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Original Contributions

ELECTRICAL WIRING CONFIGURATIONS AND CHILDHOOD CANCER

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Wertheimer, N. (Dept. of Preventive Medicine, U. of Colorado Medical Center, Box C-245, Denver, CO 80262), and E. Leeper. Electrical wiring configurations and childhood cancer. *Am J Epidemiol* 109:273–284, 1979.

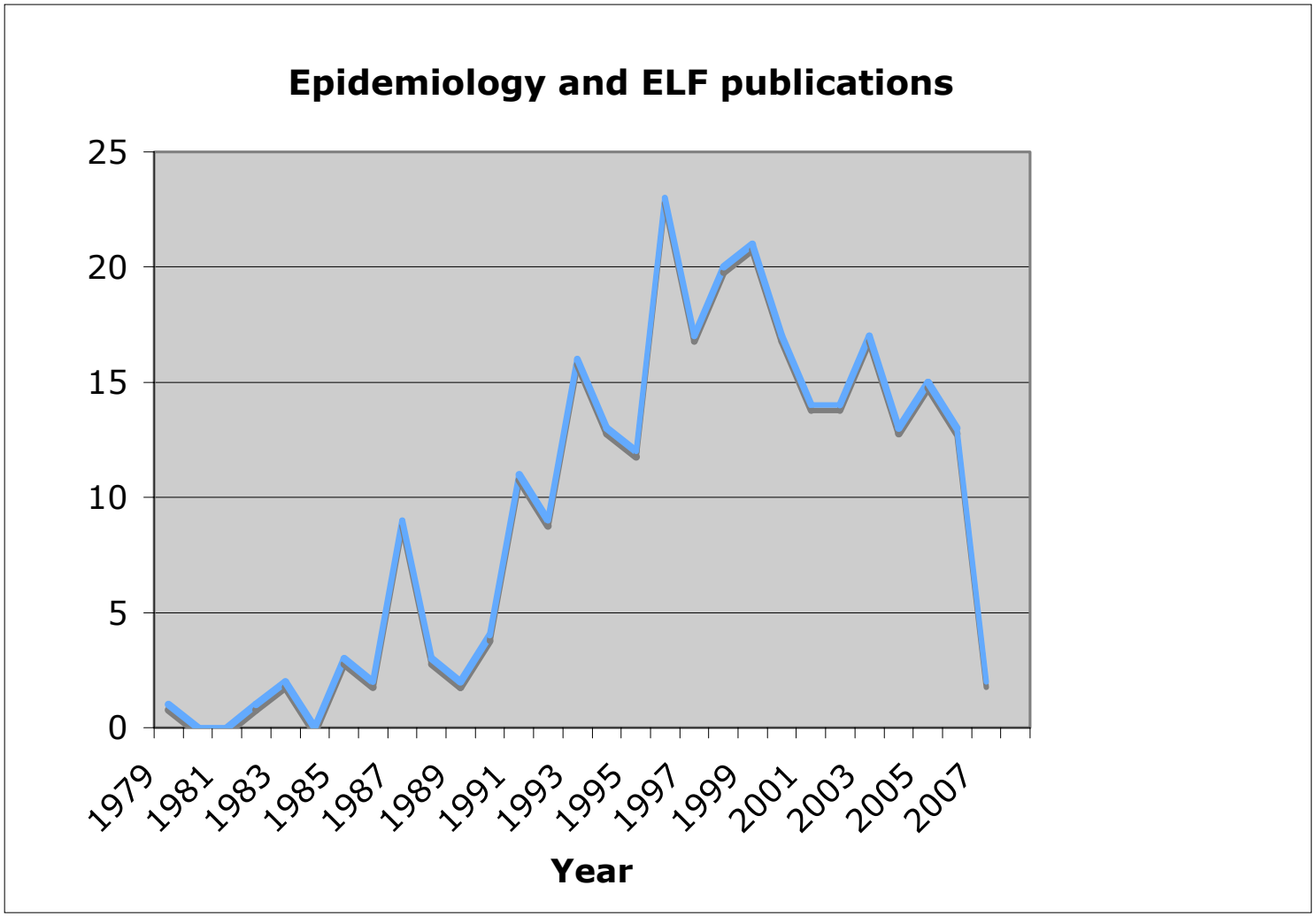
An excess of electrical wiring configurations suggestive of high current-flow was noted in Colorado in 1976–1977 near the homes of children who developed cancer, as compared to the homes of control children. The finding was strongest for children who had spent their entire lives at the same address, and it appeared to be dose-related. It did not seem to be an artifact of neighborhood, street congestion, social class, or family structure. The reason for the correlation is uncertain; possible effects of current in the water pipes or of AC magnetic fields are suggested.

electricity; electromagnetic fields; leukemia; neoplasms

Electrical power came into use many years before environmental impact studies were common, and today our domestic power lines are taken for granted and generally assumed to be voltages up to several hundred kilovolts (kv) deliver power to distribution substations where the voltage is stepped down, resulting in proportionately higher current in the medium-voltage (usually 13

- **First study on EMF and childhood cancer 1979**
- **First study on EMF and adult cancer 1982**
- **First study on occupational EMF and cancer 1982**

Followed by quite a number of studies on diseases other than cancer


Epidemiology and ELF publications
25
20
15
10
5
0
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
Year

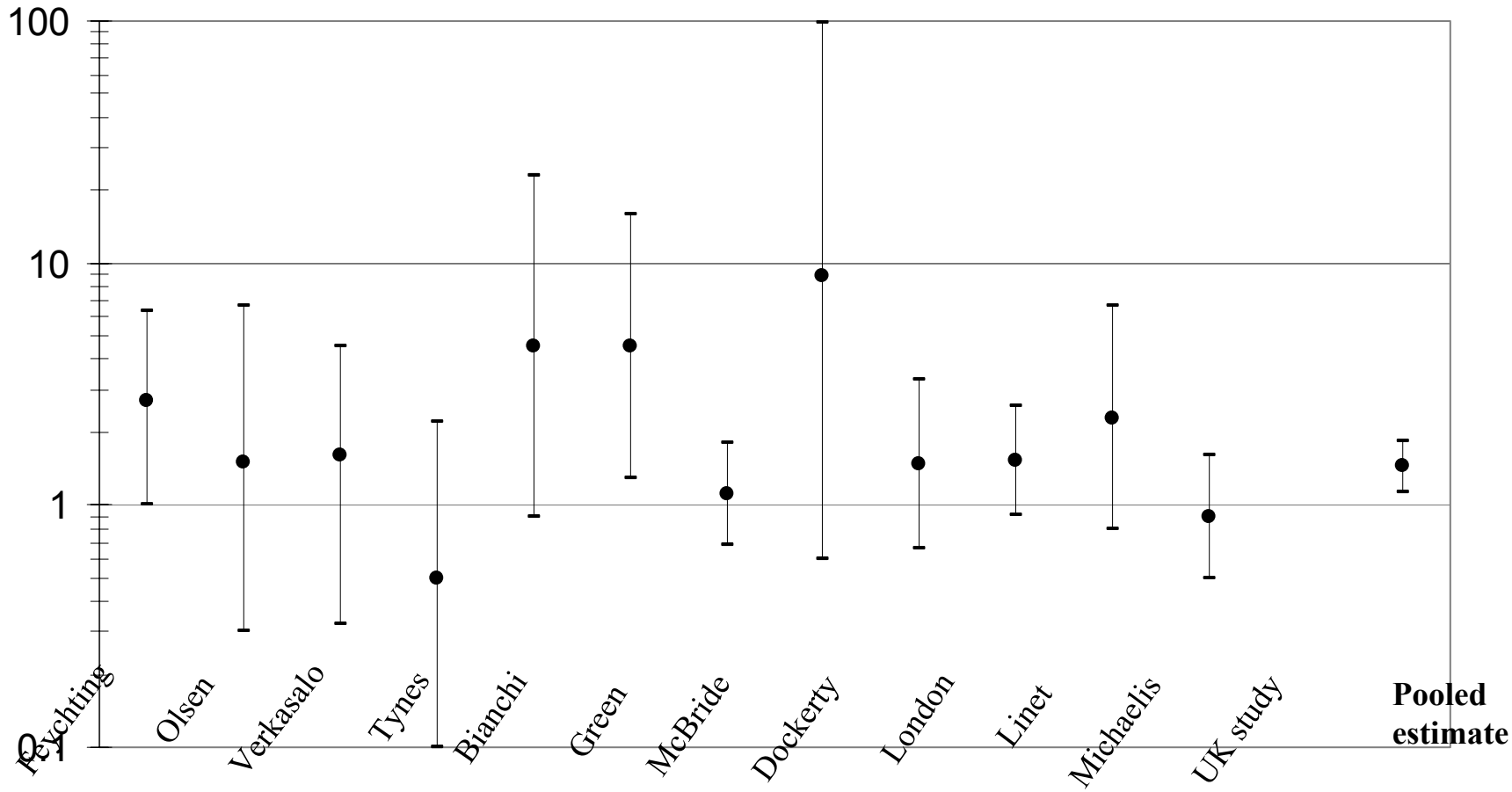
Approaches

- **Occupational sources of exposure**
  - **Linemen, welders, train drivers, eletricians, etc**
- **General environment**
  - **Power lines, transformers, wiring system etc**
- **Personal exposures**
  - **Appliances (hair dryers, razors etc)**
- **Personal meters**

Also intense methodological discussions and gradually improving methodology

- Exposure
  - Measurements
  - Distribution
  - Metric
- Selection bias
- Confounding

Childhood leukemia and magnetic fields



* upper CL=126

British Journal of Cancer (2000) **83**(5), 692–698

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A pooled analysis of magnetic fields and childhood leukaemia

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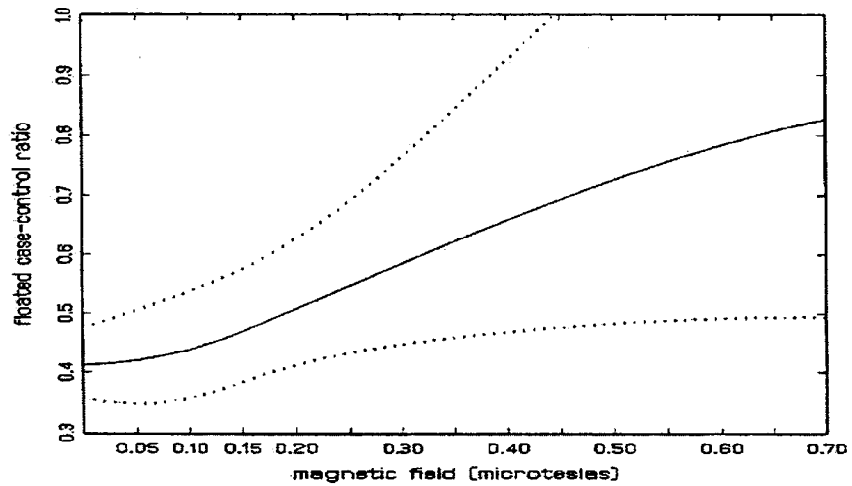
Summary Previous studies have suggested an association between exposure to 50–60 Hz magnetic fields (EMF) and child leukaemia. We conducted a pooled analysis based on individual records from nine studies, including the most recent ones. Studies 24/48-hour magnetic field measurements or calculated magnetic fields were included. We specified which data analyses we planned and how to do them before we commenced the work. The use of individual records allowed us to use the same exposure definitions, an large numbers of subjects enabled more precise estimation of risks at high exposure levels. For the 3203 children with leukaemia and 1(

Childhood leukemia and ELF
Pooled results

Exposure	RR	(95% CI)	No. cases
0.1-0.19 μT	1.08	(0.89-1.31)	233
0.2-0.39 μT	1.11	(0.84-1.47)	104
0.4μT-	2.00	(1.27-3.13)	44

Ahlbom et al. 2000

Floated Case-Control Ratio Based on the Spline Model (Greenland 1999)



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EPRI

How certain are we about causality?

Competing explanations:

- **Too crude exposure assessment?**
- **Confounding?**
- **Selection bias?**
- **Chance (bad luck)?**

Too crude exposure assessment?

All North American studies, comparing wire code and measurement results

	RR (95% CI)
VHCC	1.2 (0.8 – 1.9)
0.4 μT +	2.2 (1.1 – 4.2)

Confounding?

Potential confounders considered in meta-analysis:

Age, sex, SES, urban/rural, type of dwelling, car exhaust, mobility

None of the adjustments changed the RR estimate more than 2%

Selection bias: Sensitivity analysis

	$\geq$ 0.4 μT
• All studies	2.0 (1.3-3.1)
• US excluded	1.7 (1.0-2.8)
• Canada excl.	2.1 (1.3-3.6)

Selection bias: Stratification

	≥0.4 μT
All studies	2.0 (1.3-3.1)
Nordic countries	2.1 (0.9-4.9)
Rest of the world	1.9 (1.1-3.2)

- **Relatively strong epidemiologic evidence that ELF causes childhood leukemia**

- **No known mechanism or explanation**

Intriguing situation!

WORLD HEALTH ORGANIZATION

ORGANISATION MONDIALE DE LA SANTE

The *IARC Monographs*

International Agency for Research on Cancer
Centre international de Recherche sur le Cancer

LYON, FRANCE

IARC. Static and Extremely Low-Frequency Electric and Magnetic Fields. Vol. 80 (19–26 June 2001)

ELF magnetic fields

- Limited evidence in humans
  - Childhood leukemia

- Inadequate evidence in animals

Group 2B: Possibly carcinogenic to humans

Diseases studied in connection with EMF

- Cancer
  - Childhood
    - Leukemia
    - Brain
  - Adults
    - Leukemia
    - Brain
    - Hormone dependent
- Myocardial infarction
- Neurodegenerative diseases
- Suicide and depression
- Symptoms (electrical hyper-sensitivity)

More or less likely causes of childhood leukemia

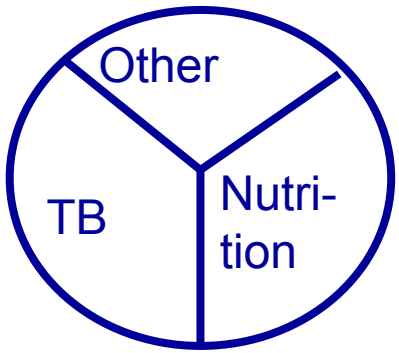
- ELF – EMF
- Ionizing radiation from medical treatment
- X-rays
- Other sources of low dose IR
- Viral infections
- Protection against viral infections
- Genetic factors

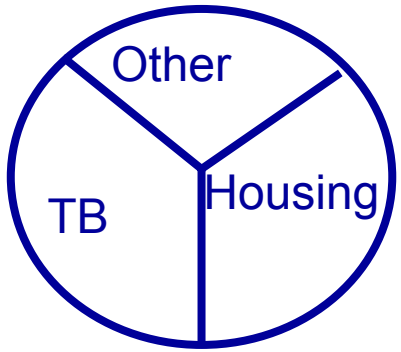
Question

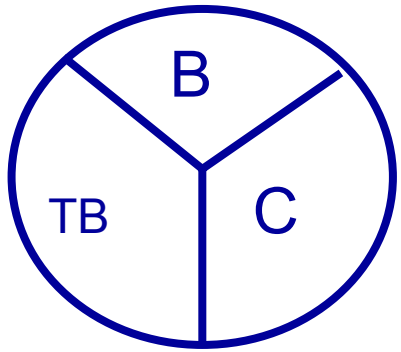
Does a strong risk for , say , viruses make an EMF risk:

1. More likely?
2. Less likely?
3. Does not affect at all?

Pie model and tuberculosis:







Pie model and lung cancer: