

EMF Health Risk Evaluations

In 1997, the U.S. National Academy of Sciences (NAS) published an evaluation of the existing scientific information on possible health risks from exposure to the extremely low frequency (ELF) electric and magnetic fields (EMF) produced by the generation, transmission, and use of electricity. As new research results became available, other national and international organizations convened scientific panels with expertise in various fields to conduct new evaluations. These organizations include the U.S. National Institute of Environmental Health Sciences (NIEHS), the UK's National Radiological Protection Board (NRPB; now the Radiation Protection Division of the Health Protection Agency), the International Agency for Research on Cancer (IARC), and the World Health Organization (WHO), which published the most recent EMF health risk evaluation in 2007. In addition, a group of epidemiologists at the International Commission on Non-Ionizing Radiation Protection (ICNIRP) reviewed the epidemiologic literature on EMF and health in 2001, and scientists at the California Department of Health Services (DHS) published the results of their health risk evaluation in 2002. Conclusions from the major health risk evaluations and reviews are summarized in the excerpts below.

World Health Organization, 2007

A comprehensive WHO EMF health risk assessment was published in the June 2007 *Environmental Health Criteria* monograph *Extremely Low Frequency Fields*. The main conclusions, quoted from the assessment, are the following:

Scientific evidence suggesting that everyday, chronic, low-intensity ELF magnetic field exposure poses a possible health risk is based on epidemiological studies demonstrating a consistent pattern of an increased risk of childhood leukaemia. Uncertainties in the hazard assessment include the role of control selection bias and exposure misclassification. In addition, virtually all of the laboratory evidence and the mechanistic evidence fails to support a relationship between low-level ELF magnetic field exposure and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal and therefore ELF magnetic fields remain classified as possibly carcinogenic [IARC classified ELF magnetic fields as possibly carcinogenic in 2001; see below].

A number of other diseases have been investigated for possible association with ELF magnetic field exposure. These include other types of cancers in both children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications, neurological disease and cardiovascular disease. The scientific evidence supporting a linkage between exposure to ELF magnetic fields and any of these diseases is 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.

From: World Health Organization. *Environmental Health Criteria 238. Extremely low frequency fields*. World Health Organization, Geneva, Switzerland, 2007.

http://www.who.int/peh-emf/research/health_risk_assess/en/index2.html

International Agency for Research on Cancer, 2002

In 2002, in its *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans* series, IARC published the results of an EMF health risk evaluation conducted by an expert scientific working group that met in 2001. IARC stated at the conclusion of the working group's review:

IARC has now concluded that ELF magnetic fields are possibly carcinogenic to humans, based on consistent statistical associations of high level residential magnetic fields with a doubling of risk of childhood leukaemia. Children who are exposed to residential ELF magnetic fields less than 0.4 microTesla [4 milligauss] have no increased risk for leukaemia. . . . no consistent evidence was found that childhood exposures to ELF electric or magnetic fields are associated with

brain tumours or any other kinds of solid tumours. No consistent evidence was found that residential or occupational exposures of adults to ELF magnetic fields increase risk for any kind of cancer.

From: International Agency for Research on Cancer. IARC Finds Limited Evidence that Residential Magnetic Fields Increase Risk of Childhood Leukaemia. Press Release No. 136, 27 June 2001. <http://www.iarc.fr/en/media-centre/pr/2001/pr136.html>

California Department of Health Services, 2002

Three DHS scientists who reviewed studies of possible health effects from ELF EMF came to these conclusions:

- To one degree or another, all three of the DHS scientists are inclined to believe that EMFs can cause some degree of increased risk of childhood leukemia, adult brain cancer, Lou Gehrig's disease, and miscarriage.
 - They strongly believe that EMFs do not increase the risk of birth defects, or low birth weight.
 - They strongly believe that EMFs are not universal carcinogens, since there are a number of cancer types that are not associated with EMF exposure.
 - To one degree or another they are inclined to believe that EMFs do not cause an increased risk of breast cancer, heart disease, Alzheimer's disease, depression, or symptoms attributed by some to a sensitivity to EMFs.
- However,
- All three scientists had judgments that were "close to the dividing line between believing and not believing" that EMFs cause some degree of increased risk of suicide, or
 - For adult leukemia, two of the scientists are "close to the dividing line between believing or not believing" and one was "prone to believe" that EMFs cause some degree of increased risk.

From: California EMF Program. California Department of Health Services. An Evaluation of the Possible Risks from Electric and Magnetic Fields (EMFs) from Power Lines, Internal Wiring, Electrical Occupations, and Appliances: Final Report June 2002. California EMF Program, Oakland, CA, 2002. <http://www.ehib.org/emf/RiskEvaluation/riskeval.html>

National Radiological Protection Board, 2001

The following paragraph summarizes the conclusions of the NRPB's 2001 evaluation of health risks from EMF:

Laboratory experiments have provided no good evidence that extremely low frequency electromagnetic fields are capable of producing cancer, nor do human epidemiological studies suggest that they cause cancer in general. There is, however, some epidemiological evidence that prolonged exposure to higher levels of power frequency magnetic fields is associated with a small risk of leukaemia in children. . . . In the absence of clear evidence of a carcinogenic effect in adults, or of a plausible explanation from experiments on animals or isolated cells, the epidemiological evidence is currently not strong enough to justify a firm conclusion that such fields cause leukaemia in children. Unless, however, further research indicates that the finding is due to chance or some currently unrecognized artefact, the possibility remains that intense and prolonged exposures to magnetic fields can increase the risk of leukaemia in children.

From: National Radiological Protection Board. ELF Electromagnetic Fields and the Risk of Cancer: Report of an Advisory Group on Non-ionising Radiation. Documents of the NRPB Vol. 12, No. 1. National Radiological Protection Board, Oxon, UK, 2001. http://www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1195733797173_

In a separate review of studies investigating possible associations between EMF and neurodegenerative disease, the NRPB concluded:

There is no good ground for thinking that exposure to extremely low frequency electromagnetic fields can cause Parkinson's disease and only very weak evidence to suggest that it could cause Alzheimer's disease. The evidence that people employed in electrical occupations have an increased risk of developing amyotrophic lateral sclerosis is

substantially stronger, but this could be because they run an increased risk of having an electric shock rather than any effect of long-term exposure to the fields *per se*.

From: National Radiological Protection Board. *ELF Electromagnetic Fields and Neurodegenerative Disease: Report of an Advisory Group on Non-ionising Radiation. Documents of the NRPB* Vol. 12, No. 4. National Radiological Protection Board, Oxon, UK, 2001.

http://www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1195733844990

International Commission on Non-Ionizing Radiation Protection, 2001

The ICNIRP Standing Committee on Epidemiology concluded in its review of the epidemiologic literature on EMF and health:

In the absence of evidence from cellular or animal studies, and given the methodological uncertainties and in many cases inconsistencies of the existing epidemiologic literature, there is no chronic disease outcome for which an etiological relation to EMF exposure can be regarded as established. . . . Among all the outcomes evaluated in epidemiologic studies of EMF, childhood leukemia in relation to postnatal exposures above 0.4 μ T [microtesla] is the one for which there is most evidence of an association. . . . On the basis of epidemiologic findings, there is evidence for an association of ALS [amyotrophic lateral sclerosis, or Lou Gehrig's disease] with occupational EMF exposure although confounding is a potential explanation. Whether there are associations with breast cancer, cardiovascular disease, and suicide and depression remains unresolved.

From: ICNIRP Standing Committee on Epidemiology: A. Ahlbom, E. Cardis, A Green, M Linet, D Savitz, and A Swerdlow. "Review of the Epidemiologic Literature on EMF and Health," *Environmental Health Perspectives*. Vol. 109, Suppl. 6, p. 911–33 (2001).

<http://www.icnirp.de/pubEMF.htm>

National Institute of Environmental Health Sciences, 1999

In 1999 the NIEHS submitted a report to the U.S. Congress that summarized the results of both a 6-year EMF research program and a health risk evaluation conducted by an international working group of 30 scientists in 1998. The report concluded:

The scientific evidence suggesting that ELF-EMF exposures pose any health risk is weak. The strongest evidence for health effects comes from associations observed in human populations with two forms of cancer: childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults. . . . the associations reported for childhood leukemia and adult chronic lymphocytic leukemia cannot be dismissed easily as random or negative findings. The lack of positive findings in animals or in mechanistic studies weakens the belief that this association is actually due to ELF-EMF, but cannot completely discount the finding. . . . no other cancers or non-cancer health outcomes provide sufficient evidence of a risk to warrant concern. . . . The NIEHS believes that the probability that ELF-EMF exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal, scientific support that exposure to this agent is causing any degree of harm.

The NIEHS concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern.

From: National Institute of Environmental Health Sciences, National Institutes of Health. *NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields*. NIH Publication No. 99-4493. National Institute of Environmental Health Sciences, Research Triangle Park, NC, 1999.

<http://www.niehs.nih.gov/health/docs/niehs-report.pdf>

National Academy of Sciences / National Research Council, 1997

An expert committee convened by the National Research Council of the National Academy of Sciences stated their conclusions in a 1997 report:

... the current body of evidence does not show that exposure to these fields presents a human-health hazard. Specifically, no conclusive and consistent evidence shows that exposures to residential electric and magnetic fields produce cancer, adverse neurobehavioral effects, or reproductive and developmental effects.

From: National Research Council. *Possible Health Effects of Exposure to Residential Electric and Magnetic Fields*. National Academy Press, Washington, D.C., 1997.

<http://books.nap.edu/openbook/0309054478/html/index.html>