EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Frequently Asked Questions About Electric and Magnetic Fields

Environmental Issues

What are electric and magnetic fields?

The use of electricity produces electric and magnetic fields (EMF). Magnetic fields are produced by the flow of electric current in a wire or cable; electric fields are produced by voltage, the electrical "pressure" that drives the current. Currents traveling on transmission lines (the lines mounted on tall towers) or distribution lines (the lines that carry electricity directly to homes and businesses) or in ground pathways all generate magnetic fields; electrical appliances and devices are other sources. Electric fields are present in rights-of-way under high-voltage transmission lines and, at lesser strengths, under distribution lines and in homes. EMF can be imagined as invisible, weightless lines of force surrounding a source. Both magnetic fields and electric fields weaken as distance from the source increases.

What is known about health effects from EMF?

EMF research initially investigated electric fields but found no evidence of any health effects at levels encountered in homes. In 1979, the focus of EMF science shifted to magnetic fields. After more than 35 years of research addressing health outcomes, there is no conclusive evidence that magnetic fields adversely affect health. Epidemiologic studies, which examine disease in both general and working populations, form a significant segment of the research. Many epidemiologic studies have investigated the possible relationship between magnetic fields and childhood leukemia. Although a cause-and-effect relationship has not been established, several expert panels have concluded that higher rates of childhood leukemia are statistically associated with higher levels of magnetic fields in homes.

Is childhood leukemia the only health effect of concern?

No. Researchers have studied cancers of different types, including adult leukemia, childhood and adult brain cancer, and male and female breast cancer. Health effects other than cancer have also been investigated. For example, two studies published in 2002 renewed interest in the possible relationship between magnetic field exposure and miscarriage. Some studies suggest that occupational magnetic field exposure might be linked to Alzheimer disease and amyotrophic lateral sclerosis (ALS, or Lou Gehrig's disease). At present, however, the evidence remains inadequate for drawing conclusions.

Considering the epidemiologic association between magnetic fields and childhood leukemia, can we conclude that magnetic fields cause cancer?

Evaluations of potential risk from any environmental exposure rely on a broad base of scientific evidence. The evidence consists of (1) data from epidemiologic studies, (2) results from laboratory studies using rodents or cell cultures, and (3) information on the possible mechanism by which an exposure could produce a biologic effect. Although a number of epidemiologic studies report an association between magnetic field exposure and childhood leukemia, experts agree that the data do not justify a conclusion that a cause-and-effect relationship exists. The vast majority of lifetime experiments in rodents do not support a link between residential levels of magnetic fields and cancer. Moreover, biophysicists have not identified a mechanism by which low-level magnetic fields could interact with living tissue to produce biologic effects. So, although epidemiologic associations cannot be dismissed, magnetic fields cannot be implicated as a cancer-causing agent.

What expert panels have evaluated EMF health effects?

During the past several years, organizations concerned with public health have convened expert panels to conduct in-depth evaluations of the scientific literature on EMF and health. Among these organizations are the World Health Organization (WHO), the International Agency for Research on Cancer (IARC), the U.S. National Institute of Environmental Health Sciences (NIEHS) , and the UK"s National Radiological Protection Board (NRPB; now the Radiation Protection Division of the Health Protection Agency). The panels convened by these organizations consisted of scientists who are specialists in a number of fields, including epidemiology, exposure assessment, laboratory sciences, physics, and engineering. A panel of three scientists from the California Department of Health Services (CDHS) also conducted an EMF health risk evaluation.

What did these panels conclude?

All of the scientific panels that assessed the literature on EMF and health pointed to an association between magnetic fields and childhood leukemia, and the NIEHS also suggested that magnetic fields in the workplace might be associated with adult leukemia. However, only the CDHS scientists indicated that the evidence was adequate to implicate magnetic fields as a contributor to adult brain cancer, miscarriage, and ALS.

Where do we go from here?

The evaluation of possible health risks from environmental factors is an ongoing process. As new data become available, government and scientific organizations often reevaluate information to determine whether previous positions on possible health effects remain valid. In 2007, the World Health Organization released the most recent health risk evaluation, which did not change the conclusion of previous evaluations that there is an epidemiologic association between magnetic fields and childhood leukemia. WHO found inadequate evidence for an association with other cancers, Alzheimer disease, ALS, or miscarriage and recommended further research on these diseases. However, WHO concluded that the evidence does not support a link with cardiovascular disease, breast cancer, or electromagnetic hypersensitivity.

Research in the United States and elsewhere continues to investigate health effects potentially associated with electrical environments. EPRI has a very active EMF research program that is investigating a number of residential and occupational health issues. The program includes in-progress studies to address many of WHO's highest priority research recommendations.

What is EPRI's role in all this?

EPRI scientists participated in both the IARC and NIEHS evaluations and contributed to the WHO evaluation. EPRI was also represented on a stakeholders advisory committee that provided input to the CDHS evaluation. EPRI is the only organization in North America funding a multidisciplinary research program to investigate uncertainties concerning the association of magnetic fields with childhood leukemia and address other EMF health and safety issues. Since its founding in 1973, EPRI has invested over $150 million in EMF research. Regular consultation with an independent scientific advisory committee of eminent scientists adds assurance that the EMF program is conducted in a manner consistent with the highest scientific principles.

Contact Information

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Product ID: 1019448 July 2009

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