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Magnetic fields:

A 1999 report to Congress by the U.S. federal research institute, the National Institute of Environmental Health Sciences (NIEHS), concluded, "[E]xposure to power-line frequency ELF-EMF is a 'possible' human carcinogen... NIEHS suggests that the power industry... reduce exposures." The NIEHS report also states, "evidence exists for an association between brain cancers and exposure to ELF-EMF and between female breast cancers and ELF-EMF exposure... Long-term exposure to electric fields decreases melatonin concentrations... ELF-EMF... could subsequently lead to changes in DNA structure... 60 Hz electric fields... suppress formation of osteoclast-like cells in marrow culture..."

https://www.niehs.nih.gov/sites/default/files/health/assets/docs_p_z/report_powerline_electric_mg_predates_508.pdf

The Government Accountability Office (GAO), a federal agency founded in 1921, noted in a 1994 report: "[S]ome research has shown that EMFs suppress the production of melatonin in rats... Laboratory studies also show that magnetic fields affect the flux of calcium ions, which regulate cellular activities. These responses, some scientists theorize, may also promote biological changes that increase the risk of cancer... Since 1979, several epidemiological studies have suggested that for people... who live near... distribution lines, the risk of cancers... may be greater than for the general population..." GAO concluded: "[T]he intensity of magnetic fields may or may not be the key parameter that determines whether the fields harm human health. Other factors that may be responsible include the frequency of the electric current... and biological effects that occur only in certain 'windows' of intensity or frequency..."

<https://www.gao.gov/assets/rced-94-115.pdf>

A 2002 NIEHS follow-up report on EMF states: "[W]e must use caution in... concluding that a lack of an effect in laboratory studies proves that an agent is safe... average exposure may not be the best measurement of EMF exposure... other parameters, such as peak exposure or time of exposure, may be important... overnight exposure to 60-Hz magnetic fields may disrupt brain electrical activity (EEG) during night sleep... Individuals exposed to the intermittent magnetic fields showed alterations in traditional EEG sleep parameters indicative of a pattern of poor and disrupted sleep..."

<https://www.nrc.gov/docs/ML1126/ML112660024.pdf>

A California Department of Health Services (DHS) 2002 report produced from an eight-year study concludes: "the DHS scientists are inclined to believe that EMFs can cause some degree of increased risk of childhood leukemia, adult brain cancer, Lou Gehrig's Disease, and miscarriage..."

<https://ehtrust.org/wp-content/uploads/CA-EMF-.pdf>

An 18-year Swiss study of 3,555,064 adults in the Swiss National Cohort (2001–2018) published in Environment International (2026) concluded: "Long-term ELF-MF exposure was associated with higher dementia mortality risk in the general population... ELF-MF exposure has been suggested as a risk factor for neurodegenerative diseases..."
<https://www.sciencedirect.com/science/article/pii/S0160412026001030>

Ground currents:

According to a 2025 article in the International Journal of Science and Research (IJSR): "Proximity to infrastructure was found to correlate with higher measured ground currents. Infrastructure-proximal measurements "yielded an average underground current density of 6.1 A/m², which is several orders of magnitude above purely capacitive theoretical estimates for comparable separations from infrastructure." Remote measurements "yielded an average underground current density of 0.008 A/m²." The article cites research proposing that DNA and voltage-gated calcium channels are affected by EMF: "Martin Blank and Reba Goodman, who... proposed that ELF fields perturb electron transfer within DNA... The resulting local destabilization can favor base-pair separation, facilitating initiation of transcription... The idea that non-thermal electromagnetic fields can modulate voltage-gated calcium channels (VGCCs) was first articulated by Dimitris J. Panagopoulos and colleagues and subsequently experimentally verified a number of times... [L]ow-frequency electric fields at levels commonly found near leaky transmission infrastructure can induce transmembrane polarization on the order of a few hundred microvolts... sufficient to shift VGCC open probability by percent-level amounts."
[https://www.horsevad.net/Publications/Horsevad---2025---Environmental Current Pollution.pdf](https://www.horsevad.net/Publications/Horsevad---2025---Environmental_Current_Pollution.pdf)

A federal agency, the Bonneville Power Administration, published a 1996 report which states: "Currents on metallic plumbing systems that are connected to the neutral wire of the power distribution system can also be a significant source of magnetic fields in some buildings... [A] study... found a statistically significant threefold increase in child cancer risk for homes... with metal water pipes, compared to homes with nonconductive pipes... Nonconductive pipes do not conduct electric grounding current, so they are not a source of magnetic fields."
<https://lealelectric.org/f/2022/01/Electrical-and-Biological-Effects-of-Transmission-Lines-A-review-December-1996.pdf>

Utility smart meters:

In a 2012 letter, the Environmental Medicine Department of the Austrian Medical Association stated that the planned area-wide introduction of smart meters could lead to health consequences. The letter added that data transmission would "lead to a

significant increase in exposure to electrosmog," and argued available transmission methods such as radio or Power Line Communication (PLC) could produce "electrosmog that is harmful to health." It further claimed that PLC systems would cause electrical wiring and connected devices to emit increased electromagnetic fields in the kilohertz range, and suggested that an increased incidence of "multisystem diseases" (affecting multiple organs or functional systems) was conceivable, with reported symptoms including fatigue, learning problems, and depression.

<https://smartmeterharm.org/wp-content/uploads/2014/07/aust-phys-chamber-pr-engl-tra ns-i1.pdf>

The American Academy of Environmental Medicine (AAEM), a medical society of licensed health-care practitioners, states that it "strongly supports the... avoidance of radiofrequency such as from... 'smart meters.' The peer reviewed, scientific literature demonstrates the correlation between RF exposure and neurological, cardiac, and pulmonary disease as well as reproductive and developmental disorders, immune dysfunction, cancer and other health conditions.

<https://www.aaemonline.org/wireless-radiofrequency-radiation-schools/>

Radio frequency radiation:

In a 1965 study by W. Bergman at Ford Motor Company (FMC), the effects resulting from radiation exposure were documented to include reduced energy, mood deterioration, impaired sleep quality, and disturbed glucose regulation. The research identifies these effects as non-thermal. Bergman explains: "The autonomic nervous system is affected by the microwaves of the centimeter wave length band. These waves affect circulation, respiration, temperature control, water balance, albumin and sugar concentration in the cerebro-spinal fluid, hydrogen ion concentration, EEG, GSR, sleep, conscious awareness, etc... The biological effect of these waves results from the resonance absorption in the ganglia... The influence of short-wave energy on sensory nerves as well as on motor nerves cannot be attributed to the evolution of heat in the test subject... [P]ersons... [exposed] often sleep fitfully, with feelings of a lack of energy, exhaustion and apathy... With longer exposure... symptoms characteristic of neurasthenia appear: restlessness, excitation, sometimes anxiety and pessimism, disturbed sleep (difficulties), extensive fatigue, debility and feeling of inactivation... All of these symptoms disappeared promptly when the corresponding persons were removed for some time from the field of the transmitter radiation."

https://www.magdahavas.com/wp-content/uploads/2010/12/German_Ford_Motor_comp any_The_Effect_of_Microwaves_on_The_Central_Nervous_System.pdf

The National Council on Radiation Protection and Measurements (NCRP) is a nonprofit organization chartered by the U.S. Congress in 1964 to provide guidance on radiation protection. A 300+ page 1986 NCRP report documents effects from electromagnetic exposure, including carcinogenicity from electric and magnetic fields. The authors warn that the specific absorption rate (SAR) is a poor metric for gauging the safety of

radiation exposure. The report states: "In experiments in which isolated chicken brains were exposed... to fields... an exodus of calcium ions (Ca 2+) from brain materials was observed... Because the average amount of energy captured by brain materials was held constant across frequencies, thermal effects alone could not be responsible for the release of Ca 2+... it can be stated that there is ample evidence that athermal interactions in biological materials... have been demonstrated... The ability of RFEM [radio frequency electromagnetic] fields to induce chromosomal and mutagenic effects has been demonstrated... micro-wave exposure may, under certain conditions, act as a cancer promoter... Exposure to RFEM fields has been demonstrated to produce a wide variety of effects on neurological, immunological, biochemical, hematologic, genetic, developmental, neuroendocrine and cellular end points in mammals... RFEM fields could be related, directly or indirectly, to carcinogenesis... RFEM exposure may result in a decreased marrow reserve of granulocytes... A response by an organism to RFEM radiation may have a thermal basis, an athermal basis, or a combined basis." The NCRP authors note the ANSI/IEEE exposure limits from which FCC standards originated assumed a body was floating and not in contact with any object and explicitly acknowledge that if the person is touching grounded or metallic objects, the 'safe' limits no longer apply. A person in contact with any grounded object creates current pathways through the body or contact currents, and most real-world environments involve contact. <https://www.ehtrust.org/wp-content/uploads/NCRP-Report-86-.pdf>

The International Association of Fire Fighters (IAFF) opposes wireless infrastructure on fire stations: "[A]s adopted... in August 2004... the IAFF oppose the use of fire stations as base stations for towers and/or antennas for the conduction of cell phone transmissions... [T]he effects of radio frequency radiation on the central nervous system... and the immune system, as well as other metabolic effects... are established... [A] large body of internationally accepted scientific evidence... points to the existence of non-thermal effects of RF/MW radiation... The Environmental Protection Agency (EPA) has stated repeatedly that the current (ANSI/IEEE) [and FCC] RF/MW safety standards protect only against thermal effects." <https://www.iaff.org/cell-tower-radiation/>

A 2015 Egyptian research article reported: "exposure to electromagnetic field EMF caused significant decreases in the serotonin and melatonin content of rat brains... [T]he decreases in serotonin levels might result from reduced synthesis resulting from radiation-induced damage to the ileal mucosa, and decrease in the absorption of tryptophan involved in the synthesis of serotonin... considering melatonin's anti-oxidative properties, lowering its levels could increase DNA susceptibility to damage and eventually the overall cancer risk... Significantly higher levels of stress biomarkers like adrenaline, noradrenaline, and cortisol have been documented in medical staffs with RFR-EMF exposures..." https://www.researchgate.net/publication/324227263_Effect_of_Exposure_to_Electromagnetic_Fields_Emfs_on_Monoamine_Neurotransmitters_of_Newborn_Rats

A 2017 review in Military Medical Research summarizes studies reporting neurological and sleep-related effects associated with shortwave (SW) electromagnetic exposure. One occupational study found workers exposed to 3–30 MHz EMF for more than two

years showed significantly increased EEG abnormalities and higher incidence of symptoms including headache, dizziness, and insomnia. Another study reported improved sleep quality in nearby residents when a 6–22 MHz broadcast transmitter was shut down. The review also cites observations that nightly melatonin excretion increased after temporary transmitter shutdown along with reported sleep improvement. The authors also state: "Generally, thermal and non-thermal mechanisms have been widely accepted... It was well accepted that the cellular membrane was a primary target for electromagnetic radiation, and it contained abundant ion channels and receptors for signaling. Numerous cellular studies have focused on the effects of SW radiation on signal transduction pathways, and the calcium (Ca²⁺)-dependent signaling pathways have received the most attention. Additionally, several studies have revealed some relationships between SW radiation and chromosome or cell cycle injury, suggesting there are other injury mechanisms." <https://pmc.ncbi.nlm.nih.gov/articles/PMC5518414/>

A 2020 article published in Environmental Research states: "the basic operation of cellular phone networks demands widespread human exposure to radio-frequency radiation (RFR)... there is already enough medical and scientific evidence to warrant long-term liability concerns for companies deploying cellular phone towers. In order to protect cell phone tower firms from the ramifications of the failed paths of other industries that have caused unintended human harm (e.g. tobacco) this article summarizes the peer-reviewed literature on the effects of RFR from cellular phone base stations... There is a large and growing body of evidence that human exposure to RFR from cellular phone base stations causes negative health effects including both i) neuropsychiatric complaints such as headache, concentration difficulties, memory changes, dizziness, tremors, depressive symptoms, fatigue and sleep disturbance; and ii) increased incidence of cancer... Overall, in epidemiological studies to date that assessed negative health effects of mobile phone base stations... 80% reported increased prevalence of adverse neurobehavioral symptoms or cancer... these effects may be cumulative... The current, U.S. standards are based solely on thermal effects... and thus do not mitigate against non-thermal effects (for which there is a growing litany of concern in the medical/scientific community)... [M]any researchers argue for the revision of standard guidelines for public exposure to... [RFR] from mobile phone base station antennas. As Roda and Perry summarize, "... a precautionary approach is better suited to State obligations under international human rights law." [...] American companies are therefore ill advised to simply follow "regulatory compliance" on this front, as there appears to be a clear cause for concern in the scientific/medical communities... cellular phone companies would potentially be in position of future legal exposure for causing widespread human health problems and premature death. It is, therefore, in American companies' best interest to act before government and regulation catches up with the science."

https://acris.aalto.fi/ws/portalfiles/portal/40738889/Limiting_Liability_with_Positioning_to_M.pdf

A 2020 review article published in Environmental Research states: "EMF can induce changes in calcium signaling cascades, significant activation of free radical processes and overproduction of reactive oxygen species (ROS) in living cells as well as altered

neurological and cognitive functions and disruption of the blood-brain barrier... It is concluded that the mechanisms underlying the symptoms of EHS are biologically plausible and that many organic physiologic responses occur following EMF exposure... The symptoms are similar to those reported by patients with multiple chemical sensitivity (MCS) and include central nervous system symptoms, including headache, fatigue, stress, sleep disturbance, "brain fog", short term memory disturbances, irritability, emotional lability and anxiety. Other symptoms that are often experienced by patients include nausea, chest pain, palpitations, shortness of breath, muscle aches, reduced libido, decreased appetite, and skin re-actions."

https://www.academia.edu/42896439/Electromagnetic_hypersensitivity_EHS_microwave_syndrome_Review_of_mechanisms

A 2021 European Parliamentary Research Service (EPRS) review notes, "The harmful effects of non-thermal biological interaction of RF-EMF with human and animal tissues have not been included in the determination of the ICNIRP 2020 guidelines (ICNIRP 2020a), despite the huge amount of available scientific publications demonstrating the harmfulness or potential harmfulness of those effects. Athermal bioresponses exist... thermal as well as non-thermal effects of RF-EMF have to be considered in risk assessment... [W]e found 950 papers on the carcinogenicity of RF-EMF in humans, and 911 papers on experimental rodent studies, totalling 1 861 studies. Regarding reproductive/developmental studies, we found 2 834 papers for epidemiology and 5 052 studies for experimental rodent studies..." EPRS concludes, "As a synthesis of what we have managed to analyse in the available scientific literature, in both human and animal studies, we can say that RF-EMF at FR1 frequencies exposure probably cause cancer, and in particular gliomas and acoustic neuromas in humans... These frequencies clearly affect male fertility. These frequencies possibly affect female fertility. They possibly have adverse effects on the development of embryos, fetuses and newborns... What epidemiological studies already showed in 2011 (IARC, 2013) has been confirmed by studies on laboratory animals, especially concerning the connection between exposure to RF-EMF and the carcinogenic effect in the nervous system."

[https://www.europarl.europa.eu/RegData/etudes/STUD/2021/690012/EPRS_STU\(2021\)690012_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2021/690012/EPRS_STU(2021)690012_EN.pdf)