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Overview of the epidemiologic studies on the health effects of ELF electric and magnetic fields (ELF-EMF) published in the second quarter of 2026.

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1. Reviews and meta-analyses

1.1 A Narrative Review on the Influence of Electromagnetic Fields Below 100 kHz on the Endocrine System

Tojza, P.M., Redlarski, G., Litzbarski, L.S., Czaplinski, M. (2026). Applied Sciences, 16, 4910. https://doi.org/10.3390/app16104910

Background & Objective

Extremely low-frequency electromagnetic fields (ELF-EMFs), generated mainly by power infrastructure and household devices, have raised scientific interest due to their potential impact on the endocrine system. Animal research consistently shows effects on melatonin secretion, stress hormone levels, thyroid activity, and reproductive function—largely mediated by oxidative stress and calcium ion imbalance. In contrast, human studies remain inconsistent, often hindered by methodological limitations and insufficient exposure characterization. This review synthesizes experimental and epidemiological studies examining low-frequency electromagnetic field exposure (≤100 kHz) and its influence on hormonal regulation.

Method

A bibliometric analysis highlights focused interest on specific endocrine targets, particularly the pineal gland. Importantly, many experimental studies use field strengths above those found near high-voltage power lines, limiting direct applicability.

Conclusions

While a definitive causal link has not been established, the widespread exposure to low-frequency electromagnetic fields justifies precautionary considerations. Several important research gaps remain, many of which are identified in this review. The topic of low-frequency electromagnetic field effects on the endocrine system requires more rigorous, long-term human studies with accurate exposure assessment.

2. Residential exposure

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3. Occupational exposure

3.1 Impact of extremely low frequency electromagnetic fields exposure on sleep quality and mental health in a Tunisian power plant: a cross-sectional study

Kacem, I., Jammeli, I., Sridi, C. et al. (2026). Frontiers in Psychiatry, 17, 1755918.

https://doi.org/10.3389/fpsyt.2026.1755918

Background & Objective

Extremely low-frequency electromagnetic fields (ELF-EMFs) are ubiquitous in our daily life. They may have an impact not only on physical health but also on mental health. To assess the impact of occupational exposure to the ELF-EMFs on sleep quality, depression, anxiety and stress among workers at the Tunisian Electricity and Gas Company (TEGC).

Method

This was a cross-sectional study. The study population included two groups: an exposed group (EG), consisting of power plant employees, and a non-exposed group (NEG), consisting of administrative workers. Exposure to ELF-EMFs was assessed via spot measurements using a magnetometer. Sleep quality, depression, anxiety and stress were assessed by the French versions of the Pittsburgh Sleep Quality Index (PSQI) and the Depression, Anxiety and Stress Scale (DASS-21).

Results

77 participants in the EG and 88 participants in the NEG were included in the study. The median value of the ELF-EMFs was 5.86 µT at the power plant [min 0.1, max 40.34 µT]. According to the PSQI global score, 64.9% of the EG had poor sleep quality versus 29.5% of the NEG. Depression was registered in 24.7% of EG and in 3.4% of NEG. Anxiety was noted in 23.4% of the EG and in none of the NEG. Stress was found in 46.8% of the EG and none of the NEG. After multivariate analysis, ELF-EMF exposure was significantly associated with poor sleep quality and depression.

Conclusion

The present study revealed that ELF-EMFs can affect sleep and mental health. Further studies are needed to explain the mechanism involved.

Limitations

First, the relatively small sample size limits the statistical power and the generalizability of findings. Second, a potential selection bias may arise from the “healthy worker effect”, because employees on sick leave or deemed unfit for work were excluded. However, this would have led to an underestimation of the prevalence of sleep disturbances, depression, anxiety, and stress.

Furthermore, the cross-sectional design does not allow the establishment of causal relationships between ELF-EMF exposure and health outcomes. The use of self-reported questionnaires to assess psychological and sleep-related symptoms introduces the possibility of subjective reporting bias, although previous studies suggest moderate concordance between self-reported and objective sleep data.

4. Exposure Assessment

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5. Leukaemia Studies

5.1 Seasonal variation in childhood acute lymphoblastic leukemia, but not in acute myeloid leukemia, or brain tumors – A Swedish population-based study

Bychkov, G., Bang, B., Engsner, N. (2026). Cancer Epidemiology, 102, 103069. https://doi.org/10.1016/j.canep.2026.103069

Background & Objective

Acute lymphoblastic leukemia (ALL), the most common malignancy in children and adolescents, arises from a heterogeneous and multifactorial etiology involving genetic and environmental factors. Studies of seasonal variation in ALL diagnosis have yielded inconsistent results, likely reflecting differences in study design and population characteristics. In this study, the authors evaluated seasonal variation across ALL immunophenotypes, including two common genetic subtypes.

Methods

The authors analyzed seasonal variation by ALL subtype in 1504 ALL patients diagnosed before the age of 18 between 1995 and 2017 using data from the National Cancer Register and the Swedish Childhood Cancer Registry. Subgroup analysis included 1305 B-cell precursor ALL (BCP-ALL) cases, including 422 high hyperdiploid (HeH) and 259 ETV6::RUNX1 fusion-positive cases, and 175 T-cell ALL (T-ALL) cases. For comparison, 214 acute myeloid leukemia (AML) cases and 1367 brain tumor cases, including 224 medulloblastomas, were analyzed. Cases were grouped into overlapping 3-month diagnostic periods and analyzed using a Bayesian GARIMAX model, an extension of the autoregressive integrated moving average (ARIMA) framework. A sensitivity analysis was performed restricted to children aged 1–17 years.

Results

Seasonal variation was observed in the overall ALL cohort, with peaks between June and October. BCPALL and T-ALL also showed informative seasonality, with August consistently included among the peak months. Similar results were obtained in the sensitivity analysis. No seasonal variation was observed in AML, medulloblastoma, or other brain tumors. Informative seasonal variation was not detected in the HeH or ETV6::RUNX1- positive subgroups, although HeH showed peak quarters consistent with the overall ALL pattern.

Conclusion

The authors demonstrate evidence of seasonal variation in childhood ALL, with consistent summer-associated peaks across immunophenotypes. In contrast, no clear seasonal pattern was observed for AML or brain tumors, suggesting that seasonality may be specific to ALL. Subtype-specific analyses indicate potential etiological heterogeneity, although larger studies are required to confirm these findings. Future research integrating genetic, environmental, and infectious data across large cohorts will be essential to elucidate the mechanisms underlying seasonal variation in childhood leukemia.

Limitations

Although seasonal variation suggests a potential role for infectious exposures, this study cannot robustly assess associations with specific pathogens as it lacks suitable data on microbial infection waves from primary care and other relevant sources, and the underlying mechanisms therefore remain speculative. Registry-based infection diagnoses based on health data from specialist care registers are an imperfect proxy, as many infections are managed in primary care and may be underreported in specialist registers, and temporal changes in healthcare utilization, coding, and testing may affect incidence. Furthermore, the GARIMAX methodology cannot reliably estimate the induction period between infection peaks and leukemia onset. Identifying specific infectious triggers will require more detailed microbiological or surveillance data. The GARIMAX methodology is based on aggregated time-series data and does not allow adjustment for individual-level covariates.

5.2 Parental, pregnancy and neonatal characteristics during the perinatal period as potential risk factors for childhood cancer: FeToxCancer case-control study

Stajnko, A., Thacher, J.D., Oudin, A.,, Lindh, C., Lundh, T., Øra, I. , et al. (2026) PLoS One, 21(4), e0333752. https://doi.org/10.1371/journal.pone.0333752

Background & Objective

Childhood cancer aetiology is poorly understood and is considered to originate in utero and early postnatal life. In this study, the authors investigated perinatal characteristics as potential risk factors.

Method

A population-based case-control study was performed, including 1340 cancer cases diagnosed <19 years and born between 1989–2021 in southern Sweden, and 13400 controls matched by sex, year, and municipality of birth. Perinatal characteristics were obtained from seven national registries. Cox regression was used to examine the associations between perinatal

characteristics and the risk of overall childhood cancer, leukaemia, CNS tumours, lymphoma, and other cancer types combined (OCT).

Results

A large score for gestational age was associated with a higher risk of overall cancer (HR, 95%CI: 1.32, 1.02–1.69) and leukaemia (HR, 95%CI: 1.58, 1.01–2.5), while a 5-min Apgar score <7 indicated a higher risk of OCT (HR, 95%CI: 2.16, 1.12–4.15). Mechanical ventilation during neonatal care was associated with a higher risk of overall cancer (HR, 95%CI: 1.88, 1.39–2.53) and OCT (HR, 95%CI: 2.09, 1.19–3.39). The aforementioned characteristics were associated with up to a threefold increased risk among children diagnosed before six months of age compared to those diagnosed later. Additionally, maternal obesity was associated with a higher risk of CNS tumours (HR, 95%CI: 1.51, 1.04–2.21) and lymphoma (HR, 95%CI: 2.26, 1.31–3.88), and maternal underweight with a higher risk of leukaemia (HR, 95%CI: 2.43, 1.40–4.22). Planned caesarean delivery indicated an increased risk of OCT (HR, 95%CI: 1.52, 1.04–2.22).

Conclusion

These findings identify several perinatal characteristics associated with childhood cancer risk, highlighting the perinatal period as an important window for future etiological research.

Limitations

A first limitation is the statistical power: given the limited statistical power, lowering the significance threshold could potentially overlook meaningful associations. Therefore, the authors chose to interpret the results cautiously in the context of existing literature rather than adjust for multiple comparisons. Nevertheless, the possibility of false positives still exists. Preterm birth reflects both immaturity and various pathological factors, with currently unclear links to GA. Consequently, in studies on neonatal outcomes, adjusting for GA, as a potential mediator factor, may introduce collider bias. In this study, the authors examined numerous maternal and pregnancy characteristics, including GA, as potential risk factors for childhood cancer, many of which have unclear relationships with GA. To assess GA both as a potential risk factor and a confounder (e.g., neonatal care, mechanical ventilation therapy) while addressing collider bias, models with and without GA were fitted. Lastly, missing data for some characteristics (e.g., BMI), as well as a lack of information on other risk factors such as family history, and environmental exposures, might represent bias in the present study.

6. REFERENCES

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