Power-frequency magnetic field and health

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Extended abstract

In 1979, an epidemiological study in Denver, Colorado, suggested that children's exposure to very weak power-frequency magnetic fields arising from electrical lines around houses might increase their risk of cancer[1]. The hypothesis was taken very seriously and exceptional research efforts have been devoted to this question worldwide. Over 400 epidemiological studies have been carried out, not only to study cancer but also many other health outcomes. At the same time, thousands of laboratory studies on cells, tissues and whole animals have been completed. In general, studies have failed to establish a causal relationship between any adverse health outcome and magnetic field exposure.

The intensity of the earth's natural static magnetic field is about 50 microteslas (µT). The human body is more or less "transparent" to the magnetic field and consequently, all tissues and cells of the body are exposed to the same magnetic field level. Humans tolerate very strong static fields, up to a few teslas without any adverse effects. Magnetic resonance imaging requires such fields, which are typically 50,000 times stronger than the natural field.

In homes, the use of electricity produces very weak magnetic fields - typically between 0.05 to 0.5 µT, a few hundred times weaker than the earth's natural field. However, the oscillating nature of power-frequency fields induces voltages and currents in the body, which become the limiting factor. The first effect known to occur in humans for a 60 Hz magnetic field appears at a field level of about 15,000 µT. The effect is a faint flickering visual sensation called magnetophosphene. It results from the stimulation of the retina of the eye as visible light does. The phenomenon is considered harmless and occurs occasionally during magnetic resonance imaging (MRI) procedures.

Most epidemiological studies were carried out among exposed workers but many others have been done among populations living close to high voltage power lines as well. No clear evidence of any adverse health effects has been identified. With regards to childhood cancer, more than 30 epidemiological studies have tried to replicate the original observation of the Denver study. Earlier studies reported some contradictory results. However, larger studies using better methodologies failed to identify any cancer risk. The more recent studies confirmed this tendency. In 2014, an exceptionally large study on childhood leukemia carried out in England. The authors concluded that past associations between the presence of power lines and childhood leukemia almost certainly cannot be attributed to power line-generated magnetic fields and might be explained by the socio-demographic characteristics of the population living near the power lines[2].

Standardized long term studies on rats and mice have been shown to be the most sensitive test for human carcinogenicity. Life-long exposure to power-frequency magnetic field levels up to 5,000 µT has not found any evidence of carcinogenicity. Moreover no other toxic or adverse effects have been observed. Studies on cells and theoretical approaches have shown no plausible mechanism by which any particular biological effects could occur at the very low magnetic field levels commonly encountered.

The amount of data generated by this international research effort is exceptional. We can safely assume that the hypothesis raised by the Denver study is very likely to be a false alarm, a situation which is not uncommon with exploratory epidemiological studies. Independent experimental lines of evidence from the physics, the biology and the toxicology confirm what common sense would have suggested: power-frequency residential magnetic field levels are much too weak to influence human biology. From a public health perspective, recommending preventive or precautionary measures is not justified. It would do more harm than good. It is time to be reasonable and reassure the public.

References

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