

Overview of the epidemiologic studies on the health effects of ELF magnetic and electric fields published in the second trimester of 2021.

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1. Reviews

Recent Research on EMF and Health Risk - Fifteenth report from Scientific Swedish Radiation Safety Authority (SSM), Scientific Council on

Electromagnetic Fields, 2020 SSM's Scientific Council on Electromagnetic Fields: Huss A, Poulsen AH, Dasenbrock C, van Rongen E, Danker-Hopfe H, Mjönes L, Moberg L, Scarfi MR, Rööslö M. *SSM Report number: 2021:08, ISSN: 2000-0456, March 2020. Available at www.stralsakerhetsmyndigheten.se.*

The present report is number fifteen in the series and covers studies published from January 2019 up to and including December 2019. No new findings that clearly change the suspicion of a causal link between weak low-frequency magnetic fields and childhood leukaemia have emerged in the report. Also the current reports do not resolve whether the consistently observed association between ELF magnetic field (ELF-MF) exposure and childhood leukaemia in epidemiology is causal or not. One study addressed the question whether occupational ELF-MF exposure or electrical shocks could underlie observed increased risks of amyotrophic lateral sclerosis, and found both to be possible risk factors. This is of interest as previous studies rather identified one or the other exposure as underlying observed associations. An Italian study addressing exposure from high voltage power lines and Alzheimer's and Parkinson's disease did not provide strong support for associations. A large Canadian study reported very slightly increased risks of birth defects in children born to mothers exposed to high voltage power lines. The number of human experimental studies continued to be very low with just one study in the current reporting period. This study systematically analysed thresholds for phosphene perception and showed that, independent from location of stimulation, perception threshold is lowest for 16 Hz. But the thresholds differ between stimulation locations.

Exposure to extremely low-frequency magnetic fields and childhood cancer: A systematic review and meta-analysis. GyeongAe Seomun, Juneyoung Lee, Jinkyung Park. *PLoS One. 2021 May 14;16(5):e0251628.*

This study assessed the association between ELF-MFs and childhood cancer through a systematic review and meta-analysis. Three databases were searched in January 2020. A meta-analysis was conducted for the association between the ELF-MFs exposure level and childhood cancer. A total of 33 studies were identified. Thirty studies with 186,223 participants were included in the meta-analysis. Children exposed to 0.2-, 0.3-, and 0.4- μ T ELF-MFs had a 1.26 (95% confidence interval [CI] 1.06-1.49), 1.22 (95% CI 0.93-1.61), and 1.72 (95% CI 1.25-2.35) times higher odds of childhood leukemia. In childhood brain tumors, children exposed to 0.2- μ T had a 0.95 (95% CI 0.59-1.56) times higher odds, and those exposed to 0.4- μ T ELF-MFs had a 1.25 (95% CI 0.93-1.61). Children exposed to 0.2- and 0.4- μ T ELF-MFs had a 1.10 (95% CI 0.70-1.75) and 2.01 (95% CI 0.89-4.52) times higher odds of any childhood cancers.

Conclusions: Significant associations were observed between exposure to ELF-MFs and childhood leukemia. Furthermore, a possible dose-response effect was also observed.

Residential exposure to electromagnetic fields and risk of amyotrophic lateral sclerosis: a dose-response meta-analysis. Tommaso Filippini, Elizabeth E Hatch, Marco Vinceti. *Sci Rep.* 2021 Jun 7;11(1):11939.

Amyotrophic lateral sclerosis (ALS) is neurodegenerative disease characterized by a fatal prognosis and still unknown etiology. Some environmental risk factors have been suggested, including exposure to magnetic fields. Studies have suggested positive associations in occupationally-exposed populations, but the link with residential exposure is still debated as is the shape of such relation. Due to recent availability of advanced biostatistical tools for dose-response meta-analysis, the authors carried out a systematic review in order to assess the dose-response association between ALS and residential exposure to magnetic fields. They performed an online literature searching through April 30, 2021. Studies were included if they assessed residential exposure to electromagnetic fields, based either on distance from overhead power lines or on magnetic field modelling techniques, and if they reported risk estimates for ALS. Six eligible studies were identified, four using distance-based and one modelling-based exposure assessment, and one both methods. Both distance-based and particularly modelling-based exposure estimates appeared to be associated with a decreased ALS risk in the highest exposure category, although estimates were very imprecise (summary RRs 0.87, 95% CI 0.63-1.20, and 0.27, 95% CI 0.05-1.36). Dose-response meta-analysis also showed little association between distance from power lines and ALS, with no evidence of any threshold.

Conclusions: The authors found scant evidence of a positive association between residential magnetic fields exposure and ALS, although the available data were too limited to conduct a dose-response analysis for the modelled magnetic field estimates or to perform stratified analyses.

2. Residential exposure

Modern health worries and idiopathic environmental intolerance attributed to electromagnetic fields are associated with paranoid ideation. Renáta Szemerszky, Zsuzsanna Dömötör, Michael Witthöft, Ferenc Köteles. *J Psychosom Res.* 2021 Jul;146:110501.

Paranoid ideation is assumed to characterize worries about possible harmful effects of modern technologies (MHWs) and idiopathic environmental intolerances (IEIs), such as IEI attributed to electromagnetic fields (IEI-EMF). Empirical evidence on these associations is scarce. In a cross-sectional on-line survey, participants of a community sample (n = 700; mean age: 28.4 ± 12.0; 434 females) completed the Somatosensory Amplification Scale, the Modern Health Worries Scale, and the Paranoid Ideation scale of the Symptom Checklist 90 Revised. They were considered IEI-EMF if (1) they categorized themselves so, (2) they had experienced symptoms that they attributed to the exposure to electromagnetic fields, and (3) the condition impacted their everyday functioning. Paranoid ideation was significantly positively associated with MHWs (standardized $\beta = 0.150$, $p < .001$) even after controlling for socio-demographic variables and somatosensory amplification tendency, an indicator of somatic symptom distress. Also, paranoid ideation explained significant

variability in IEI-EMF (OR = 1.090, 95% CI: 1.006-1.180, p = .035) even after statistically controlling for socio-demographic variables and somatosensory amplification.

Conclusions: Paranoid ideation was found to be associated with MHWs and IEI-EMF. This association appears independent of general somatic symptom distress in both cases. This might partly explain the temporal stability of these constructs.

3. Occupational exposure

None

4. Human experimental studies

None

5. Exposure assessment

None

6. Leukaemia studies

Cancer Incidence and Mortality among Petroleum Industry Workers and Residents Living in Oil Producing Communities: A Systematic Review and Meta-Analysis. Felix M Onyije, Bayan Hosseini, Kayo Togawa, Joachim Schüz, Ann Olsson. *Int J Environ Res Public Health*. 2021 Apr 20;18(8):4343.

Petroleum extraction and refining are major sources of various occupational exposures and of air pollution and may therefore contribute to the global cancer burden. This systematic review and meta-analysis is aimed at evaluating the cancer risk in petroleum-exposed workers and in residents living near petroleum facilities. Relevant studies were identified and retrieved through PubMed and Web of Science databases. Summary effect size (ES) and 95% confidence intervals (CI) were analysed using random effect models, and heterogeneity across studies was assessed (I²). Overall, petroleum industry work was associated with an increased risk of mesothelioma (ES = 2.09, CI: 1.58-2.76), skin melanoma (ES = 1.34, CI: 1.06-1.70), multiple myeloma (ES = 1.81, CI: 1.28-2.55), and cancers of the prostate (ES = 1.13, CI: 1.05-1.22) and urinary bladder (ES = 1.25, CI: 1.09-1.43) and a decreased risk of cancers of the esophagus, stomach, colon, rectum, and pancreas. Offshore petroleum work was associated with an increased risk of lung cancer (ES = 1.20; 95% CI: 1.03-1.39) and leukemia (ES = 1.47; 95% CI: 1.12-1.92) in stratified analysis.

Conclusions: Residential proximity to petroleum facilities was associated with childhood leukemia (ES = 1.90, CI: 1.34-2.70). Very few studies examined specific exposures among petroleum industry workers or residents living in oil producing communities.

Breastfeeding and the risk of childhood cancer: a systematic review and dose-response meta-analysis. Qing Su, Xiaohui Sun, Liwen Zhu, Qin Yan, Peiwen Zheng, Yingying Mao, Ding Ye. *BMC Med.* 2021 Apr 13;19(1):90.

The aim of this study was to quantitatively summarize the available evidence on the association of breastfeeding with the risk of childhood cancer. A literature search of PubMed and Embase databases was performed to identify eligible observational studies published from inception to July 17, 2020. The categorical and dose-response meta-analysis was conducted by pooling relative risk (RR) or odds ratio (OR) estimates with 95% confidence intervals (CIs). Potential sources of heterogeneity were detected by meta-regression and stratification analysis. Sensitivity analysis and publication bias test were also carried out. Forty-five articles involving 475,579 individuals were included in the meta-analysis. Among the thirty-three studies on the association between breastfeeding and risk of childhood leukemia, the pooled risk estimates were 0.77 (95% CI, 0.65-0.91) and 0.77 (95% CI 0.63-0.94) for ever versus non/occasional breastfeeding and longest versus shortest breastfeeding duration group, respectively. There was clear indication for non-linear dose-response relationship between breastfeeding duration and the risk of childhood leukemia (P non-linear < 0.001). The most protective effect (OR, 0.66, 95% CI 0.62-0.70) was observed at a breastfeeding duration of 9.6 months. Four studies examined the association between breastfeeding and risk of childhood neuroblastoma, and significant inverse associations were consistently observed in both the comparisons of ever breastfeeding versus non/occasional breastfeeding (OR = 0.59, 95% CI 0.44-0.81) and longest versus shortest breastfeeding (OR = 0.61, 95% CI 0.44-0.83). However, no associations of breastfeeding with risk of other cancers were found.

Conclusions: This study supports a protective role of breastfeeding on the risk of childhood leukemia, also suggesting a non-linear dose-response relationship.

Residential proximity to plant nurseries and risk of childhood leukemia. Andrew Nguyen, Catherine M Crespi, Ximena Vergara, Nicholas Chun, Leeka Kheifets. *Environ Res.* 2021 May 29;200:111388.

Pesticides are a potential risk factor for childhood leukemia. Studies evaluating the role of prenatal and/or early life exposure to pesticides in the development of childhood leukemia have produced a range of results. In addition to indoor use of pesticides, higher risks have been reported for children born near agricultural crops. No studies have looked at pesticide exposure based on proximity of birth residence to commercial plant nurseries, even though nurseries are located much closer to residences than agricultural crops and can potentially result in chronic year-round pesticide exposure. The objectives of this study was to evaluate whether risk of childhood leukemia is associated with pesticide use as determined by distance of residence at birth to commercial, outdoor plant nurseries. The authors conducted a large statewide, record-based case-control study of childhood leukemia in California, which included 5788 childhood leukemia cases and an equal number of controls. Pesticide exposure was based on a spatial proximity model, which combined geographic information system data with aerial satellite imagery. Overall, the results supported an increased childhood leukemia risk only for birth residences very close to nurseries. For birth residences less than 75 m from plant nurseries, we found an increased risk of childhood leukemia (odds ratio (OR) 2.40, 95% confidence interval (CI) 0.99-5.82) that was stronger for acute lymphocytic leukemia (OR 3.09, 95% CI 1.14-8.34). The association was robust to choices of reference group, cut points and data quality.

Conclusions: These findings suggest that close proximity to plant nurseries may be a risk factor for childhood leukemia and that this relationship should be further evaluated.