

# **Childhood leukemia and electromagnetic radiation**

**A review of epidemiological studies**

ELF

# Background

- **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, also on diseases other than cancer**

# Diseases studied in connection with EMF

- **Cancer**
  - **Childhood**
    - **Leukemia**
    - **Brain**
  - **Adults**
    - **Leukemia**
    - **Brain**
    - **Hormone dependent**
- **Myocardial infarction**
- **Neurodegenerative diseases**
- **Suicide and depression**
- **Hyper-sensitivity**

# Environmental risk factors and childhood leukemia

**A long list of potential risk factors have been looked at, but without firm conclusions**

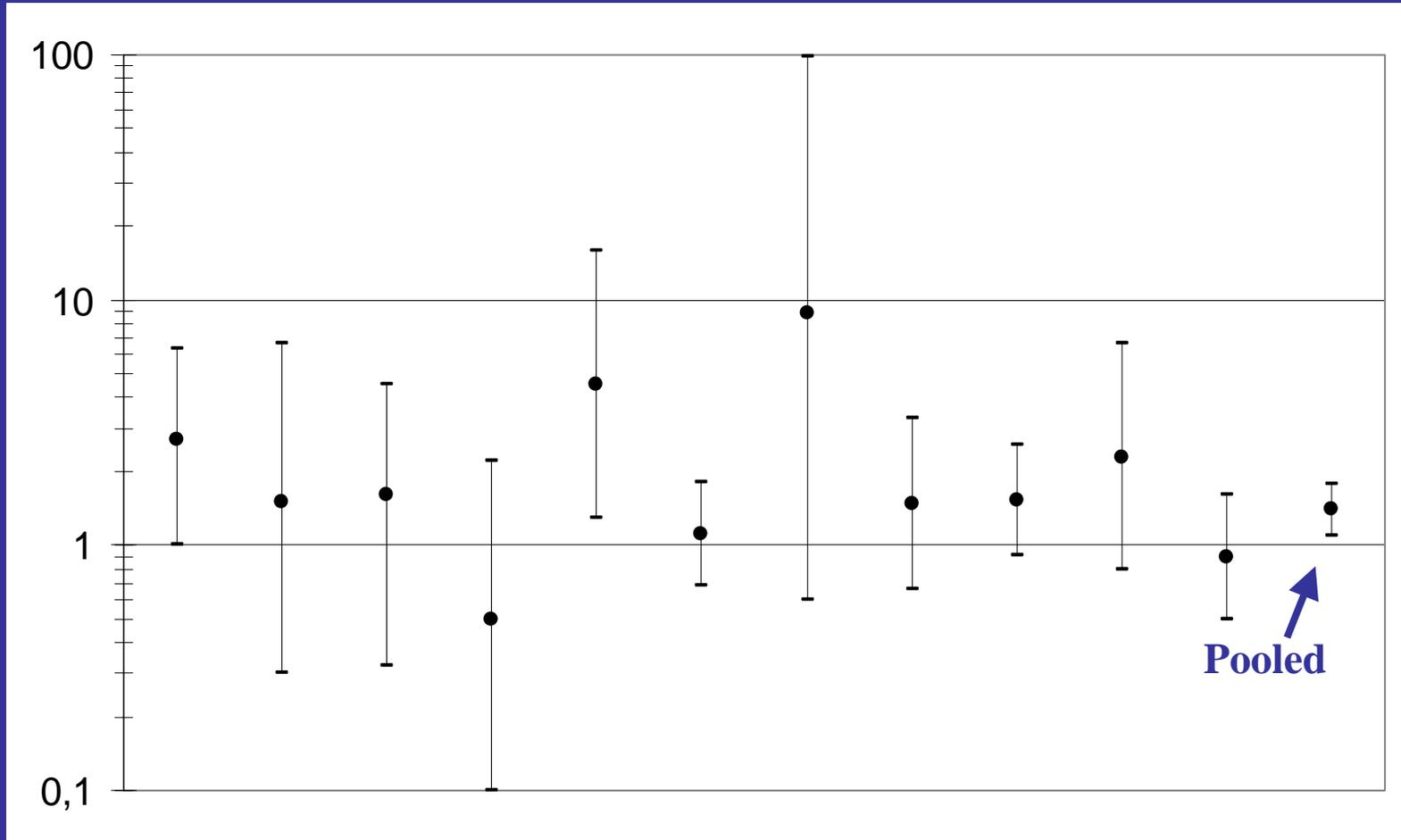
- **Traffic exhaust**
- **Radon**
- **Passive smoking**
- **Parental occupational exposure**
- **etc.**

## Studies on EMF and childhood leukemia

### Best available exposure assessment

	RR	95% c.i.
Wertheimer & Leeper	3.0	1.8 - 4.9
Fulton	1.0	0.6 - 1.8
Tomenius	1.1	0.3 - 4.1
Savitz	2.8	0.9 - 8.0
Coleman	1.5	0.7 - 3.5
Myers	0.8	0.1 - 9.6
London	2.2	1.1 - 4.3
Feychting	2.7	1.0 - 6.3
Olsen	1.5	0.3 - 6.7
Verkasalo	1.6	0.3 - 4.5
Tynes	0.5	0.1 - 2.2
Michaelis	3.2	0.9 - 11.6
Linet	1.2	0.9 - 1.8
Dockerty	15.5	1.1 - 224
MacBride	1.1	0.6 - 1.7
Green	4.5	1.3 - 15.9
UKCCS	0.9	0.5 - 1.6

# Childhood leukemia studies with 24/48 hour measurements or calculated fields

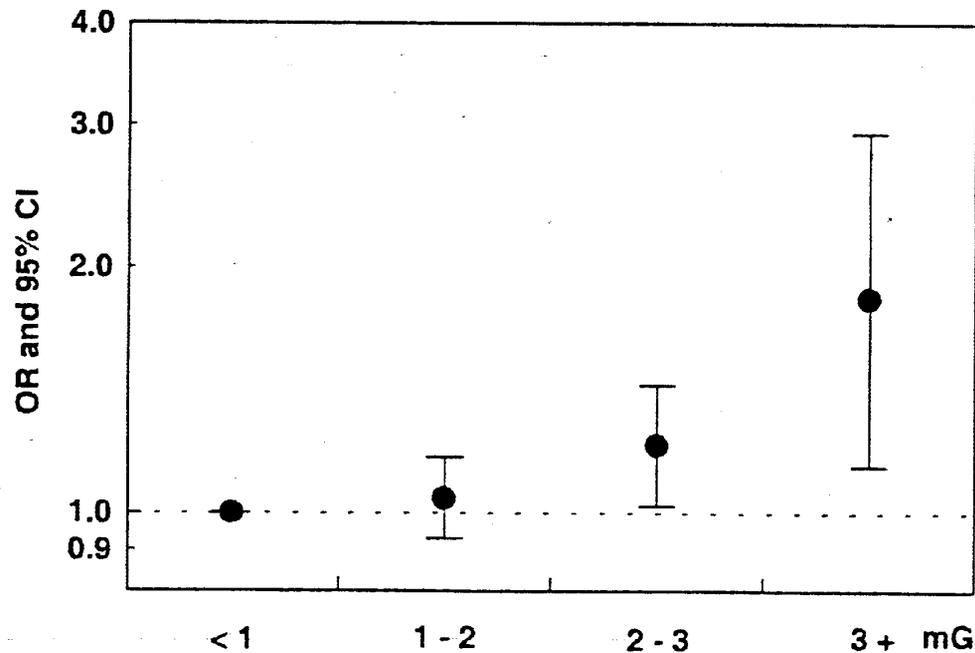


## Pooling EMF and childhood leukemia

Exposure	RR	(95% CI)	No. cases
0.1-0.19 $\mu\text{T}$	1.08	(0.89-1.31)	233
0.2-0.39 $\mu\text{T}$	1.11	(0.84-1.47)	104
>0.4 $\mu\text{T}$	2.00	(1.27-3.13)	44

Ahlbom et al. 2000

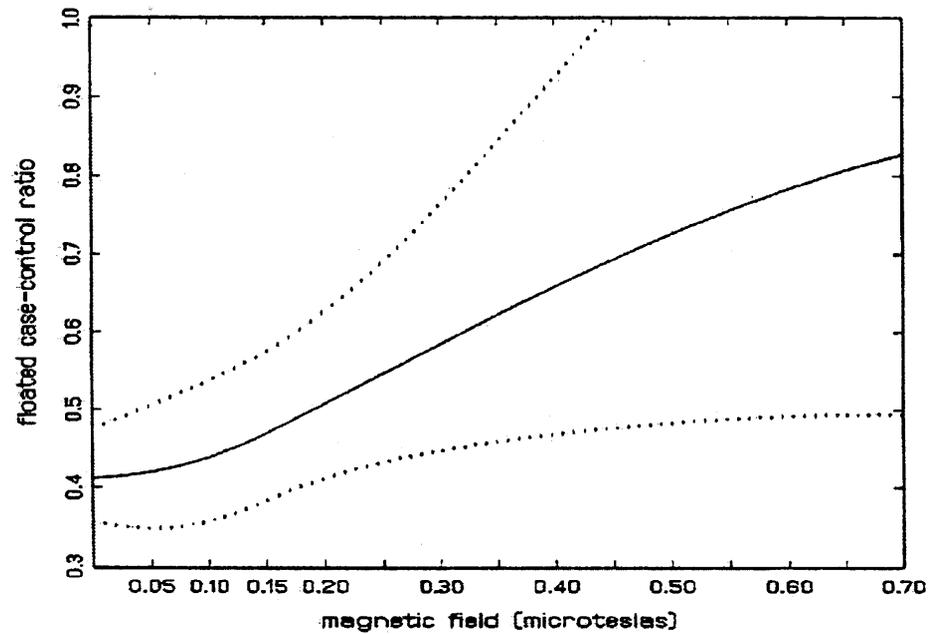
# Pooled Analysis\* of Childhood Leukemia Studies



\* Based on 10 studies;  
similar results for American and European studies

Greenland  
1999

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



ALL KE 3\_00.12

EPRI

# How certain are we about causality?

## Competing explanations:

- Too crude exposure assessment?
- Confounding?
- Selection bias?

# 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 $\mu$ T +	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

	$\geq 0.4 \mu\text{T}$
• 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

	$\geq 0.4 \mu\text{T}$
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)

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

Overall, extremely low frequency magnetic fields were evaluated as *possibly carcinogenic to humans (Group 2B)*, based on the statistical association of higher level residential ELF magnetic fields and increased risk for childhood leukaemia.

**Two scenarios:**

**Threshold effect**

**Linear effect with  
measurement error**

**RR**

**$\mu T$**

# Unresolved issues

## Impact of:

- In utero exposure
- Age at exposure
- Night time exposure
- Various exposure metrics
  - peaks
  - TWA
- Etc.

**To advance, a better handle on relevant biophysical mechanisms is needed, maybe from a better understanding of leukemia etiology in general**

**RF**

# **Occupational studies**

**Several occupational studies exist**

**Most on military personnel**

## **Transmitter studies**

**For children, only available data are from transmitter studies,  
but they are inconclusive**

Welcome to the  
International Scientific Conference  
for  
Childhood Leukaemia  
incidence  
causal mechanisms  
prevention