The Impacts of Electricity Lines and Substations on Physical Health – literature search

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This literature search brings together current research on the possible physical health impacts of electricity lines and substations. It has been prepared to support open discussion and help people understand what the scientific evidence currently shows.

Researchers from around the world have studied whether exposure to extremely low-frequency electromagnetic fields (ELF-EMF) from electricity infrastructure is linked to health effects. The evidence we identified includes recent scientific reviews and studies looking at a range of topics, such as childhood and adult cancers, reproductive health, general physical health, and conditions sometimes described as electromagnetic hypersensitivity.

Across this research, some studies suggest associations between long-term ELF-EMF exposure and certain health outcomes, particularly childhood leukaemia. However, these findings show correlation rather than proven cause, and results across the wider evidence base remain mixed. For many other health conditions, including adult cancers and cardiovascular disease, recent research does not show consistent evidence of increased risk.

The scientific reviews also highlight that the biological mechanisms behind any potential effects are not yet well understood, and further research is needed.

This search provides a snapshot of available English-language research published since 2000 and is not a complete assessment of all studies worldwide. Some papers may later be corrected or retracted, and users are encouraged to read the original sources where possible to understand the full context.

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Mae'r chwiliad llenyddiaeth hwn yn dwyn ynghyd ymchwil gyfredol ar effeithiau iechyd corfforol posibl llinellau ac is-orsafoedd trydan. Fe'i lluniwyd i gefnogi trafodaeth agored a helpu pobl i ddeall beth mae'r dystiolaeth wyddonol yn ei ddangos ar hyn o bryd.

Mae ymchwilwyr o bob cwr o'r byd wedi astudio a yw amlygiad i feysydd electromagnetig amledd hynod o isel (ELF - EMF) o seilwaith trydan yn gysylltiedig ag effeithiau iechyd. Mae'r dystiolaeth a nodwyd gennym yn cynnwys adolygiadau ac astudiaethau gwyddonol diweddar sy'n edrych ar ystod o bynciau, megis cancr ymhlith plant ac oedolion, iechyd atgenhedlol, iechyd corfforol cyffredinol, a chyflyrau a ddisgrifir weithiau fel gorsensitifrwydd electromagnetig.

Mae rhai astudiaethau yn y gwaith ymchwil hwn yn awgrymu cysylltiadau rhwng amlygiad hirdymor ELF - EMF a chanlyniadau iechyd penodol, yn enwedig lewcemia ymhlith plant. Fodd bynnag, mae'r canfyddiadau hyn yn dangos cydberthynas yn hytrach nag achos pendant y mae modd ei brofi, ac mae'r canlyniadau ar draws y sylfaen dystiolaeth ehangach yn parhau i fod yn gymysg. Ar gyfer llawer o gyflyrau iechyd eraill, gan gynnwys cancr ymhlith oedolion a chlefyd cardiofasgwlaidd, nid yw ymchwil ddiweddar yn dangos tystiolaeth gyson o risg uwch.

Mae'r adolygiadau gwyddonol hefyd yn dangos nad oes yna ddealltwriaeth dda o fecanweithiau biolegol unrhyw effeithiau posibl eto, a bod angen ymchwil bellach.

Mae'r chwiliad hwn yn rhoi cipolwg ar yr ymchwil a gyhoeddwyd yn Saesneg ers 2000 ac nid yw'n cwmpasu'r holl astudiaethau a gyflawnwyd ledled y byd. Efallai y bydd rhai papurau yn cael eu cywiro neu eu tynnu yn ôl yn ddiweddarach, ac anogir defnyddwyr i ddarllen y ffynonellau gwreiddiol lle bo hynny'n bosibl i ddeall y cyd-destun llawn.

It should be noted that this literature search was returned to members of the Independent Advisory Group in the second half of March 2025. The group stopped considering new submissions at the end of March 2025 to work on the report and recommendations, and therefore members would have had very limited opportunity to consider any of the specific papers referenced in these results in their findings.

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Dylid nodi bod y chwiliad llenyddiaeth hwn wedi'i ddychwelyd i aelodau'r Grŵp Cynghori Annibynnol yn ystod ail hanner mis Mawrth 2025. Rhoddodd y grŵp y gorau i ystyried darnau newydd ddiwedd mis Mawrth 2025 i weithio ar yr adroddiad a'r argymhellion, ac felly ychydig iawn o gyfle y byddai'r aelodau wedi eu cael i ystyried unrhyw un o'r papurau penodol y cyfeirir atynt yn y canlyniadau hyn yn eu canfyddiadau.

Results / Canlyniadau

Topic	Title	Citation	Year of publication	Link to abstract/full text (if available)
Cancer	Electromagnetic fields and cancer [Review]	National Cancer Institute 'Electromagnetic fields and cancer' NCI, reviewed 30 May 2022 [Reviews a range of exposure from power line studies with a focus on childhood leukemia, and more general residential exposure in adults.]	2022	Full Text
Cancer	Extremely low frequency electromagnetic fields and cancer: How source of funding affects results [Review]	Carpenter, D.O. (2019) 'Extremely low frequency electromagnetic fields and cancer: How source of funding affects results', Environmental Research, 178, p. 108688. Available at: https://doi.org/10.1016/j.envres.2019.108688. *"• Magnetic field exposure causes childhood leukemia in government-funded studies.* *•Magnetic field exposure does not cause childhood leukemia in industry-funded studies.* *• Magnetic field exposure increases risk of adult leukemia, brain and breast cancer."*	2019	Abstract
Cancer	Biological effects of non-ionizing electromagnetic fields: Two sides of a coin [Review]	Saliev, T. et al. (2019) 'Biological effects of non-ionizing electromagnetic fields: Two sides of a coin', Progress in Biophysics and Molecular Biology, 141, pp. 25–36. Available at: https://doi.org/10.1016/j.pbiomolbio.2018.07.009. *"Though significant research effort and published reports demonstrated the ability of EMF to trigger DNA damage, there is still insufficient evidence to provide an irrevocable proof of its carcinogenic and mutagenic potential for humans."*	2019	Open Access
Cancer - Breast	Environmental factors and breast cancer [Review]	Strumylaite L, Mechonosina K & Tamasauskas S (2010). 'Environmental factors and breast cancer'. Medicina (Kaunas, Lithuania), 46(12), 867-73. *"The data on the effect of electro-magnetic fields are not consistent. Although evidence about the effect of environmental factors on the risk of breast cancer is not convincing, some of these factors together with inheritance, reproductive life, and age at exposure could be associated with an increased risk of the disease."*	2010	Open Access
Cancer – Childhood brain	Risk factors for childhood brain tumours: A systematic review and meta-analysis of observational studies from 1976 to 2022 [Review]	Onyije, F.M. et al. (2024) 'Risk factors for childhood brain tumours: A systematic review and meta-analysis of observational studies from 1976 to 2022', Cancer Epidemiology, 88, pp. 102510–102510. Available at: https://doi.org/10.1016/j.canep.2023.102510. *"Children exposure to ELF-MF ≤ 0.1–≤ 0.4 μT (3 case-control [44], [79], [113] and 6 cohort studies [130], [132], [148], [153], [160], [181]) or to ELF-MF ≥ 0.4μT (3 cohort studies [130], [148], [181]) during childhood were not associated with CBT [childhood brain tumours], not separately and not in combined analysis. Exposure to powerlines (Very Low Current Configuration (VLCC), Ordinary High Current Configuration (OHCC), and Very High Current Configuration (VHCC)) based on 3 case-control studies was not associated with CBT".*	2024	Open Access
Cancer – Childhood leukaemia	Exposure to extremely low-frequency magnetic fields and childhood cancer: A systematic review and meta-analysis [Review]	Seomun G, Lee J, Park J (2021) 'Exposure to extremely low-frequency magnetic fields and childhood cancer: A systematic review and meta-analysis'. PLoS ONE 16(5): e0251628. https://doi.org/10.1371/journal.pone.0251628 *"In this large pooled analysis of more than 36,000 children diagnosed with childhood leukemia, statistically significant associations were observed between exposure to ELF-MF and childhood leukemia. Further-more, the intensity of the association between exposure to ELF-MFs and childhood leukemia was high, as indicated by the dose–response effect."*	2021	Open Access

Cancer – Childhood leukaemia	Changes over time in the reported risk for childhood leukaemia and magnetic fields [Review]	Swanson, J., Kheifets, L. and Vergara, X. (2019) 'Changes over time in the reported risk for childhood leukaemia and magnetic fields', Journal of Radiological Protection, 39(2), pp. 470–488. Available at: https://doi.org/10.1088/1361-6498/ab0586. *"[...] We find suggestions of higher risks in studies looking at higher exposures and in studies with better quality exposure assessment. We conclude that there is a decline in reported risk from the mid 1990s to now, which is unlikely to be solely explained by improving study quality but may be due to chance, and an elevated risk remains."*	2019	Abstract
Children	Health effects of electromagnetic fields on children [Review]	Moon, J.-H. (2020) 'Health effects of electromagnetic fields on children', Clinical and Experimental Pediatrics, 63(11), pp. 422–428. Available at: https://doi.org/10.3345/cep.2019.01494. *"Precautionary approaches are recommended for children until the potential health effects of EMF are confirmed."*	2020	Open Access
EM Hypersensitivity	EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses. [Review]	Belyaev, I., et al (2016) 'EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses'. Reviews on Environmental Health, Vol. 31 (Issue 3), pp. 363-397. https://doi.org/10.1515/reveh-2016-0011 *"This EMF Guideline gives an overview of the current knowledge regarding EMF-related health risks and provides recommendations for the diagnosis, treatment and accessibility measures of EHS to improve and restore individual health outcomes as well as for the development of strategies for prevention."*	2016	Open Access
General Health	Insights in the biology of extremely low-frequency magnetic fields exposure on human health. [Review]	Karimi, A., Ghadiri Moghaddam, F. & Valipour, M. (2020) 'Insights in the biology of extremely low-frequency magnetic fields exposure on human health.' Mol Biol Rep 47, 5621–5633 (2020). https://doi.org/10.1007/s11033-020-05563-8 "*Accumulated epidemiologic evidence indicates a correlation between exposure to ELF-EMF and childhood cancer incidence, Alzheimer's disease (AD), and miscarriage. However, adult cancer does not show augmented risk caused by the ELF-EMF. Also, no consistent evidence exists in cardiovascular disease mortality due to ELF-EMF exposure. There is a lack of comprehensive mechanisms for explaining the biological effect of ELF-EMF. Eventually, more studies are needed to clarify the mechanisms of these magnetic fields."*	2020	Abstract
General Health	Electric and magnetic fields: health effects of exposure [Review]	UK Health Security Agency [was Public Health England?] (2013) 'Electric and magnetic fields: health effects of exposure'. UKHSA *"The results of some studies of human populations have suggested that there may be an increase in risk of childhood leukaemia at higher than usual magnetic field exposures in homes, some of which are near to large power lines.* *Studies have also looked at whether exposure is linked to the risk of other illnesses such as Alzheimer's disease. Although there have been some results suggesting a link, the overall balance of evidence is towards no effect and much weaker than that for childhood leukaemia."*	2013	Full Text
Guidelines	Factsheet on the guidelines for limiting exposure to time-varying electric and magnetic fields (1Hz – 100 kHz) [Review]	International Commission on Non-Ionizing Radiation Protection (ICNIRP) (2010) ' Factsheet on the guidelines for limiting exposure to time-varying electric and magnetic fields (1Hz – 100 kHz)' publishing in Health Phys 99(6): 818-836 **See also:** ICNIRP (2010) ICNIRP Guidelines for limiting exposure to time-varying electric and magnetic fields (1Hz-100kHz)' published in Health Physics 99(6) 8180236 Full Text *Radiation Protection Dosimetry* 2008, Vol. 132, Issue 2, Dec 2008. Special issue on Childhood Leukaemia. Open Access [Summarises review position, noting no adverse effects on the neuroendocrine system; no substantial evidence for association with Parkinson's disease, multiple sclerosis or cardiovascular disease. Notes inconclusive evidence on links with Alzheimer's disease or amyotrophic lateral sclerosis. Evidence on reproductive effects is weak. Notes an increased risk with childhood leukemia, but considers the possibility of bias, confounding factors and chance in these reports.	2010	Full Text

		Further notes no reported biophysical basis for causing leukemia in children.]		
Guidelines	Health Effects of Exposure to EMF [Review]	SCENIHR (Scientific Committee on Emerging and Newly Identified Health Risks). (2009) 'Health Effects of Exposure to EMF'. 19 January 2009. European Commission, Directorate-General for Health & Consumers. **See also** Laypersons guide to SCENIHR Report – Section 7 - Extremely low frequency fields like those from power lines and household appliances Electromagnetic Fields 2009 Update *"The previous opinion stated that ELF magnetic fields are a possible carcinogen. This conclusion was chiefly based on childhood leukaemia results. It was also concluded that a consistent relationship between ELF fields and self-reported symptoms has not been demonstrated. Regarding breast cancer and cardiovascular disease, an association was considered unlikely. For neurodegenerative diseases and brain tumours, the link to ELF fields remained uncertain"*	2009	Full Text See Section 3.5 Extremely Low Frequency Fields
Reproductive effects	The influence of the built environment on adverse birth outcomes [Review]	Woods N, Gilliland J, Seabrook JA. (2017) 'The influence of the built environment on adverse birth outcomes'. Journal of Neonatal-Perinatal Medicine. 2017;10(3):233-248. doi:10.3233/NPM-16112 *"Only two studies in this review examined proximity to power lines. In a study from Quebec, Canada, [61] adjusted odds ratios for mothers residing <50 m from a power line were compared to mothers residing >400 m, and all were non-significant once maternal age and socioeconomic status was accounted for[...] Similarly, de Vocht et al. [62] found that, despite the high odds ratios, there were no significant associations for mothers residing <50 m compared to those residing >50 m for LBW, SGA, and PTB [...]*	2017	Open Access
Cancer	Extremely low frequency electric fields and cancer: Assessing the evidence. [Review]	Kheifets, L., Renew, D., Sias, G. and Swanson, J. (2010), 'Extremely low frequency electric fields and cancer: Assessing the evidence'. Bioelectromagnetics, 31: 89-101. https://doi.org/10.1002/bem.20527 *"Overall, there seems little basis to suppose there might be a risk for electric fields, and, in contrast to magnetic fields, and with a possible exception of occupational epidemiology, there seems little basis for continued research into electric fields."*	2010	Abstract
Cancer - Breast	Electromagnetic Fields and Female Breast Cancer [Review]	Feychting, M., Forssén, U. (2006) 'Electromagnetic Fields and Female Breast Cancer.' Cancer Causes Control 17, 553–558 (2006). https://doi.org/10.1007/s10552-005-9008-3 *"Most of the recent well-designed residential studies report no increased risks, and similar findings are reported in the majority of studies of bed heating devices. Overall, the weight of the evidence available today does not suggest an increased risk of breast cancer related to EMF exposure."*	2006	Abstract
Cancer - Breast	Breast Cancer and Electromagnetic Fields—A Review	Caplan, L. (2000) 'Breast Cancer and Electromagnetic Fields—A Review', Annals of Epidemiology, 10(1), pp. 31–44. Available at: https://doi.org/10.1016/s1047-2797(99)00043-5. *"The biologic plausibility of an association between EMF and breast cancer, coupled with suggestive data from occupational studies and unexplained high incidence rates of breast cancer, suggests that further investigation of this possible association is warranted."*	2000	Abstract
Cancer – Childhood leukaemia	Impact of high electromagnetic field levels on childhood leukemia incidence. [Review]	Teepen, J.C. and van Dijck, J.A.A.M. (2012), 'Impact of high electromagnetic field levels on childhood leukemia incidence'. Int. J. Cancer, 131: 769-778. https://doi.org/10.1002/ijc.27542 *"Three pooled analyses of case–control studies showed a 1.4- to 1.7-fold increased CL [childhood leukemia] risk for extremely low-frequency EMF (ELF-EMF) exposure levels above 0.3 μT. Several biases may have played a role in these studies, but are unlikely to fully explain the increased risk."*	2012	Abstract
Cancer – Childhood leukaemia	Exposure to electromagnetic fields (non-ionizing	Calvente, I. et al. (2010) 'Exposure to electromagnetic fields (non-ionizing radiation) and its relationship with childhood leukemia: A systematic review', Science of The Total	2010	Abstract

	radiation) and its relationship with childhood leukemia: A systematic review	Environment, 408(16), pp. 3062–3069. https://doi.org/10.1016/j.scitotenv.2010.03.039. *"Studies to date have not convincingly confirmed or ruled out an association between non-ionizing radiation and the risk of childhood leukemia. Discrepancies among the conclusions of the studies may also be influenced by confounding factors, selection bias, and misclassification."*		
Cancer – Childhood leukaemia	Electromagnetic fields and epidemiology: An overview inspired by the fourth course at the International School of Bioelectromagnetics [Review]	Schüz, J., Lagorio, S. and Bersani, F. (2009), 'Electromagnetic fields and epidemiology: An overview inspired by the fourth course at the International School of Bioelectromagnetics'. Bioelectromagnetics, 30: 511-524. https://doi.org/10.1002/bem.20510 *"Further studies on the relation between childhood leukaemia and ELF magnetic fields would be worthwhile if they focus on heavily exposed groups and attempt to minimize possible selection bias."*	2009	Abstract
EM Hypersensitivity	Definition, epidemiology and management of electrical sensitivity. Report for the Radiation Protection Division of the Health Protection Agency [Review]	IRVINE, N. (2005) 'Definition, epidemiology and management of electrical sensitivity. Report for the Radiation Protection Division of the Health Protection Agency'. Health Protection Agency, October 2005. (HPA-RPD-010)	2005	Full Text
General Health	Human disease resulting from exposure to electromagnetic fields [Review]	Carpenter, D. (2013) 'Human disease resulting from exposure to electromagnetic fields'. Reviews on Environmental Health, Vol. 28 (Issue 4), pp. 159-172. https://doi.org/10.1515/reveh-2013-0016 *"This review summarizes the evidence stating that excessive exposure to magnetic fields from power lines and other sources of electric current increases the risk of development of some cancers and neurodegenerative diseases, and that excessive exposure to RF radiation increases risk of cancer, male infertility, and neurobehavioral abnormalities. The relative impact of various sources of exposure, the great range of standards for EMF exposure, and the costs of doing nothing are also discussed."*	2013	Abstract
General Health	Electric and magnetic fields: the facts [Review]	Energy Networks Association (2012) 'Electric and magnetic fields: the facts' ENA, January 2012 *"Research still continues to seek greater clarity; however, the balance of scientific evidence to date suggests that EMFs do not cause disease. This guide, produced by the UK electricity industry, summarises the background to the EMF issue, explains the research under-taken with regard to health and discusses the conclusion reached."*	2012	Full Text
General Health	How dangerous are mobile phones, transmission masts, and electricity pylons? [Review]	Wood AW (2006) 'How dangerous are mobile phones, transmission masts, and electricity pylons?' Archives of Disease in Childhood 2006;91:361-366. *"This article reviews the strength of the available epidemiological and laboratory evidence and notes that this falls short of what is normally required to establish a causal link. However, because of scientific uncertainty a cautious approach is often advocated, but here, too, there may be a tendency to judge these risks more harshly than those in other areas with similar strength of evidence."*	2006	Open Access
General Health	EMF AND HEALTH [Review]	Feychting, M., Ahlbom, A. and Kheifets, L. (2005) 'EMF AND HEALTH', Annual Review of Public Health, 26(1), pp. 165–189. https://doi.org/10.1146/annurev.publhealth.26.021304.144445. *"Studies have consistently shown increased risk for childhood leukemia associated with ELF magnetic fields, whereas ELF fields most likely are not a risk factor for breast cancer and cardiovascular disease. There are still inadequate data for other outcomes."*	2005	Abstract
General Health	Review of the epidemiologic	Ahlbom, I.C. et al. (2001) 'Review of the epidemiologic literature on EMF and Health.', Environmental Health Perspectives, 109(suppl 6), pp. 911–933. Available at: https://doi.org/10.1289/ehp.109-1240626.	2001	Open Access

	literature on EMF and Health	Published for ICNIRP – International Commission on Non-Ionizing Radiation Protection *"Among all the outcomes evaluated in epidemiologic studies of EMF, childhood leukemia in relation to postnatal exposures above 0.4 microT is the one for which there is most evidence of an association. [...] On the basis of epidemiologic findings, evidence shows an association of amyotrophic lateral sclerosis with occupational EMF exposure although confounding is a potential explanation. Breast cancer, cardiovascular disease, and suicide and depression remain unresolved."*		
Reproductive effects	Non-cancer EMF effects related to children [Review]	Feychting, M. (2005), 'Non-cancer EMF effects related to children'. Bioelectromagnetics, 26: S69-S74. https://doi.org/10.1002/bem.20153 *"Most studies of ELF exposures have not demonstrated any consistent risk increases for adverse pregnancy outcomes, but limitations in the exposure assessment methods and very limited power to study high exposure levels prevents any conclusions. Findings of an increased risk of spontaneous abortion in relation to maximum magnetic field exposures in two studies need to be confirmed. [...]Different types of symptoms and effects on cognitive function in relation to both ELF and RF fields have been reported in adults, but scientific studies have not confirmed that these symptoms are caused by the electromagnetic fields. No information is available for children."*	2005	Abstract
Reproductive effects	Adverse human reproductive outcomes and electromagnetic fields: A brief summary of the epidemiologic literature' [Review]	Shaw, G.M. (2001), 'Adverse human reproductive outcomes and electromagnetic fields: A brief summary of the epidemiologic literature'. Bioelectromagnetics, 22: S5-S18. https://doi.org/10.1002/1521-186X(2001)22:5+<::AID-BEM1020>3.0.CO;2-L *"(3) the paucity of data on other parental EMF exposures and subsequent adverse outcomes of pregnancy limits drawing a valid scientific conclusion. Since those earlier reviews appeared, the number of new investigations have been relatively small. These new studies do not substantially alter the above summary conclusions. The lack of epidemiologic data in this area, coupled with some speculations about potential biological effects associated with EMFs, raises the importance of researching this area further."*	2001	Abstract
Aerosols	Characteristics and potential human health hazards of charged aerosols generated by high-voltage power lines [Korea]	Jung, J.-S. et al. (2018) 'Characteristics and potential human health hazards of charged aerosols generated by high-voltage power lines', International Journal of Occupational Safety and Ergonomics, 25(1), pp. 91–98. doi: 10.1080/10803548.2018.1460036. *"Estimated production of charged aerosols from HVPLs found that people who work with HVPLs are highly likely to be exposed to charged aerosols."*	2018	Abstract
Cancer - adult	Electric field and air ion exposures near high voltage overhead power lines and adult cancers: a case control study across England and Wales	Toledano, M.B. et al. (2020) 'Electric field and air ion exposures near high voltage overhead power lines and adult cancers: a case control study across England and Wales', International Journal of Epidemiology, 49(Supplement_1), pp. i57–i66. Available at: https://doi.org/10.1093/ije/dyz275. *Our results do not provide evidence to support hypotheses that air ion density or electric fields in the vicinity of power lines are associated with cancer risk in adults."*	2020	Open Access
Cancer – Brain	Residential proximity to power lines and risk of brain tumor in the general population [France]	Carles, C. et al. (2020) 'Residential proximity to power lines and risk of brain tumor in the general population', Environmental Research, 185, p. 109473. Available at: https://doi.org/10.1016/j.envres.2020.109473. *" We found significant associations between cumulated duration living at <50 m to high voltage lines and: i) all brain tumors (OR 2.94; 95%CI 1.28–6.75); ii) glioma (OR 4.96; 95%CI 1.56–15.77). Further investigations are needed, particularly to improve the quality and availability of geographical and technical data on power lines."*	2020	Abstract
General Health	ELF-MF Exposure, Actual and Perceived, and Associated Health Symptoms: A Case Study of an Office	Raz-Steinkrycer, L. S., Dubnov, J., Gelberg, S., Jia, P., & Portnov, B. A. (2022). 'ELF-MF Exposure, Actual and Perceived, and Associated Health Symptoms: A Case Study of an Office Building in Tel Aviv-Yafo, Israel'. Sustainability, 14(17), 11065. https://doi.org/10.3390/su141711065 *"The analysis revealed that feelings of weakness, headache, frustration, and worry were associated with both measured and*	2022	Open Access

	Building in Tel Aviv-Yafo, Israel	*perceived ELF-MF exposure (p < 0.01), while perceived ELF-MF exposure was also found to be associated with eye pain and irritation (OR = 1.4, 95% CI = 1.2–1.6), sleepiness (OR = 1.3, 95% CI = 1.1–1.5), dizziness and ear pain (OR = 1.2, 95% CI = 1.0–1.4). We conclude that high-voltage power lines produce both physiological and psychological effects in nearby workers, and, hence, proximity to such power lines should become a public health issue."*		
Oxidative damage	The Effects of Antioxidant Vitamins on Proinflammatory Cytokines and Some Biochemical Parameters of Power Plant Workers: A Double-Blind Randomized Controlled Clinical Trial [Iran]	Bagheri Hosseinabadi, M., Khanjani, N., Norouzi, P., Faghihi-Zarandi, A., Darban-Sarokhalil, D., Khoramrooz, S.S., Mirbadie, S.R. and Mirzaii, M. (2021), 'The Effects of Antioxidant Vitamins on Proinflammatory Cytokines and Some Biochemical Parameters of Power Plant Workers: A Double-Blind Randomized Controlled Clinical Trial'. Bioelectromagnetics, 42: 18-26. https://doi.org/10.1002/bem.22294 See also: Hosseinabadi MB, et al (2020)' Investigating the effects of vitamins E and C on oxidative stress and hematological parameters among power plant workers: A double-blind randomized controlled clinical trial'. Toxicology and Industrial Health. 2020;36(2):99-109. doi:10.1177/0748233720908993 Abstract *"Taking antioxidant vitamins can prevent an increase of proinflammatory cytokines induced by prolonged exposure to ELF-MFs."*	2021	Abstract
Oxidative damage	'The effect of vitamin E and C on comet assay indices and apoptosis in power plant workers: A double blind randomized controlled clinical trial [Iran]	Bagheri Hosseinabadi, M. et al. (2020) 'The effect of vitamin E and C on comet assay indices and apoptosis in power plant workers: A double blind randomized controlled clinical trial', Mutation Research/Genetic Toxicology and Environmental Mutagenesis, 850-851, p. 503150. Available at: https://doi.org/10.1016/j.mrgentox.2020.503150. *"The use of antioxidant vitamins such as E and C, can increase the activity of the non-enzymatic antioxidant defense system, and protect DNA from damage caused by exposure to extremely low frequency magnetic fields. But, taking these vitamins has no effect on apoptosis. It seems that consumption of vitamin E affected all investigated comet assay indices and can be probably considered as the best intervention."*	2020	Abstract
Oxidative damage	Resveratrol may reverse the effects of long-term occupational exposure to electromagnetic fields on workers of a power plant [China]	Zhang D, Zhang Y, Zhu B, Zhang H, Sun Y, Sun C (2017) 'Resveratrol may reverse the effects of long-term occupational exposure to electromagnetic fields on workers of a power plant' Oncotarget, 2017, 8(29), 47497-47506 https://doi.org/10.18632/oncotarget.17668 *"This study supported that occupational and long-term exposure to high-voltage electricity lines has an adverse effect on homeostasis of human body, and resveratrol supplement could be an effective protection strategy against the adverse effects induced by ELF-EMFs."*	2017	Open Access
Oxidative damage	Effects of dietary green tea polyphenol supplementation on the health of workers exposed to high-voltage power lines [China]	Zhang Y, Zhang D, Zhu B, Zhang H, Sun Y, Sun C (2016) 'Effects of dietary green tea polyphenol supplementation on the health of workers exposed to high-voltage power lines' Environmental toxicology and pharmacology, 2016, 46, 183-187 https://doi.org/10.1016/j.etap.2016.07.016 *"Oxidative stress and oxidative damage to DNA were assessed by urinary tests of 8-isoprostane and 8-OHdG. Significant increased urinary 8-isoprostane and 8-OHdG were observed in workers with ELF-EMFs exposure, which were diminished after 12 months of GTPS. No protective effects of GTPS on oxidative stress and oxidative damage to DNA were observed after three months of GTPS withdraw."*	2016	Abstract
Reproductive effects	Exposure to Electromagnetic Fields of High Voltage Overhead Power Lines and Female Infertility [Iran]	Esmailzadeh S, Delavar MA, Aleyassin A, Gholamian SA, Ahmadi A. (2019) 'Exposure to Electromagnetic Fields of High Voltage Overhead Power Lines and Female Infertility. Int J Occup Environ Med. 2019 Jan;10(1):11-16. doi: 10.15171/ijoem.2019.1429. PMID: 30685773; PMCID: PMC6522214. [N=462 Women] *"Women living within 500 meters of the lines (OR 4.14, 95% CI 2.61 to 6.57) and 500–1000 meters of the line (OR 1.61, 95% CI 1.05 to 2.47) carried a significantly higher risk of infertility than those women living more than 1000 meters away from the power lines. After adjusting for confounding factors, women living within 500 meters of the lines carried a higher risk (aOR 4.44, 95% CI 2.77 to 7.11) of infertility compared with women living more than 1000 meters of the lines."*	2019	Open Access

Reproductive effects	Preterm birth among women living within 600 meters of high voltage overhead Power Lines: a case-control study [Iran]	Sadeghi, T. et al. (2017) 'Preterm birth among women living within 600 meters of high voltage overhead Power Lines: a case-control study', Romanian Journal of Internal Medicine, 55(3), pp. 145–150. Available at: https://doi.org/10.1515/rjim-2017-0017. [N=135 preterm births] *"There were 28 households, 20 cases (14.8%) and 8 controls (5.3%) situated within 600 meters of high voltage power lines. The adjusted OR for spontaneous preterm birth and birth defect in women who were living in less than 600 meters from high voltage power lines was higher compared to those living at farther distance (OR = 3.28, CI: 1.37 to 7.85) and (OR = 5.05, CI: 1.52 to 16.78), respectively."*	2017	Open Access
Sleep	Daytime 50 Hz magnetic field exposure and plasma melatonin and urinary 6-sulfatoxymelatonin concentration profiles in humans. [Belgium]	Crasson, M., Beckers, V., Pequeux, C., Claustrat, B. and Legros, J.J. (2001), 'Daytime 50 Hz magnetic field exposure and plasma melatonin and urinary 6-sulfatoxymelatonin concentration profiles in humans.' Journal of Pineal Research, 31: 234-241. https://doi.org/10.1034/j.1600-079X.2001.310307.x [N=21, experimental study] *"We conclude that this study does not indicate that daytime acute MF exposure influences either melatonin secretion or aMT6s excretion. Inter-individual differences in pineal production of melatonin, however, have to be taken into account in further studies."*	2001	Abstract
Cancer	Non-ionizing radiation as possible carcinogen [Review - Focus on mobile phones].	Gupta, S., Sharma, R. S. and Singh, R. (2020) 'Non-ionizing radiation as possible carcinogen', International Journal of Environmental Health Research, 32(4), pp. 916–940. doi: 10.1080/09603123.2020.1806212. *"The review provides the latest research evidence based both on in vitro studies, in vivo studies, and possible gaps in our knowledge. Moreover, the present review also summarizes available literature in this subject, reports and studies which will help to form guidelines for its exposure limits to the public."*	2020	Abstract