

Are there any health effects associated with electric and magnetic fields?

Established effects. A number of known effects on the human body which result from relatively high-level electric and magnetic fields (EMF) have been identified such as hair movement, the magnetophosphene effect and microshocks. These effects, described below, occur at field strengths well above field strengths found on the ground below a transmission line.

Hair movement

Hair can be caused to move by an electric charge induced at the body's surface.

The magnetophosphene effect

Results from currents induced in humans by either electric or magnetic fields. These weak currents can cause a flickering in the peripheral vision, similar to the effect when you rub your eyes and see white spots. Prevention of this effect determines guideline levels for magnetic fields.

Although the magnetophosphene effect is mildly distracting, it is temporary and has no lasting health effect after field levels reduce.

Microshocks

Microshocks may occur in particular circumstances when the body comes into contact with objects such as fence lines that may have a current induced in them by the electric and magnetic field. This is similar in effect to the small shock you might feel from a car door. The avoidance of microshocks determines the guideline for electric fields.

Possible effects from Extremely Low Frequency (ELF) magnetic fields

Since the late 1970s, there have been epidemiological investigations into the possibility of health effects associated with lower-level environmental exposures to EMF.

Epidemiology is the study of how often diseases occur in different groups of people and why. It has been used to look for differences between the health of people in populations who are exposed and those who are not exposed to power frequency EMF. A difficulty in epidemiological studies is in isolating other

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potential factors that could contribute to any observed health effect from EMF exposure. These may include factors such as age or socioeconomic status of individuals in the population studied, as well as less obvious ones. However, epidemiology can find possible effects that might otherwise be missed.

Other scientific approaches are also applied to understand the nature of any cause and effect. For example, laboratory experimentation is conducted to look for any effects of exposure on cells and animals. Theoretical science is also applied to assess the plausibility of mechanisms by which EMF exposure might lead to an effect.

Several decades ago, some researchers in the United States published an epidemiological study that suggested the possibility that there could be an association between certain cancers and electric and magnetic fields from power distribution systems. Since then there have been many studies with varying results.

In June 2007 the World Health Organization reported on the possible health effects of exposure to extremely low frequency electric and magnetic fields. In its summary section WHO states the following.

'Scientific evidence suggesting that everyday, chronic low-intensity (above 0.3–0.4 μ T) power-frequency magnetic field exposure poses a health risk is based on epidemiological studies demonstrating a consistent pattern of increased risk for childhood leukaemia. Uncertainties in the hazard assessment include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields and childhood leukaemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level ELF magnetic fields and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern.'

Although a causal relationship between magnetic field exposure and childhood leukaemia has not been established, the possible public health impact has been calculated assuming causality in order to provide a potentially useful input into policy. However, these calculations are highly dependent on the exposure distributions and other assumptions, and are therefore very imprecise. Assuming that the association is causal, the number of cases of childhood leukaemia worldwide that might be attributable to exposure can be estimated to range from 100 to 2400 cases per year. However, this represents 0.2 to 4.9% of the total annual incidence of leukaemia cases, estimated to be 49 000 worldwide in 2000. Thus, in a global context, the impact on public health, if any, would be limited and uncertain.

A number of other diseases have been investigated for possible association with ELF magnetic field exposure. These include cancers in both children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications and neurological disease. The scientific evidence supporting a linkage between ELF magnetic fields and any of these diseases is much weaker than for childhood leukaemia and in some cases (for example, for cardiovascular disease or breast cancer) the evidence is sufficient to give confidence that magnetic fields do not cause the disease.'

The weight of international scientific opinion is that no causal connection has been confirmed between lower level EMF in the environment and the health effects suggested by epidemiological research.

Childhood leukaemia is a rare disease with 4 out of 100,000 children between the age of 0 to 14 diagnosed every year.

In New Zealand the Interagency Advisory Committee on the Health Effects of Electromagnetic Fields last reported on the potential health effects of EMF to the Government in 2004. In its executive summary it stated:

'Although questions still remain over the reason for a weak association between exposure to relatively high levels of low frequency magnetic fields and childhood leukaemia, there is no good reason to believe that there is a cause and effect relationship between the two, or to reformulate exposure limits based on these findings. If the association represents a truly causal link, it has been estimated that in worst case magnetic fields would be responsible for less than 0.5% of cases of childhood leukaemia. A New Zealand study (Dockerty, J.D., et al.) found that none of the [86] cases of childhood leukaemia reported over a four year period was associated with exposure to high levels of magnetic fields'.

In June 2001, the International Agency for Research on Cancer (IARC), which is part of the World Health Organization and is responsible for the classification of environmental agents in terms of the likelihood that they are a cause of cancer, delivered a finding about the category into which extremely low frequency or power frequency fields would be placed.

IARC has three categories to classify potential carcinogens, "is carcinogenic to humans", "probably carcinogenic to humans" and "possibly carcinogenic to humans". Some examples of well-known agents that have been classified by IARC are listed below:

Classification	Examples of Agents
Carcinogenic to humans	Asbestos Mustard gas Tobacco (smoked and smokeless) Gamma radiation Formaldehyde
Probably carcinogenic to humans	Diesel engine exhaust Sun lamps UV radiation
Possibly carcinogenic to humans	Coffee Styrene Gasoline engine exhaust Welding fumes ELF magnetic fields

Source: WHO EMF Fact Sheet No. 263 (updated).

IARC, using its standard approach that weighs human, animal and laboratory evidence, classified extremely low frequency magnetic fields as possibly carcinogenic to humans. This is based on epidemiological studies of childhood leukaemia. Evidence for all other cancers in children and adults, as well as other types of exposures (i.e. static fields and ELF electric fields) was considered "not classifiable" either due to insufficient or inconsistent scientific information.

The classification "Possibly carcinogenic to humans" indicates an agent for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence for carcinogenicity in experimental animals.

In its June 2007 report on possible EMF health effects the World Health Organization state, *'New human, animal and in vitro studies, published since the 2002 IARC monograph, do not change the overall classification of ELF magnetic fields as a possible human carcinogen.'*

The research to date establishes that if the "worst case" current data on an apparent association between EMF and cancer in young children was adopted, it would mean that of approximately 200 cases of childhood leukaemia that occur in New Zealand every five years, statistically one might be associated with exposure to mains electric power.

The weight of international scientific opinion is that no causal connection can be confirmed between lower-level EMF in the environment and the health effects suggested by epidemiology.

Effects on farm animals

Where EMF levels are within the ICNIRP Guidelines (See Fact Sheet 4), there is unlikely to be any perceptible effect on animals. Transpower follows these ICNIRP Guidelines in the design of its assets.

Electric field strengths do have the potential to cause surface stimulatory effects. Although these would not be harmful in themselves, the potential exists for causing startle reactions.

The possibility of electric currents in conductors (such as fences) under lines requires attention as there is the potential for microshocks. This risk is controllable by effective grounding of any metallic structures, including power pylons and fences under or immediately adjacent to the lines.

Are electric and magnetic fields radiation?

There is no high-frequency radiation or radioactive emissions of any type from power lines. Such properties only occur above the frequency of visible light, thousands of millions of times higher than ELF fields.

This is one of five fact sheets produced by Transpower to provide the public with information about electric and magnetic fields. This fact sheet gives an overview of Transpower's understanding of the international consensus on electric and magnetic fields as they relate to health. Other fact sheets that are available and provide more detailed information cover:

- **Fact Sheet 1 on electric and magnetic fields and Transpower**
- **Fact Sheet 2 on the nature of electric and magnetic fields**
- **Fact Sheet 3 on the typical strength of electric and magnetic fields**
- **Fact Sheet 4 on guidance on safe levels of electric and magnetic fields.**

If you have further questions concerning EMF please call Transpower on 0508 526 369 or contact us through our website www.transpower.co.nz.