


January 1994

Coping with the Risk of Cancer in Children Living Near Power Lines

Eileen N. Abt

Follow this and additional works at: <https://scholars.unh.edu/risk>

 Part of the [Cancer Biology Commons](#), [Disorders of Environmental Origin Commons](#), [Energy and Utilities Law Commons](#), [Maternal, Child Health and Neonatal Nursing Commons](#), and the [Power and Energy Commons](#)

Repository Citation

Eileen N. Abt, *Coping with the Risk of Cancer in Children Living Near Power Lines*, 5 RISK 65 (1994).

This Article is brought to you for free and open access by the University of New Hampshire – School of Law at University of New Hampshire Scholars' Repository. It has been accepted for inclusion in RISK: Health, Safety & Environment (1990-2002) by an authorized editor of University of New Hampshire Scholars' Repository. For more information, please contact ellen.phillips@law.unh.edu.

Coping with the Risk of Cancer in Children Living Near Power Lines

Eileen N. Abt*

Introduction

Risks to children living near power lines have been a public health concern since 1979 when an epidemiological study linked exposure to electromagnetic fields (emfs) with childhood cancer,¹ and this research was sensationalized by Paul Brodeur.² While epidemiological studies have found a correlation,³ and children have relatively few exposures to account for observed associations,⁴ overall research still leaves much doubt. In fact, a panel of eleven prominent scientists, the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC), has stated:⁵

Epidemiologic findings of an association between electric and magnetic fields and childhood leukemia or other childhood or adult cancers, are inconsistent and inconclusive. No plausible biological mechanism is presented that would explain causality.

* Ms. Abt received her B.A. (Biology) from Brandeis University and M.S. (Environmental Health) from the Harvard School of Public Health. She is an Associate with Clement International, in Fairfax, VA.

¹ Nancy Wertheimer & Ed Leeper, *Electrical Wiring Configurations and Childhood Cancer*, 109 *Am. J. Epidemiol.* 273 (1979).

² *Currents of Death* (1989) and *Calamity on Meadow Street*, *New Yorker*, July 9, 1990, at 38.

³ Others considered here are David Savitz, *Case-Control Study of Childhood Cancer and Exposure to 60-Hz Magnetic Fields*, 128 *Am. J. Epidemiol.* 21 (1988); Stephanie London et al., *Exposure to Residential Electric and Magnetic Fields and Risk of Childhood Leukemia*, 134 *Am. J. Epidemiol.* 923 (1991) and Maria Feychting & Anders Ahlbom, *Magnetic Fields and Cancer in People Residing Near Swedish High Voltage Power Lines*, *Inst. Miljomedicin, Karolinska Institutet*, 2-10 (1992).

⁴ U.S. Environmental Protection Agency, *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields 1-3* (1990).

⁵ *Health Effects of Low-Frequency Electric and Magnetic Fields*, 27 *Envtl. Sci. & Tech.* 51 (1993).

They conclude that there is no justification for a major expansion of the research effort to investigate the health effects of extremely low frequency emfs.⁶

This must be taken in the context of about \$20 million now being spent annually on such investigations — about half of this by the Department of Energy (DOE) and the Electric Power Research Institute (EPRI), an industrial research organization.⁷ Many believe that DOE and EPRI sponsorship may lead to bias, and, in any case, the public is less likely to trust their studies.⁸

The population at risk and the uncertain research picture makes public communication about emf risks extremely difficult and susceptible to inaccurate, if not sensationalist,⁹ stories in the public media. For example, a recent article in *Time* stated that:¹⁰

Strung along high towers, ["high-tension" electric transmission] lines carry large amounts of electricity over long distances. Homes, schools, and playgrounds should not be built anywhere near them.

Another article in *Popular Science* warned:¹¹

If you are house hunting stay away from homes near a power line right-of-way. Check out the nearby school's location as well. If your local utility is planning to build high voltage transmission lines, ask your county or state board of health to investigate risks.

Such stories may lead to individual and collective actions that are costly and, worse — if something other than emfs prove to be the cause of increased childhood cancers, may prove ineffective. For example, in the U.S., approximately 10 million acres of land and 1 million homes lie close enough to power lines to receive emf exposures above levels

⁶ *Id.*

⁷ Keith Florig, *Containing the Costs of the EMF Problem*, 257 *Science* 468, 488 (1992).

⁸ *Id.*

⁹ *Supra* note 2. See also, Harold R. Piety, *What We Don't Know About EMF*, *Public Utilities Fortnightly*, Nov. 15, 1989, at 15.

¹⁰ Phillip Elmer-Dewitt, *Mystery — and Maybe Danger — in the Air*, *Time*, Dec. 24, 1990, at 67, 69.

¹¹ Ann Marie Cunningham, *Electromagnetic Fields: In Search of the Truth*, *Popular Science*, Dec. 1991, at 90.

found in most homes. If public fears were to result in only 1% decline in the market value of these properties, this would amount to approximately \$1 billion in lost property value.¹²

Background

U.S. Power Distribution

Utilities provide power to businesses and homes via 60 hertz (Hz) alternating current. Electricity is generated by large power plants at about 20 kilovolts (kV), and step-up transformers increase the voltage to about 765 kV to increase long-distance transmission efficiency. Voltage is decreased at substation step-down transformers and delivered through primary distribution lines, carrying voltages, from 5 to 35 kV, to distribution step-down transformers. These transformers reduce the voltage to the level needed by businesses and homes (usually 115 volts). Magnetic fields created by electric current are greatest at step-down transformers. Secondary distribution lines then carry this power to residences.¹³

The U.S. has about 350,000 miles of transmission lines and two million miles of distribution lines.¹⁴ Because of the ubiquity of power lines, one-third of children in the U.S. live in homes associated with high current configuration power lines.¹⁵

Epidemiological Studies

As mentioned earlier, the initial evidence of a link between emfs and cancer was provided by Wertheimer and Leeper.¹⁶ They conducted a case-control study in Denver, Colorado that examined the relationship between cancer mortality in 344 children under 19 years of age and exposure to magnetic fields at the time of their birth and death. Current flow, based on the size of wiring and distance of homes

¹² Florig, *supra* note 7, at 469.

¹³ Gordon L. Hester, *Electric and Magnetic Fields, Managing an Uncertain Risk*, Environment, Jan./Feb. 1992, at. 9.

¹⁴ Indira Nair, M. Granger Morgan & Keith Florig, *Biological Effects of Power Frequency Electric and Magnetic Fields* 4 (1989) (report for the Office of Technology Assessment).

¹⁵ EPA, *supra* note 4.

¹⁶ *Supra* note 1.

from substations or transformers, was used as a proxy for magnetic field exposure. Exposure was divided into high and low current configurations. Using a control group of the same size, a two to threefold increase in risk of cancer was found among children living in high current configuration homes.

This study was controversial because the exposure assessment included only outside wiring, not other sources of magnetic fields. Also, investigators who performed the wire coding were not blinded.¹⁷ This led to attempts to duplicate their results and improve exposure assessments. In a later study, also conducted in Denver, Savitz compared 356 children with cancer to 282 controls recruited through random digit dialing. Exposure was determined both from the wire configuration classifications used earlier and actual short-term emf measurements made inside homes. The study found an association between high current configuration homes and an approximately twofold increase in cancer, but no association was found between emf measurements and cancer.¹⁸

A third case-control study was conducted by London et al. in Los Angeles County, California. Using two groups of 232 children under ten years of age, the association between emf exposures and leukemia was examined. Exposure was evaluated by the Wertheimer and Leeper classifications; spot measurements at locations inside and outside homes and measurement in each child's bedroom. Also, data was collected concerning use of electrical appliances in the homes. Many potentially confounding factors were controlled. Once again, high current configuration homes were associated with a twofold increase in leukemia, but no association was found with measured emfs.¹⁹

A fourth study avoided many problems in earlier studies. It examined all children who had lived within 300 meters of any 220 and 400 kV power line in Sweden between 1960 to 1985. This yielded a study population, including adults, of 500,000 individuals. Exposure was assessed with spot and 24 hour measurements in homes. Long term

¹⁷ *Id.*

¹⁸ Savitz, *supra* note 3.

¹⁹ London et al., *supra* note 3.

exposure was also calculated, accounting for distance, line configuration and load, with historical loads being obtained from records by station managers. This study associated historical field measurements with a fourfold increase in leukemia, with the association being proportional to calculated field strength.²⁰ However, once more, no association was observed between actual field measurements and cancer.

The last three studies, because of failure to find any correlation between cancer and measured emfs, leave question about the risk of cancer from power lines. None eliminate the possibility that field strength is a surrogate for another risk factor. Moreover, the Savitz and London studies have been criticized for possible selection bias because they obtained controls through random digit dialing. This would reduce participation by those difficult to recruit by phone.²¹ Such questions have sparked investigators to turn in vitro and animal studies in an attempt to discern a possible mechanism for emfs' causing cancer.

In Vitro and Animal Studies

In vitro studies have shown that emfs affect cell membranes but appear incapable of damaging DNA. From the latter, it seems that emfs cannot directly cause cancer.²² However, there is a possibility that such forces might play an indirect role. For example, one investigator has suggested that low frequency emfs may enhance the ability of a tumor promoter to impair cell to cell communication.²³

Most lifetime animal carcinogenicity studies have been conducted at much higher emf strength levels than those received by humans.²⁴ However, one has found that rats exposed to 60 Hz emfs had decreased secretion of melatonin.²⁵ That hormone may retard cancer growth of cells, but this has apparently not been established.²⁶

²⁰ Feychting & Ahlbom, *supra* note 3.

²¹ Committee on Interagency Radiation Research and Policy Coordination, *Health Effects of Low-Frequency Electric and Magnetic Fields V-9* (1992).

²² EPA, *supra* note 4, at 1-6.

²³ W. Ross Adey, *Nonlinear Electrodynamics in Cell Membrane Transductive Coupling*, in *Membrane Transport and Information Storage* 1, 21 (1990).

²⁴ EPA, *supra* note 4, at 1-4.

²⁵ B. W. Wilson et al., *60-Hz Electric Field Effects on Pineal Melatonin Rhythms: Time Course for Onset and Recovery*, 7 *Bioelectromagnetics* 239 (1986).

In another recent study, a tumor initiator was applied to the skins of mice; then weekly applications of a tumor promoter were made. Half of the mice were exposed to 60 Hz emfs; the others were not. Mice exposed to emfs were found to have an increased *rate* of tumor development. However, no difference between the groups were found in the *number* of short or long term tumors formed.²⁷ So, the uncertainty continues.

Summary

The most convincing evidence for an association between exposure to emfs from power lines and cancer comes from epidemiological studies. However, some scientists find this association implausible because, e.g., the strengths of these fields are negligible compared to those produced endogenously by cells²⁸ and exposures are usually lower than those encountered with household appliances.²⁹

Despite uncertainties, epidemiological studies nevertheless suggest that risk of excess cancer deaths associated with living near distribution lines producing stronger than average magnetic fields may be about 5 per 100,000 children per year.³⁰ This is comparable to the risk of childhood leukemia from in utero exposure to diagnostic x-rays, as well as more speculative risks of childhood cancer associated with not breast feeding or with smoking during the first trimester. Still, if these risks are real, they would cause approximately 100 to 1000 deaths annually.³¹

²⁶ See, e.g., Kenneth R. Foster, *Weak Magnetic Fields: A Cancer Connection?* in *Phantom Risk: Scientific Inference and the Law* 47, 76 (K.R. Foster, David E. Bernstein & Peter W. Huber eds. 1993 (critical of the study)).

²⁷ M. A. Stuchly et al., *Modification of Tumor Promotion in the Mouse Skin by Exposure to an Alternating Magnetic Field*, 65 *Cancer Ltrs.* 1 (1992).

²⁸ Florig, *supra* note 7, at 468.

²⁹ Foster, *supra* note 26, at 48-9.

³⁰ Florig, *supra* note 7, at 469.

³¹ *Id.*

Risk Management

Options

Given considerable uncertainty about the link between emfs and cancer in children, risk managers have several options. One is to do nothing. This seems to be supported by those who do not believe emf exposures present a credible health risk.³² As noted earlier, the CIRRPC, a panel of prominent scientists, has concluded that the scientific evidence of extremely low frequency emf exposures presenting a hazard is inadequate to warrant increased research.³³

Yet, because of ubiquitous exposure to emfs, the topic must be fully investigated. If no action is taken, public fear will continue to thwart construction of power lines, lower already declining property values near transmission lines, promote further court battles and pressure utilities to alter the design of power lines — all with major costs.³⁴

Moreover, the need for more research is widely supported by many policy makers and scientists. More in vitro studies are needed to better understand the field strengths required to produce cell changes, more chronic animal studies are needed at exposures comparable to those of humans living near power lines, and further epidemiological studies with better measures of exposure should be conducted.³⁵ Also, prospective studies need to be undertaken to better control bias and confounding variables. While no single study can establish causation, several carefully designed epidemiological studies, all associating emf exposure with cancer, coupled with supporting animal and in vitro studies can do so.³⁶ There seems to be enough concern to warrant further research, if not more aggressive action. Moreover, whatever the cause, a two to fourfold increase in cancer among certain children³⁷ would seem to warrant continued if not increased research.

³² See, e.g., Foster, *supra* note 26, at 48: “[T]he case for the hazard is very weak, and I doubt whether any exists at all.”

³³ *Supra* note 21.

³⁴ Florig, *supra* note 7, at 488.

³⁵ CIRRPC, *supra* note 21, at V-17;

³⁶ Nair, Morgan & Florig, *supra* note 14, at 66.

³⁷ See *supra*, *Epidemiological Studies*. See also, *supra* at notes 30 and 31.

Measures might also be undertaken to reduce emf exposures. These include establishing field strength standards on power lines as in New York and Florida,³⁸ burying power lines and arranging lines to maximize cancellation of generated magnetic fields. However, some have costs exceeding any that could be easily justified in light of current scientific evidence.

This raises the possibility of taking only measures with costs that are comparatively low compared to apparently low credibility of risks.³⁹ Such "prudent avoidance" might involve, e.g., not walking under power lines or purchasing a house located near a transformer. The problem, of course, is attempting to determine what is "prudent" under the circumstances. Also, would "prudent" measures voluntarily undertaken by utilities help allay public anxieties and build credibility or would they be construed as acknowledging an emf hazard and engender even greater public apprehension?

Given the uncertainties, management of cancer risks from power lines has proven extremely difficult. Federal agencies have been unable to reach consensus. The U.S. Environmental Protection Agency (EPA), possibly the most likely candidate for taking regulatory action, had a research program on the effects of emfs in the early 1980's, but its funds were cut by the Reagan administration.⁴⁰ In a 1990 draft report, EPA recognized the correlation between proximity to power lines and cancer but did not find that overall evidence warranted classifying emfs as carcinogenic.⁴¹ In 1991, it published another draft report,⁴² indicating that further research was needed. It has still taken no regulatory action, but it is expected to issue a report examining more current research this year.

³⁸ David L. Chandler, *Study Finds Power Line Tie to Leukemia*, Boston Globe, Nov. 12, 1992, at 1.

³⁹ *Exploring the Options for Magnetic Field Management*, EPRI Journal, Oct./Nov. 1990, at 5, 8.

⁴⁰ Graeme Browning, *High-Voltage Debate*, National Journal, Aug. 17, 1991, at 2027.

⁴¹ *Supra* note 4.

⁴² Review Draft — A Research Strategy for Electric and Magnetic Fields: Research Needs and Priorities.

Meanwhile, as noted above, public anxiety leads to various actions. Utilities are changing the design of distribution circuits in residential areas and are placing more lines underground, on higher poles or in more compact configurations.⁴³ Field strength standards for power lines have been established in two states.⁴⁴ Alexandria, Virginia and other municipalities are burying power lines.⁴⁵ Such measures are estimated to cost more than \$1 billion per year.⁴⁶ Public fears have also led to litigation and verdicts against utilities — some to recover for losses in property value caused by fear, regardless of whether those fears are well grounded according to current scientific understanding.⁴⁷

The Need for Better Public Communication

Informing the public about emf risks does not seem to be an option as much as a necessity. People appear to be concerned more about what they do not than what they do understand.⁴⁸ Yet, risk communication concerning emfs is difficult. The topic is emotionally charged: Children appear to be most at risk, and emf exposures are largely involuntary and unavoidable. Communication is also difficult because average citizens understand little about electricity or magnetism.

Perhaps some of the anxiety that, in and of itself, causes problems would be lower if risks from emf exposure were put in the context of known, preventable risks of equal or greater magnitude — including childhood deaths from poisons and bicycle accidents.⁴⁹ If nothing else, the public might be better informed about sure risks that can be easily addressed.

Some such measures are now underway. The EPA Office of Radiation and Indoor Air is publishing documents for the public. One, “EMFs in Your Environment: Magnetic Field Measurements of

⁴³ Florig, *supra* note 7, at 469.

⁴⁴ *See supra*, at note 38.

⁴⁵ Browning, *supra* note 40.

⁴⁶ Florig, *supra* note 7, at 488.

⁴⁷ *See, e.g., The Legal Perspective* [On Phantom (Or Not So Phantom) Risks] in *Phantom Risk*, *supra* note 26, at 137, 143.

⁴⁸ *But see*, Brandon B. Johnson, *Advancing Knowledge's Role in Lay Risk Perception*, 4 *Risk* 189 (1993).

⁴⁹ Dolores Kong, *Scientists Warn Against Panic Over Electromagnetic Field Effects*, *The Boston Globe*, Nov. 13, 1992.

Everyday Application,” provides general information. Another, “Questions and Answers on EMFs,” addresses common concerns.

Moreover, many electric utilities are distributing literature and answering questions. Some utilities will also measure magnetic fields in concerned customers’ homes; if emfs are found to be high, ways are suggested for reducing them.

Summary and Conclusions

Epidemiological studies show a two to fourfold increased risk of cancer in children living near certain electric power lines. However, because none show such a correlation with measured field strength, and in vitro and animal studies have failed to show a mechanism by which emfs can induce cancer, considerable uncertainty remains about what should be done.

While one analysis of the literature suggests that the evidence of an emf link with childhood cancer is too weak to warrant an increase in research expenditures, research should at least continue and possibly be expanded. Although the *relative* risks are small and, to date, uncertain, the stakes are large. Hundreds, if not thousands, of children are potentially affected, and the costs of cautionary measures can be very high. For maximum credibility, federally sponsored research should be managed by agencies, such as the EPA or National Institutes of Health, that are neutral toward the issue, rather than DOE that may be seen as being advantaged or disadvantaged, depending on research results.

Finally, neutral bodies with the necessary expertise should give full attention to communicating accurate and current information about links between emfs and cancer to the public. If people had a better understanding of why many experts believe fears to be wholly unwarranted, this might help allay anxieties that, in and of themselves, are proving to have costs. In any case, as much information as possible is needed to inform actions now being undertaken by individual citizens, state and local governments, and utilities.

