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1. Reviews and meta-analyses

1.1 Environmental Risk Factors for Childhood Central Nervous System Tumors: an Umbrella Review.

Hoang, T., Whitcomb, E., Reardon, E., Spector, L., Lupo, P., Scheurer, M., Williams, L. (2022). *Current Epidemiology Review*, 9, 338-360. <https://doi.org/10.1007/s40471-022-00309-5>

Background and Objective: Childhood central nervous system tumors (cCNSt) are the most common solid tumors in individuals under 20 years old, yet environmental risk factors are not well established. Therefore, the authors conducted an umbrella review to summarize the current literature on risk factors related to cCNSt.

Results: Childhood exposure to ionizing radiation from medical devices was the strongest risk factor. There was evidence of positive associations with several other factors, including maternal age, birth weight, and pesticide exposure. Maternal occupational exposure to extremely low frequency (ELF) radiation may be associated with risk of offspring cCNSt. Carpenter et al. identified two studies which were included in Su et al. meta-analysis that reported maternal and paternal exposure to ELF-magnetic fields (MF) were associated with cCNSt (maternal OR: 1.16, 95% CI: 1.06-1.26; paternal OR: 1.15, 95% CI: 0.98-1.34). Overall, there is lacking evidence that postnatal exposure to non-ionizing radiation impacts cCNSt risk.

Conclusion: Because cCNSt are highly heterogeneous, future research is needed to examine risk factors by molecular and histological subtypes and to apply novel, unbiased exposure assessments.

Study limitation: Exposure assessments were limited to data linkages, parental recall via questionnaires, or measurements at diagnosis.

1.2 Recent Research on EMF and Health Risk: Sixteenth report from SSM's Scientific Council on Electromagnetic Fields, 2021.

The Swedish Radiation Safety Authority's Scientific Council on Electromagnetic Fields (2022). www.sme.se

Background and Objective: The Swedish Radiation Safety Authority's (SSM) Scientific Council on Electromagnetic Fields monitors current research on potential health risks in relation to exposure to electromagnetic fields and provides the authority with advice on assessing possible health risks. The Council gives guidance when the authority must give an opinion on policy matters when scientific testing is necessary. The council is required to submit a written report each year on the current research and knowledge situation. This is a consensus report. This means that all members of the

Scientific Council agree with the complete report. This increases the strength of the given conclusions. The report has the primary objective of covering the previous year's research in the area of electromagnetic fields (EMF) and health but also to place this in the context of present knowledge. The report gives the authority an overview and provides an important basis for risk assessment.

Methods: This report reviews studies on electromagnetic fields (EMF) and health risks, published from January 2020 up to and including December 2020. The report is the sixteenth in a series of annual scientific reviews which consecutively discusses and assesses relevant new studies and put these in the context of available information. The report covers different areas of EMF (static, low frequency, intermediate and radio frequency fields) and different types of studies such as biological, human and epidemiological studies. The result will be a gradually developing health risk assessment of exposure to EMF.

Results and conclusion: No new established causal relationships between EMF exposure and health risk have been identified. The studies presented in this report do not resolve whether the consistently observed association between ELF magnetic field (ELF-MF) exposure and childhood leukaemia in epidemiology is causal or not.

2. Residential exposure

2.1 Exposure to electromagnetic fields does not modify neither the age of onset nor the disease progression in ALS patients.

Vasta, R., Callegaro, S., Grassano, M. et al. (2022). Amyotrophic Lateral Sclerosis and Frontotemporal Degeneration, 0, 1-4. <https://doi.org/10.1080/21678421.2022.2142800>

Background and Objective: Being exposed to electromagnetic fields has been suggested to increase the risk of developing Amyotrophic Lateral Sclerosis (ALS). In this study, the authors investigated the effect of exposure to electromagnetic fields on ALS onset age and progression rate (DALSFRS-r). Method: A large cohort of ALS patients (n=1098) was geo-localized at the time of their diagnosis. Concomitantly, data on the distribution of powerlines and repeater antennas (extremely low frequency electromagnetic fields) during the same period were retrieved. Exposure to each repeater antenna was calculated as the sum of $1/(\text{distance from each antenna})^2$. Exposure to powerlines was calculated as summing each patient's address as the center of several circles of variable radius (100, 250, 500, 1000, and 2000m). For each radius, the exposure was calculated as the length of the powerlines included in the circle. Finally, patients were divided into low-and high-exposed based on the median of the exposure and compared using the Mann-Whitney test. A regression model (one for each radius) was also performed.

Results: Neither the onset age nor the DALSFRS-r differed among patients' low-and high-exposed to electromagnetic fields. Similarly, the authors could not find any significant relationship using the regression models.

Conclusion: These findings suggest that electromagnetic fields do not modify the ALS phenotype or progression.

3. Occupational exposure

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4. Human Experimental Studies

4.1 Alterations in Heart Rate Variability and Electroencephalogram during 20-Minute Extremely Low Frequency Electric Field Treatment in Healthy Men during the Eyes-Open Condition.

Shinba, T., Nedachi, T., Harakawa, S. (2022). IEEJ Transactions on electrical and electronic engineering. <https://doi.org/10.1002/tee.23695>

Background and Objective: The author's previous study examined the neural effects of extremely low frequency electric field (ELF-EF) using electroencephalogram (EEG) and heart rate variability (HRV) measurement and revealed that the theta power of EEG increases during 1-min EF treatment (30 kV and 50Hz). In the present study, the effects of a longer treatment duration were assessed.

Methods: EF was applied between two electrodes, one above the head and the other under the feet, for 20 min to 10 healthy men sitting on a chair. Occipital EEG and HRV were measured in the eyes-open condition.

Results: Power spectrum analysis showed that during the EF treatment, the power of alpha and theta rhythms as well as the low frequency component of HRV increased, and the heart rate decreased. These effects did not persist after the end of EF treatment. It is suggested that ELF-EF treatment alters not only the brain activity but also the autonomic activity reflected in HRV.

Comment and limitations: The present study has some limitations, including the small sample size. Both EEG and autonomic effects were observed, but the relation of these two parameters could not be assessed due to the small sample size. Female participants should be recruited to check the effects of gender. ELF-EF with different magnitudes and different frequencies should be employed in future studies.

5. Exposure Assessment

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6. Leukaemia Studies

6.1 Incidence of childhood leukemia before and after shut down of nuclear power plants in Germany in 2011: A population-based register study during 2004 to 2019.

Russo, A., Blettner, M., Merzenich, H., Wollschlaeger, D., Erdmab, F., Gianicolo, E. (2023). The International Journal of Cancer, 152, 913-920. <https://doi.org/10.1002/ijc.34303>

Background and Objective: The association between leukemia and proximity to nuclear-power-plants (NPPs) has been assessed in several countries with inconsistent results. A case-control study from Germany had shown an increased risk for childhood leukemia (diagnoses 1980-2003) near NPPs. Germany began shutting down nuclear reactors in 2011, following the Fukushima disaster. The authors tested whether the previously observed association between leukemia and proximity to NPP persisted despite the shutdown.

Methods: The authors used an ecological study design to investigate the incidence of leukemia during 2004 to 2019 in children aged 0 to 14 years living near NPPs where at least one reactor was shut down

in 2011. The authors defined study and control areas as municipalities whose surface area was at least 75% within 10 km or between 10 and 50 km of NPPs, respectively. They calculated age-standardized rates and incidence rate ratios (IRR) using control-areas as the reference. Standardized incidence ratios (SIR) were also calculated separately for each NPP using incidence rates of the German population as a reference.

Results: IRR decreased from 1.20 (95% confidence interval: 0.81-1.77) in 2004 to 2011 to 1.12 (0.75-1.68) in 2012 to 2019. Analyses of single plants showed an excess of childhood leukemia during 2004 to 2019 for the Unterweser-NPP, based only on three cases, and the Krümmel-NPP (n = 14; SIR: 1.98, 1.17-3.35).

Conclusion: The authors found a slight decrease in leukemia incidence rate ratios after the shutdown of nuclear reactors in 2011. Due to the small number of cases, risk estimates have large uncertainty. Further research including a longer follow-up is warranted. The consistent excess of incidence cases around Krümmel may require analytical epidemiological analysis.

6.2 Residential proximity to croplands at birth and childhood leukaemia

Bamouni, S., Hemon, D., Faure, L., Clavel, J., Goujon, S. (2022). Environmental Health, 21, 103. <https://doi.org/10.1186/s12940-022-00909-0>

Background and Objective: Domestic and parental occupational pesticide exposures are suspected of involvement in the occurrence of childhood acute leukaemia (AL), but the role of exposure to agricultural activities is little known. In a previous ecological study conducted in France, the authors observed an increase in acute lymphoblastic leukaemia (ALL) incidence rate with increasing viticulture density in the municipalities of residence at diagnosis. This study aimed to test the hypothesis that residential proximity to croplands at birth increases the risk of childhood AL, with a particular focus on vineyards.

Methods: The authors identified all the primary AL cases diagnosed before the age of 15 years in the cohorts of children born in the French municipalities between 1990 and 2015. Crop densities were estimated in each municipality of residence at birth using agricultural census data, for ten crop types. Variations in standardized incidence ratios (SIR) were evaluated with Poisson regression models, for all AL, ALL and acute myeloid leukaemia (AML), separately.

Results: Among the 19,809,700 children born and residing in mainland France at birth in 1990-2015, 8,747 AL cases (7,236 ALL and 1,335 AML) were diagnosed over the period. The authors did not evidence any statistically significant positive association between total crop density or any specific crop density in the municipality of residence at birth and all AL, ALL or AML. Interestingly, the authors observed a higher ALL incidence rate in the municipalities with the highest viticulture densities (SIR = 1.25 95%CI [1.01-1.54]). Adjusting for the main potential confounders did not change the results.

Conclusion: This study does not support the hypothesis that residential proximity to croplands, particularly vineyards, around birth plays a role in childhood leukaemia. The slightly higher ALL incidence rate in children born in the municipalities with the highest viticulture densities may reflect the previously-observed association at diagnosis.