Living with electric and magnetic fields (EMF)

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As for back as 1972, a report was presented during a CIGRE session raised the possibility that exposure to power frequency (50/60 Hz) high electric fields might adversely affect workers' health. In 1979, an epidemiological study in Denver, Colorado suggested that children's exposure to power-frequency magnetic fields in the home might increase their risk of cancer.

For nearly 40 years, substantial research budgets have been devoted worldwide to the question of possible health effects of power frequency electric and magnetic fields. Over 400 epidemiological studies have been carried out around the world 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 carried out. The amount of data generated by this international research effort is exceptional. In general, studies have failed to establish a causal relationship between any particular adverse health outcome and electric or magnetic field exposure.

CIGRE has always recognized the importance of this issue in terms of its potential impact on the health and safety of workers in the electricity industry, and on the general public. CIGRE Administrative Council has an Expert Group comprising occupational and public health physicians supported by other scientists and engineers. Their role is to keep the President, members and others regularly informed on the issue of power-frequency electric and magnetic fields and health.

No adverse health effects have been found with exposure to electric fields. This position deals mainly about concerns related to magnetic fields exposure.

Magnetic fields and the human body

In homes, the use of electricity produces very low level magnetic fields typically between 0.05 to 0.5 microtesla (μT). Utility workers are exposed to average magnetic field levels up to 20 times the residential exposure with occasional periods up to 1,000 μT exposure.

The first effect known to occur in humans appears at magnetic fields level of around 15,000 μT. The effect is a faint flickering visual sensation called magnetophosphenes. 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.

The studies and their results

Most epidemiological studies were carried out among exposed workers but many others have been carried out among populations living close to high voltage power lines as well. No adverse health effect has been established. With regards to childhood cancer, more than 40 epidemiological studies have tried to replicate the original observation of the Denver study. Earlier studies reported some contradictory results. However, larger studies using sophisticated methodologies failed to identify a causal link.

In 2014, an exceptionally large study carried out in England showed that the association between the presence of a high voltage transmission lines and childhood leukemia observed in the 1960-70s diminished over time and was no longer present during recent decades. The authors concluded that past associations between the presence of powerlines and childhood leukemia almost certainly cannot be attributed to powerline-generated magnetic fields but most likely to the evolving population characteristics of people living near powerlines.

Long term studies on animals exposed to magnetic field levels up to 5,000 μT have not found any toxic or adverse effect. 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.

Conclusion

Considering the fact that 50/60 Hz electric and magnetic fields have been extensively studied worldwide and that no adverse health effect has been clearly identified, it is reasonable to conclude that a causal relationship with any particular disease including childhood leukemia, other cancers, cardiovascular diseases, neurodegenerative disorders and reproductive outcomes is very unlikely.

The knowledge gained from this research is very reassuring. Based on currently available scientific evidence, and considering the fact that the levels at which people are exposed are very low, there is no need to apply preventive measures regarding daily exposures to power frequency electric and magnetic fields. Present exposure limits recommended by international organizations offer adequate protection. The International Commission on Non-Ionizing Radiation Protection recommends a limit of 200 μT for the public and 1,000 μT for the workers.

Should new research projects be carried out, there would be little to gain in pursuing the study of very low level magnetic field exposure commonly encountered at home or in the vicinity of electrical equipment. However, only a few experimental studies in humans looking at very high magnetic field levels known to produce an effect on the central nervous system like magnetophosphenes have been done. Since those effects constitute the scientific basis of exposure limits recommended by international organizations, those studies are useful and should be encouraged.

CIGRE will continue to monitor the issue and to update its view in the light of any new developments. ■

1. The Tesla (symbol T) is a unit of measurement of the strength of the magnetic field.