

[Electromagnetic Fields and Cancer - NCI](#)

Electric fields are produced whether or not a device is turned on, whereas magnetic fields are produced only when current is flowing, which usually requires a device to be turned on. Power lines produce magnetic fields continuously because current is always flowing through them. Electric fields are easily shielded or weakened by walls and other objects, whereas magnetic fields can pass through buildings, living things, and most other materials.

Electric and magnetic fields together are referred to as electromagnetic fields, or EMFs. The electric and magnetic forces in EMFs are caused by electromagnetic radiation. There are two main categories of EMFs:

- Higher-frequency EMFs, which include x-rays and gamma rays. These EMFs are in the ionizing radiation part of the electromagnetic spectrum and can damage DNA or cells directly.
- Low- to mid-frequency EMFs, which include static fields (electric or magnetic fields that do not vary with time), magnetic fields from electric power lines and appliances, radio waves, microwaves, infrared radiation, and visible light. These EMFs are in the non-ionizing radiation part of the electromagnetic spectrum and are not known to damage DNA or cells directly. Low- to mid-frequency EMFs include extremely low frequency EMFs (ELF-EMFs) and radiofrequency EMFs. ELF-EMFs have frequencies of up to 300 cycles per second, or hertz (Hz), and radiofrequency EMFs range from 3 kilohertz (3 kHz, or 3,000 Hz) to 300 gigahertz (300 GHz, or 300 billion Hz). Radiofrequency radiation is measured in watts per meter squared (W/m²).

Why are non-ionizing EMFs studied in relation to cancer?

Power lines and electrical appliances that emit non-ionizing EMFs are present everywhere in homes and workplaces. For example, wireless local networks are nearly always “on” and are increasingly commonplace in homes, schools, and many public places.

No mechanism by which ELF-EMFs or radiofrequency radiation could cause cancer has been identified. Unlike high-energy (ionizing) radiation, EMFs in the non-ionizing part of the electromagnetic spectrum cannot damage DNA or cells directly. Some scientists have speculated that ELF-EMFs could cause cancer through other mechanisms, such as by reducing levels of the hormone melatonin. There is some evidence that melatonin may suppress the development of certain tumors.

Studies of animals have not provided any indications that exposure to ELF-EMFs is associated with cancer (10–13). The few high-quality studies in animals have provided no evidence that Wi-Fi is harmful to health (8).

Although there is no known mechanism by which non-ionizing EMFs could damage DNA and cause cancer, even a small increase in risk would be of clinical importance given how widespread exposure to these fields is.

What have studies shown about possible associations between non-ionizing EMFs and cancer in children?

Numerous epidemiologic studies and comprehensive reviews of the scientific literature have evaluated possible associations between exposure to non-ionizing EMFs and risk of cancer in children (13–15). (Magnetic fields are the component of non-ionizing EMFs that are usually studied in relation to their possible health effects.) Most of the research has focused on leukemia and brain tumors, the two most common cancers in children. Studies have examined associations of these cancers with living near power lines, with magnetic fields in the home, and with exposure of parents to high levels of magnetic fields in the workplace. No consistent evidence for an association between any source of non-ionizing EMF and cancer has been found.

Exposure from power lines. Although a study in 1979 pointed to a possible association between living near electric power lines and childhood leukemia (16), more recent studies have had mixed findings (17–25). Most of these studies did not find an association or found one only for those children who lived in homes with very high levels of magnetic fields, which are present in few residences.

Several studies have analyzed the combined data from multiple studies of power line exposure and childhood leukemia:

- A pooled analysis of nine studies reported a twofold increase in risk of childhood leukemia among children with exposures of 0.4 μT or higher. Less than 1% of the children in the studies experienced this level of exposure (26).

- A meta-analysis of 15 studies observed a 1.7-fold increase in childhood leukemia among children with exposures of 0.3 μT or higher. A little more than 3% of children in the studies experienced this level of exposure (27).
- More recently, a pooled analysis of seven studies published after 2000 reported a 1.4-fold increase in childhood leukemia among children with exposures of 0.3 μT or higher. However, less than one half of 1% of the children in the studies experienced this level of exposure (28).

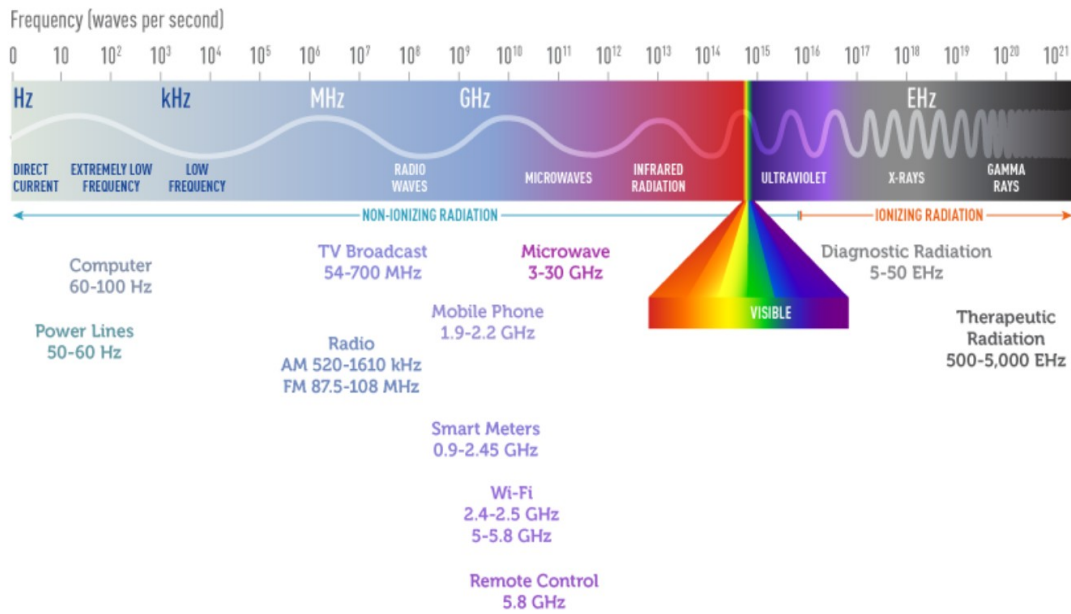
For the two pooled studies and the meta-analysis, the number of highly exposed children was too small to provide stable estimates of the dose-response relationship. This means that the findings could be interpreted to reflect linear increases in risk, a threshold effect at 0.3 or 0.4 μT , or no significant increase.

The interpretation of the finding of increased childhood leukemia risk among children with the highest exposures (at least 0.3 μT) is unclear.

What do expert organizations conclude about the cancer risk from EMFs?

In 2002, the International Agency for Research on Cancer (IARC), a component of the World Health Organization, appointed an expert Working Group to review all available evidence on static and extremely low frequency electric and magnetic fields (13). The Working Group classified ELF-EMFs as “possibly carcinogenic to humans,” based on limited evidence from human studies in relation to childhood leukemia. Static electric and magnetic fields and extremely low frequency electric fields were determined “not classifiable as to their carcinogenicity to humans” (13).

ELECTROMAGNETIC SPECTRUM



The electromagnetic spectrum represents all of the possible frequencies of electromagnetic energy. It ranges from extremely long wavelengths (extremely low frequency exposures such as those from power lines) to extremely short wavelengths (x-rays and gamma rays) and includes both non-ionizing and ionizing radiation.

[BACK TO TOP](#)