated values of 0.3 and 0.4  $\mu\text{T}$ , according to recent European research and earlier Belgian research.

The study is inconclusive about other disorders in children or adults in connection with exposure to magnetic fields from the electricity supply. Most research has focused on neurodegenerative disorders, which mainly affect older adults. If an association already exists, the additional risk of these conditions is very limited.

**Amyotrophic lateral sclerosis, occupational exposure to extremely low frequency magnetic fields and electric shocks: a systematic review and meta-analysis.** Hamed Jalilian, Kamran Najafi, Yahya Khosravi, Martin Rösli. *Rev Environ Health*. 2020 Sep 18.

Exposure to extremely low frequency magnetic fields (ELF-MF) and electric shocks occurs in many workplaces and occupations but it is unclear whether any of these exposures cause Amyotrophic lateral sclerosis (ALS). The aim of this systematic review and meta-analysis is to explore whether occupational exposure to ELF-MF and/or electric shocks are risk factor for ALS. The authors searched PubMed, Embase, and Web of Science databases up to the end of 2019. Pooled risk estimates were calculated using random-effects meta-analysis including exploration of the sources of heterogeneity between studies and publication bias. Twenty-seven publications fulfilled the inclusion criteria. A weak, significant, association between occupational exposure to ELF-MF and the risk of ALS (RRPooled estimate: 1.20; 95%CI: 1.05, 1.38) with moderate to high heterogeneity ( $I^2=66.3\%$ ) and indication of publication bias (PEgger's test=0.03) was found. No association was observed between occupational exposure to electric shocks and risk of ALS (RRPooled estimate: 0.97; 95%CI: 0.80, 1.17) with high heterogeneity ( $I^2=80.5\%$ ), and little indication for publication bias (PEgger's test=0.24).

Conclusions: The findings indicate that occupational exposure to ELF-MF, but not electric shocks, might be a risk factor for ALS. However, given the moderate to high heterogeneity and potential publication bias, the results should be interpreted with caution.

## **2. Residential exposure**

### **Extremely Low-Frequency Magnetic Fields and the Risk of Childhood B-Lineage Acute Lymphoblastic Leukemia in a City With High Incidence of Leukemia and Elevated**

**Exposure to ELF Magnetic Fields.** Juan C Núñez-Enríquez, Víctor Correa-Correa, Janet Flores-Lujano, María L Pérez-Saldivar, Elva Jiménez-Hernández, Jorge A Martín-Trejo , Laura E Espinoza-Hernández, Aurora Medina-Sanson, Rocío Cárdenas-Cardos, Luz V Flores-Villegas, José G Peñaloza-González, José R Torres-Nava, Rosa M Espinosa-Elizondo, Raquel Amador-Sánchez, Roberto Rivera-Luna, Juan J Dosta-Herrera, Javier A Mondragón-García, Juana E González-Ulibarri, Sofía I Martínez-Silva, Gilberto Espinoza-Anrubio, David A Duarte-Rodríguez, Luis R García-Cortés, Ana E Gil-Hernández, Juan M Mejía-Aranguré. *Bioelectromagnetics*. 2020 Sep 23.

The aim of this study was to investigate the association between ELF-MF exposure and the risk of B-lineage acute lymphoblastic leukemia (B-ALL). A case-control study was conducted in Mexico City during the period from 2010 to 2011. Residential 24-h ELF-MF measurements were obtained for 290 incident B-ALL patients and 407 controls, aged less than 16 years. Controls were frequency-matched by sex, age ( $\pm 18$  months), and health institution. The adjusted odds ratios (aOR) and 95% confidence intervals (CIs) were calculated. ELF-MF exposure at  $< 0.2 \mu\text{T}$  was used to define the reference group. ELF-MF exposure at  $\geq 0.3 \mu\text{T}$  was observed in 11.3% of the controls. Different ELF-MF intensity cut-off values were used to define the highest exposure category; the highest exposure category for each cut-off value was associated with an increased risk of B-ALL compared with the corresponding lower exposure categories. The aORs were as follows:  $\geq 0.2 \mu\text{T} = 1.26$  (95% CI: 0.84-1.89);  $\geq 0.3 \mu\text{T} = 1.53$  (95% CI: 0.95-2.48);  $\geq 0.4 \mu\text{T} = 1.87$  (95% CI: 1.04-3.35);  $\geq 0.5 \mu\text{T} = 1.80$  (95% CI 0.95-3.44);  $\geq 0.6 \mu\text{T} = 2.32$  (95% CI: 1.10-4.93). ELF-MF exposure as a continuous variable (per  $0.2 \mu\text{T}$  intervals) was associated with B-ALL risk (aOR = 1.06; 95% CI: 1.01-1.12).

Conclusions: In the present study, the proportion of children exposed to  $\geq 0.3 \mu\text{T}$  is among the highest reported worldwide. Additionally, an ELF-MF exposure  $\geq 0.4 \mu\text{T}$  may be associated with the risk of B-ALL.

## **3. Occupational exposure**

None

## **4. Human experimental studies**

None

## **5. Human experimental studies**

**Extremely low frequency electromagnetic field exposure measurement in the vicinity of wind turbines.** Alexias Aris, Kiouvrekis Yiannis, Tyrakis Charilaos, Mohammed Alkhorayef, Abdelmoneim Sulieman, Tsougos Ioannis, Theodorou Kiki, Kappas Constantin. *Radiat Prot Dosimetry*. 2020 Jul 17;189(3):395-400.

There is an exponential growth of public concern worldwide regarding the exposure to electromagnetic fields (EMF) generated by wind turbines. The high concern of the general population enhances the fact that EMF exposure remains a crucial issue that demands specific actions and reliable data to evaluate possible health hazards. EMF exposure measurements were conducted in two wind farm (W/F) areas in Greece. The magnetic field strength concentrated in the proximity of 22 wind turbines (20 type of Gamesa Eolica Siemens of total power of 17 MW and 2 type of E53 Enercon, 800 KW each). Measurements were conducted using a Narda-NBM-550 basic unit (Narda Safety Test Solutions Company) using EHP-50F probe. The EMF exposure measurements were processed applying the weighted peak method (WPM), according to the 2013/35/EU Directive. WPM provides correction of the measured value of pulse signals, taking into account the phases of the various frequency components. The data were classified under two scenarios of EMF exposure: 'high wind' and 'low wind' conditions. The variation of the magnetic field strength was calculated between 1.13 and 1.42% (WPM). Measurements indicate that the intensity of the emitted magnetic field at the base of the wind turbines, in both high and low wind conditions, was relatively low (mean = 0.146  $\mu$ T), while decreasing rapidly with increasing distance and reaching background values 6 m from the base.

Conclusions: The results of the present study indicate that EMF levels are similar or even lower compared to those in urban areas and well below the national and international safety limits.

**Extremely Low-Frequency Magnetic Fields Exposure Measurement during Lessons in Elementary Schools.** JinKyung Park , EunHye Jeong , GyeongAe Seomun. *Int J Environ Res Public Health*. 2020 Jul 22;17(15):5284.

Schools are an important place for children's exposure to electromagnetic fields, which may cause adverse health effects. To better understand environmental extremely low-frequency magnetic fields (ELF-MFs) exposure among elementary school students, the authors measured numeric values of ELF-MFs in five classrooms at four schools during digital learning class hours. The measurement of ELF-MFs was taken with an EMDEX II field analyzer. Specifically the level of exposure to ELF-MFs for each student's seating position in the classroom was examined. The results showed that ELF-MFs exposure levels were lower than those in the International Commission on Non-Ionizing Radiation Protection guidelines. However, there were significant differences in the level of magnetic field exposure at each school and at each student's seat. The exposure to ELF-MFs at students' seat positions was mostly caused by electrical appliances, electronic wiring, and distribution boxes, but the exposure level decreased as the distance increased. Therefore, it is important to design safe and appropriate environments for digital learning in schools, such as proper seating arrangements, to avoid ELF-MFs exposure to students as much as possible.

Conclusions: The results showed that ELF-MFs exposure levels were low.

## **6. Leukaemia studies**

### **Residential proximity to agriculture and risk of childhood leukemia and central nervous system tumors in the Danish national birth cohort.**

Patel DM, Gyldenkærne S, Jones RR, Olsen SF, Tikellis G, Granström C, Dwyer T, Stayner LS, Ward MH. *Environ Int.* 2020 Jul 22;143:105955.

Living in an agricultural area or on farms has been associated with increased risk of childhood cancer but few studies have evaluated specific agricultural exposures. The authors prospectively examined residential proximity to crops and animals during pregnancy and risk of childhood leukemia and central nervous system (CNS) tumors in Denmark. The Danish National Birth Cohort (DNBC) consists of 91,769 pregnant women (96,841 live-born children) enrolled in 1996-2003. For 61 childhood leukemias and 59 CNS tumors <15 years of age that were diagnosed through 2014 and a ~10% random sample of the live births (N = 9394) with geocoded addresses, pregnancy addresses were linked to crop fields and animal farm locations and estimated the crop area (hectares [ha]) and number of animals (standardized by their nitrogen emissions) by type within 250 meters (m), 500 m, 1000 m, and 2000 m of the home. Pesticide applications (grams, active ingredient) were estimated based on annual sales data for nine herbicides and one fungicide that were estimated to have been applied to >30% of the area of one or more crop. The authors used Cox proportional hazard models (weighted to the full cohort) to estimate hazard ratios (HR) and 95% confidence intervals (CI) for the association of childhood leukemia and CNS tumors with crop area, animals, and pesticide applications adjusted for gender and maternal age. Sixty-three percent of mothers had crops within 500 m of their homes during pregnancy; winter and spring cereals were the major crop types. Compared to mothers with no crops <500 m, the authors found increasing risk of childhood leukemia among offspring of mothers with increasing crop area near their home (highest tertile >24 ha HR: 2.0, CI:1.02-3.8), which was stronger after adjustment for animals (within 1000 m) (HR: 2.6, CI:1.02-6.8). They also observed increased risk for grass/clover (highest tertile >1.1 ha HR: 3.1, CI:1.2-7.7), peas (>0 HR: 2.4, CI: 1.02-5.4), and maize (>0 HR: 2.8, CI: 1.1-6.9) in animal-adjusted models. They found no association between number of animals near homes and leukemia risk. Crops, total number of animals, and hogs within 500 m of the home were not associated with CNS tumors but an increased risk was observed with >median cattle compared with no animals in crop-adjusted models (HR = 2.2, CI: 1.02-4.9). In models adjusted for total animals, the highest tertiles of use of three herbicides and one fungicide were associated with elevated risk of leukemia but no associations were statistically significant; there were no associations with CNS tumors.

Conclusions: Risk of childhood leukemia was associated with higher crop area near mothers' homes during pregnancy; CNS tumors were associated with higher cattle density. Quantitative estimates of crop pesticides and other agricultural exposures are needed to clarify possible reasons for these increased risks.

### **Agricultural crop density in the municipalities of France and incidence of childhood leukemia: An ecological study.**

Astrid Coste, Stéphanie Goujon, Laure Faure, Denis Hémon, Jacqueline Clavel. *Environ Res.* 2020 Aug;187:109517.

Pesticide exposure is suspected to play a role in the etiology of childhood leukemia (AL). Various sources of exposure have been explored, but few studies have investigated the risk of childhood AL in relation to residential exposure to agricultural pesticides. Since around 50% of France is agricultural land, with marked pesticide use, France is a suitable location to investigate for an

association. 11,487 cases of AL diagnosed in children aged 0-14 years were registered by the French National Registry of Childhood Hematological Malignancies over 1990-2014. National agricultural census data for 1990, 2000 and 2010 were used to estimate the densities of the most common crops in France. The incidence of AL was estimated in the 35,512 municipalities, by age and gender, and 3 observation periods, and expressed as the standardized incidence ratio (SIR). A moderate log-linear association was observed between viticulture density and the incidence of AL, with a 3% increase in SIR for a 10% increase in viticulture density (SIRR = 1.03; 95%CI [1.00-1.06]). The association remained for lymphoblastic AL but not for myeloid AL. The association was stable after stratification by geographic area, age and period, and after adjustment on UV radiation and a French deprivation index. No consistent association was observed for other crop types.

Conclusions: This nationwide study shows a moderate increase in incidence of childhood AL in municipalities where viticulture is common. Future individual studies are needed to know whether this observation is confirmed and related to particular use of pesticides.