



Review EMF Epidemiology

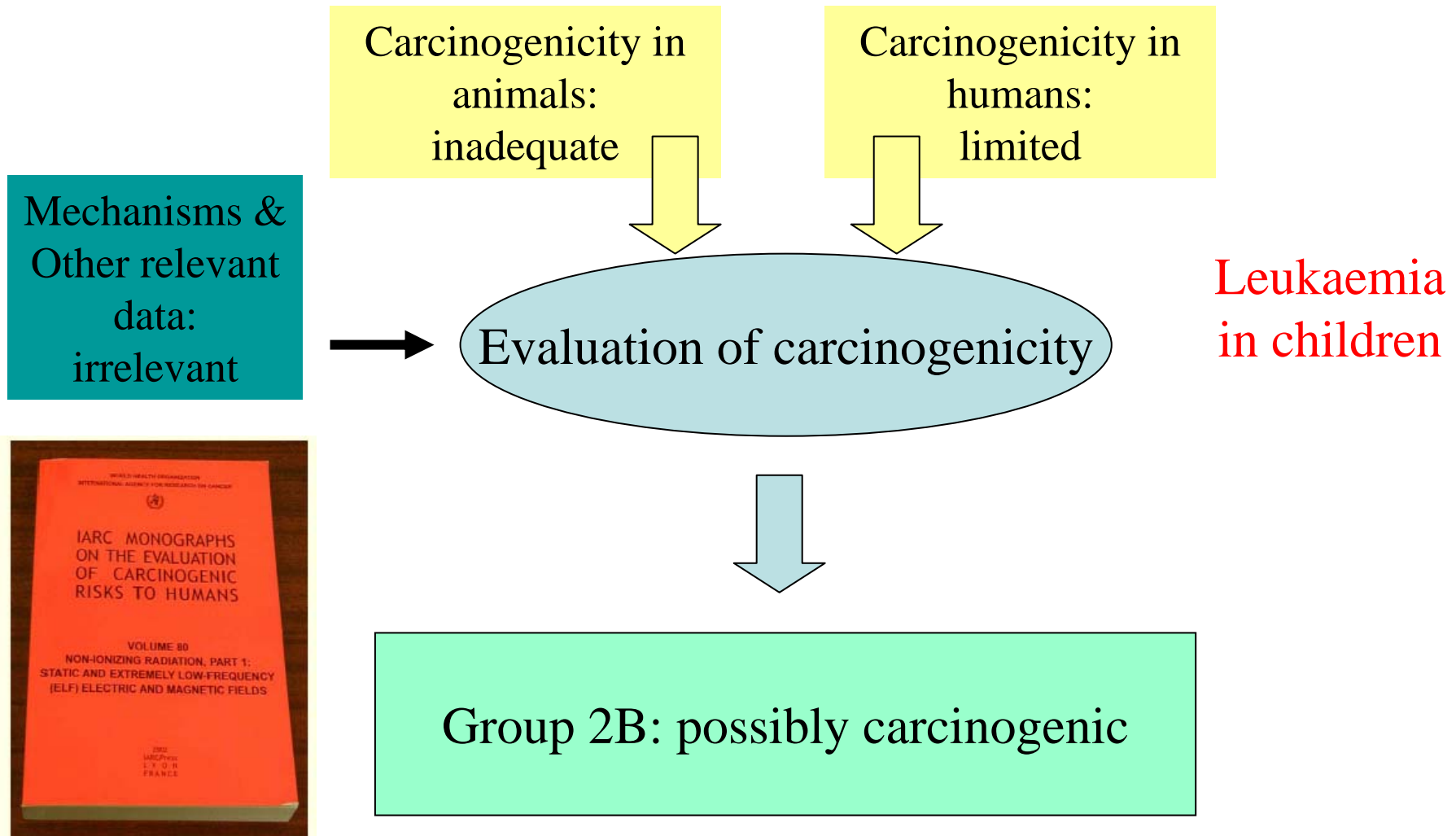
Joachim Schüz
Section of Environment and Radiation
International Agency for Research on Cancer
Lyon, France

International Agency for Research on Cancer



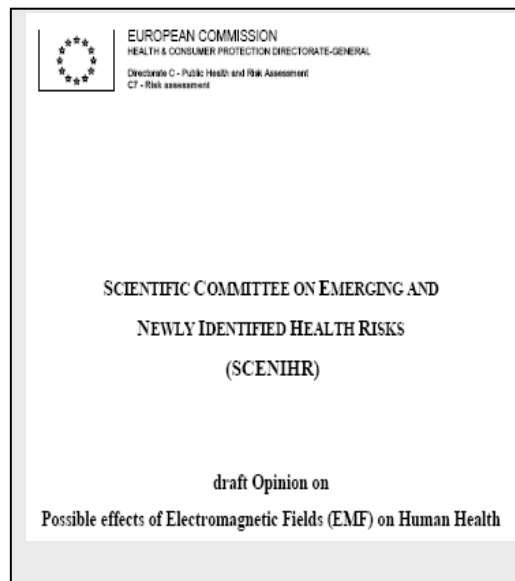
NIR & Children's Health 2011

Leukaemia in children (1)

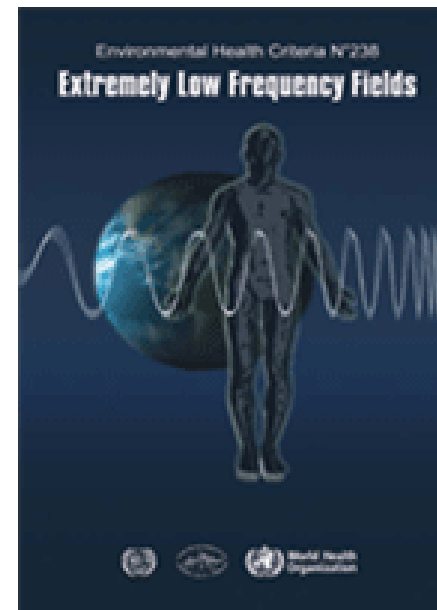


Leukaemia in children (2)

- Consistency in epidemiological studies
 - lack of known mechanism / little support from experimental research
 - concern about bias and error in observational studies
- Average exposure to ELF magnetic fields $>0.3/0.4 \mu\text{T}$
- Less data on other cancers except childhood brain tumours

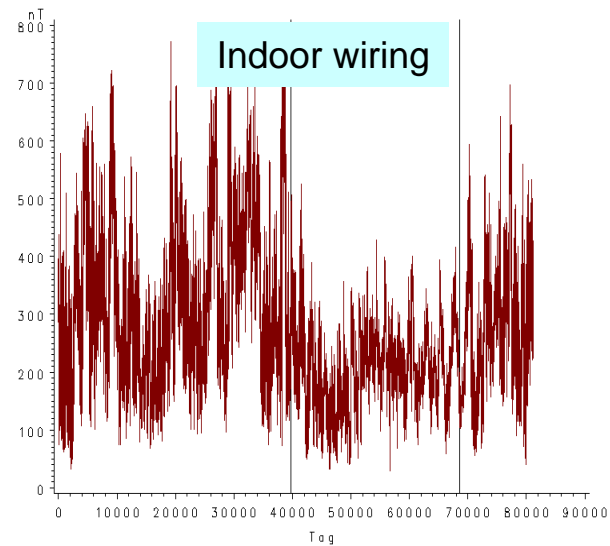
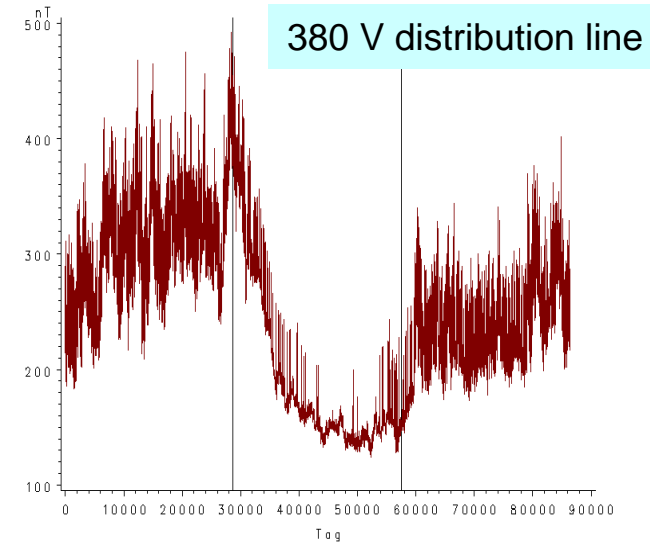
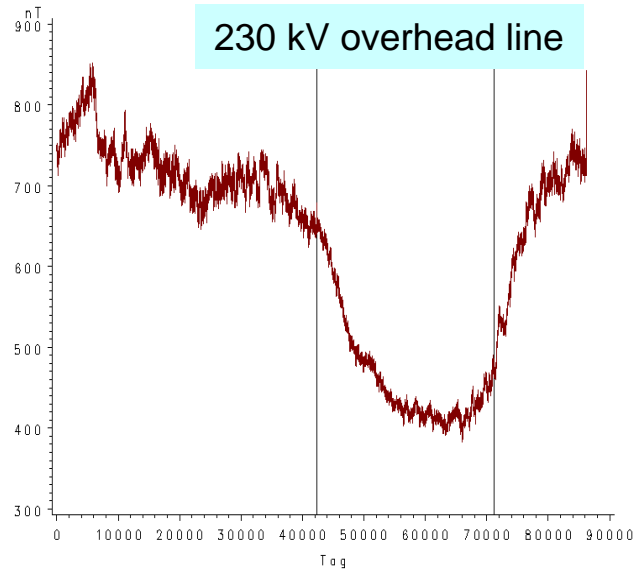


EC SCENIHR 2009

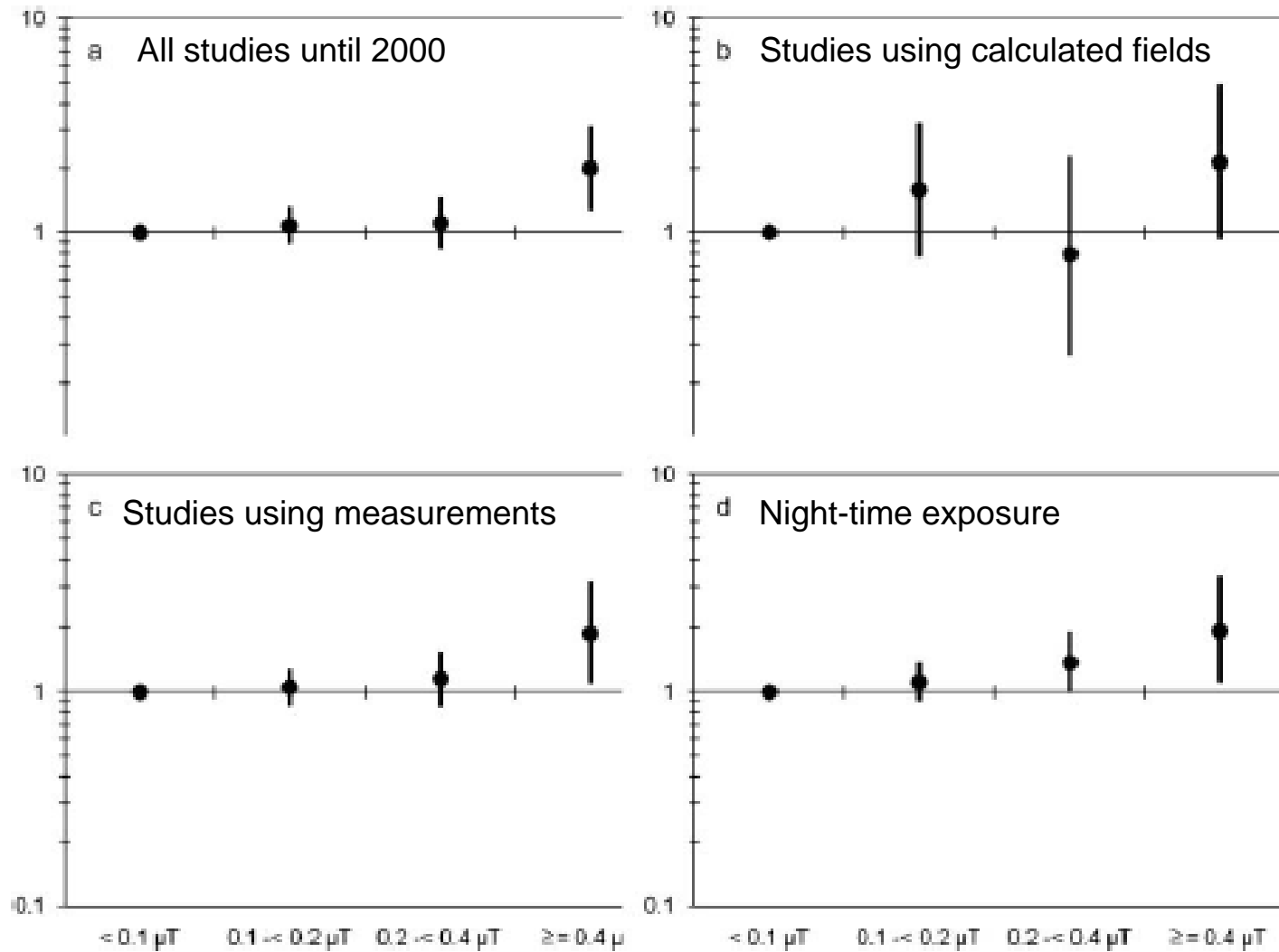


WHO EHC 2007

EMF exposures



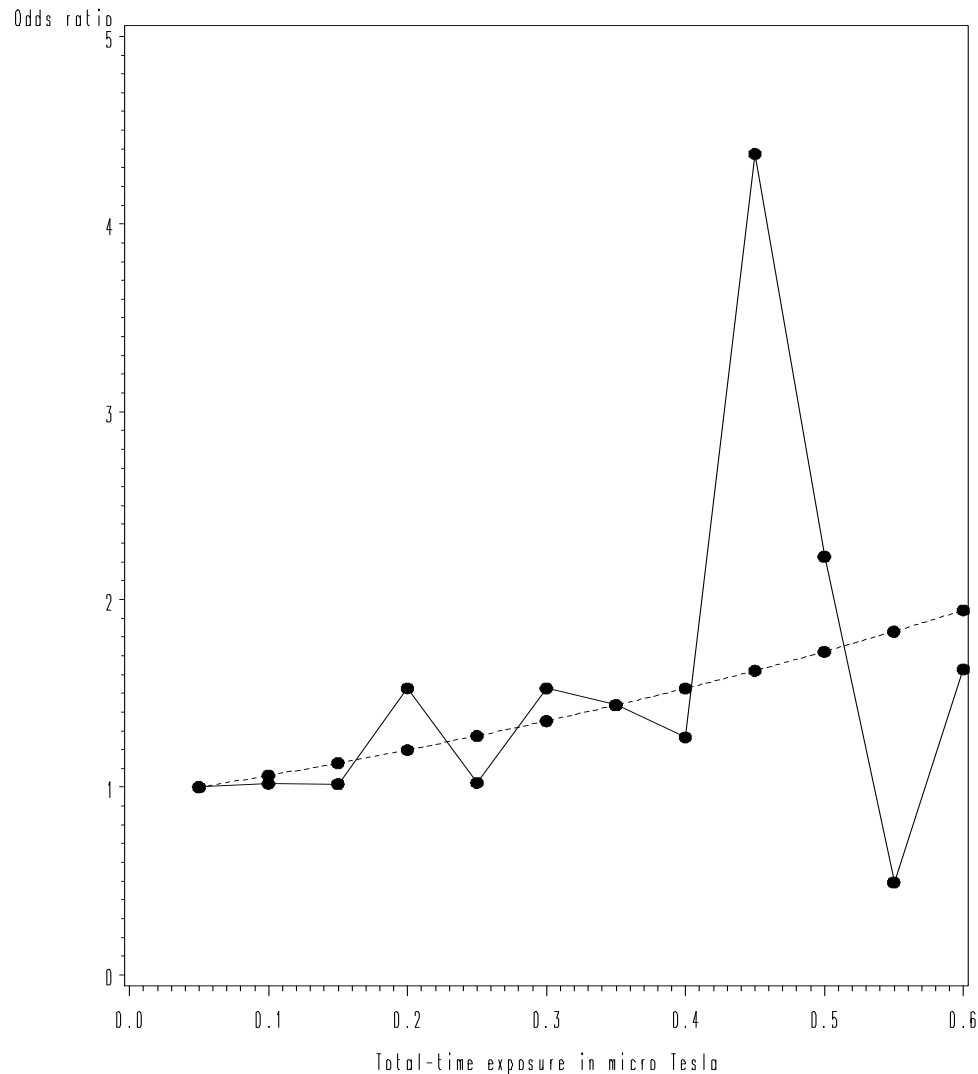
Epidemiological studies (1)



a-c: Ahlbom et al., Br J Cancer, 2000

d: Schüz et al, Am J Epidemiol, 2007

Epidemiological studies (2)



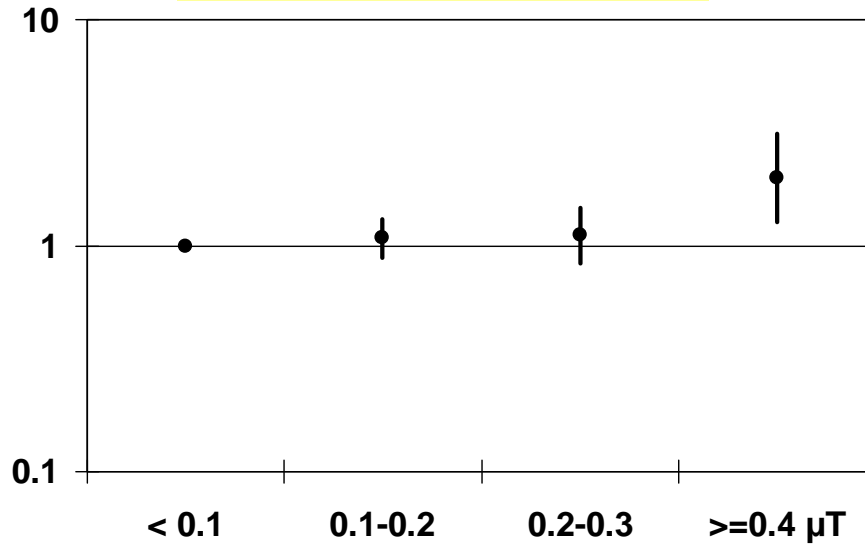
Study population:
 1842 cases
 3099 controls

Steps of 0.2 μT :
 Slope 1.22
 95% CI (1.06, 1.40)
 Log-linear model
 Adequate model fit

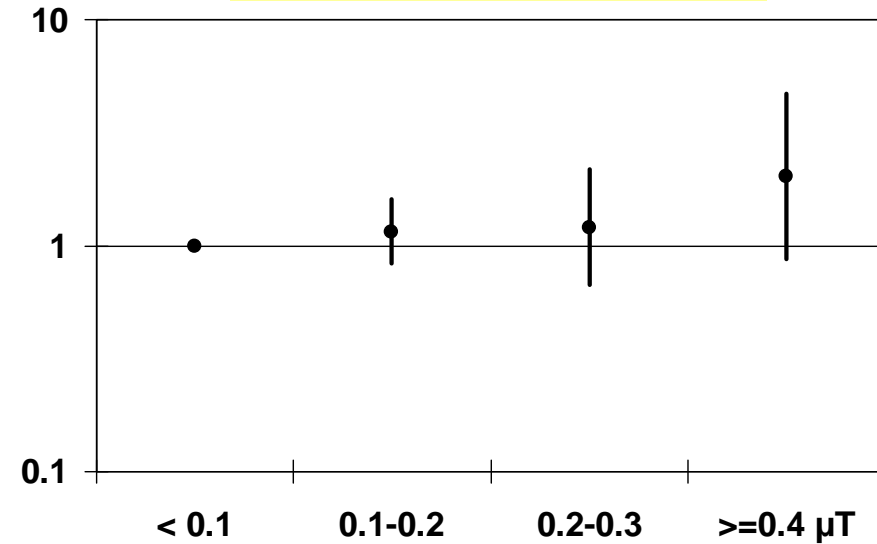
Measurement-based studies:
 US, Canada, Germany, UK

Epidemiological studies (3)

Ahlbom et al., Br J Cancer, 2000

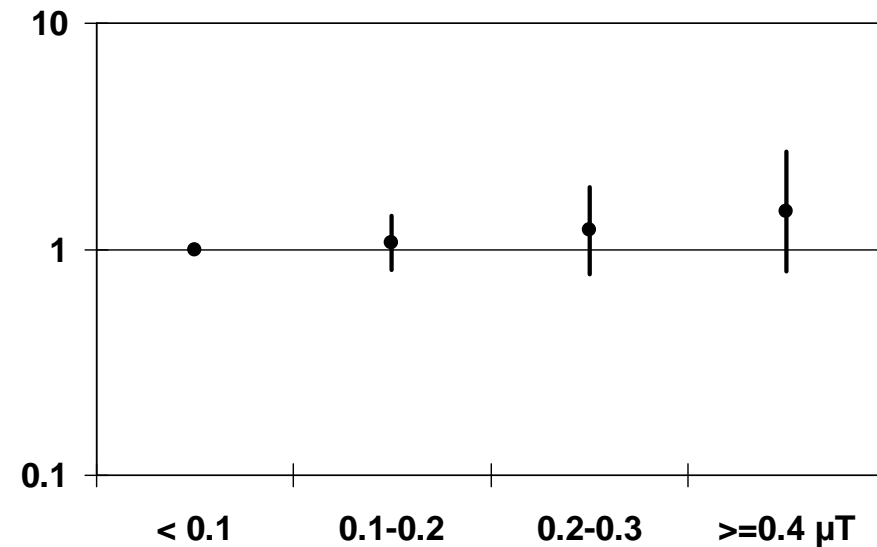


Kheifets et al., Br J Cancer, 2010



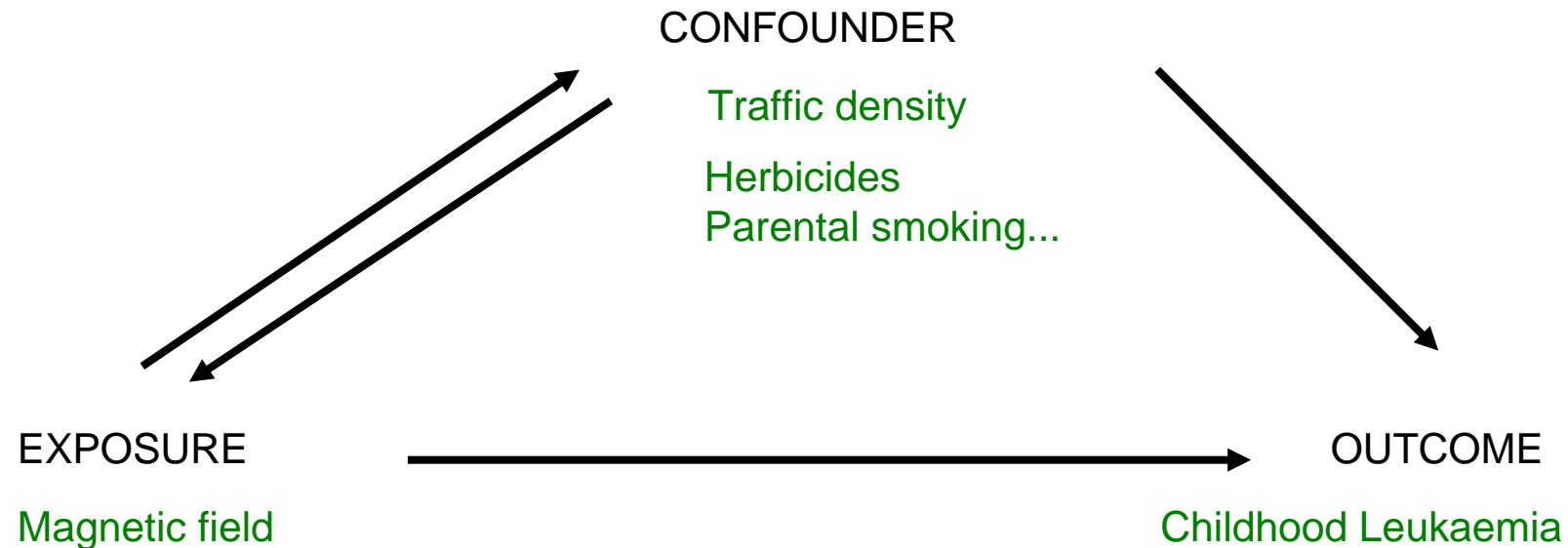
Studies conducted after the pooled analysis by Ahlbom et al:

- excluding Brazil
- including Brazil



Confounding? - unlikely

Schüz, Health Phys, 2007



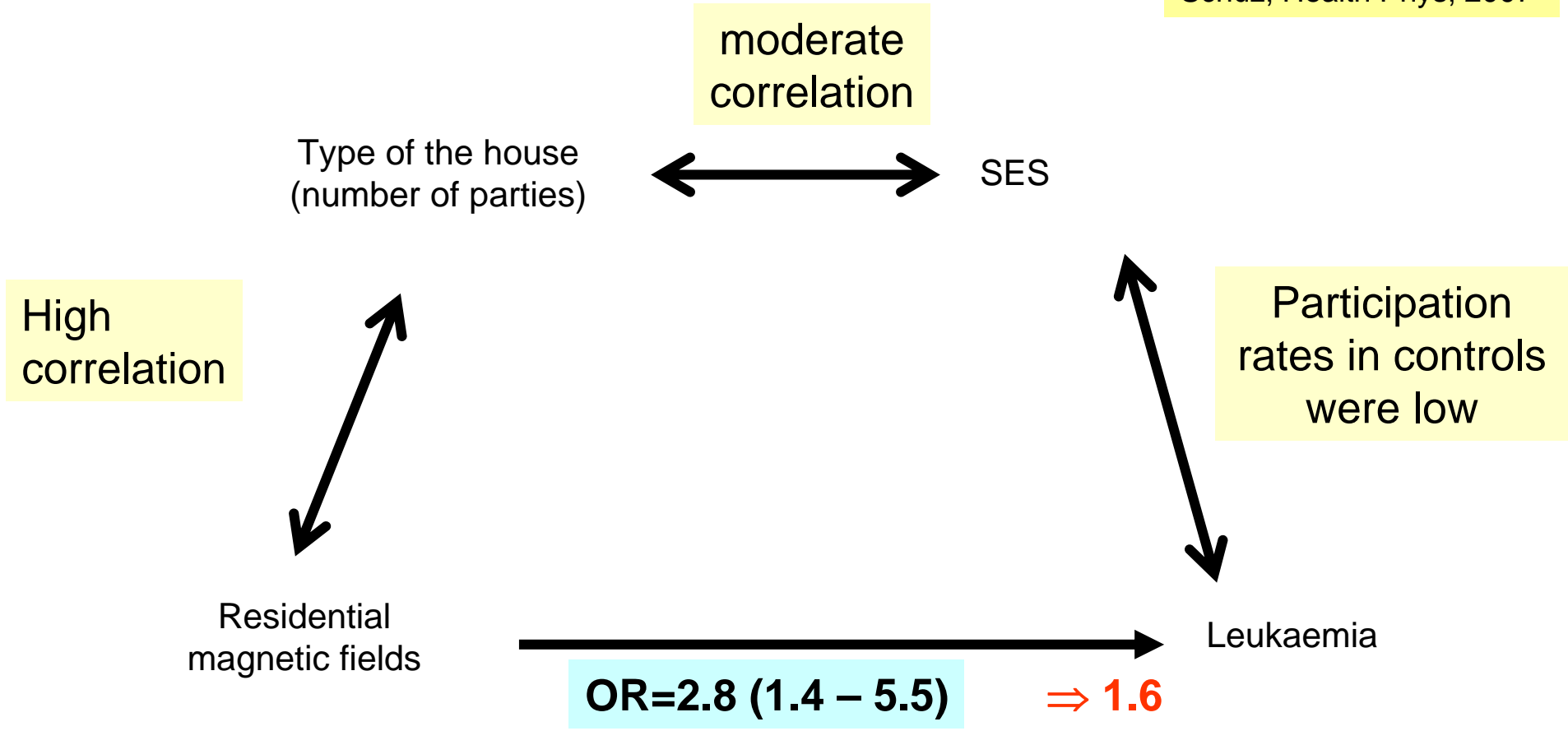
Simulation study:

To explain the observed association, a confounder must be associated with the risk of leukemia at the order of a RR >5

→ unlikely

Selection bias? - likely

Schüz, Health Phys, 2007

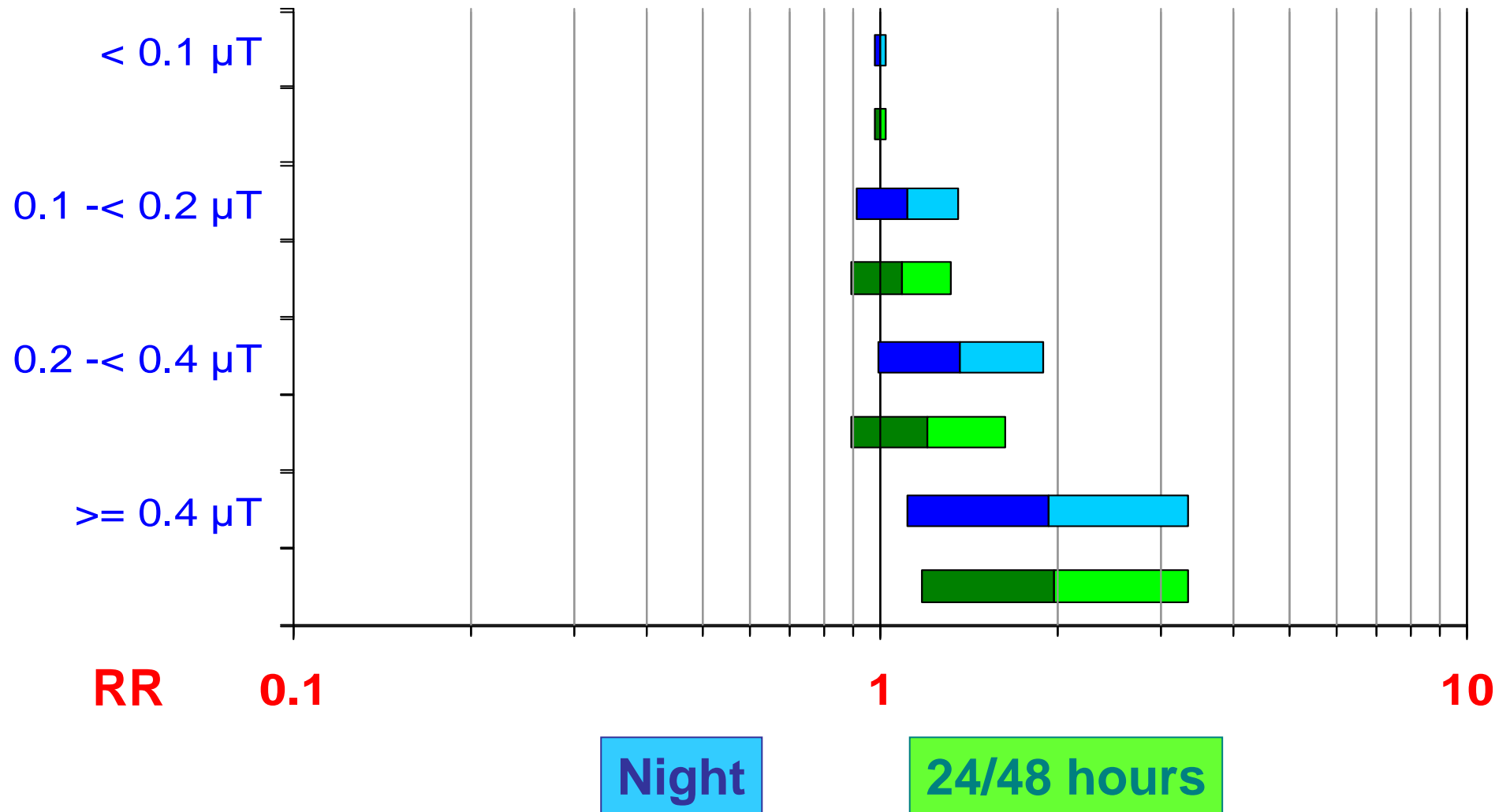


Simulation study:

Likely to explain some of the observed association, but unclear whether in its entirety

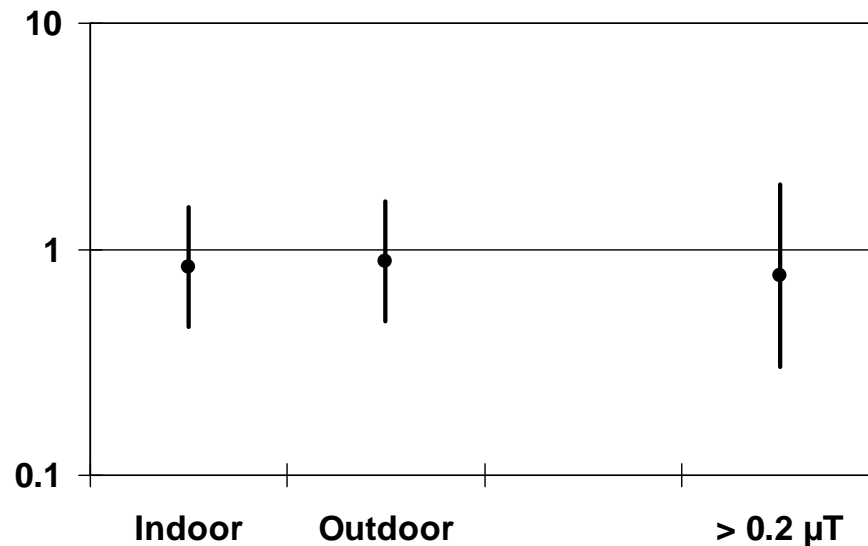
Biological plausibility (1)

Night-time exposure



Biological plausibility (2) Contact currents

- Contact currents confounding the association between magnetic fields and childhood leukaemia
- Contact currents observed in relation to higher exposures from power lines
- Rather strong association required



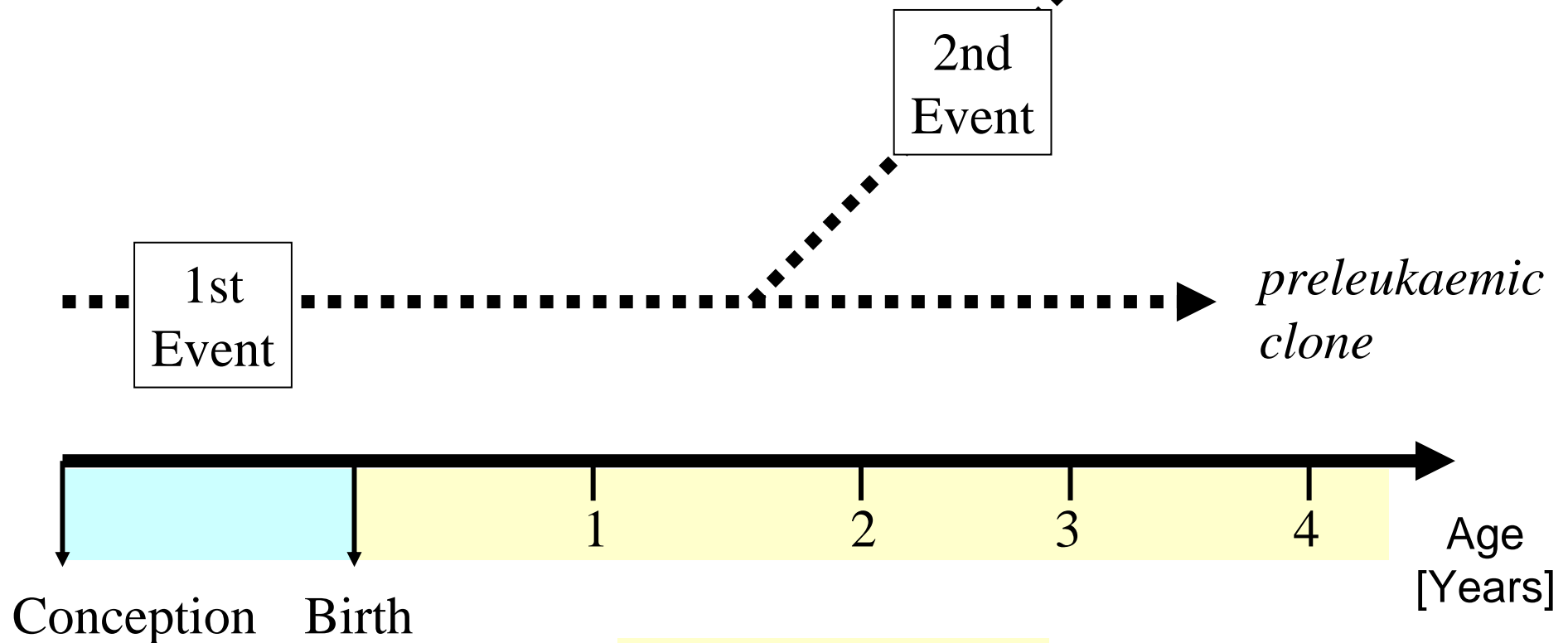
Does et al., Radiation Res, 2011

Biological plausibility (3) Promotion of leukaemia

Evidence:

1. Abberations found in neonatal blood spots
2. Conversion rate low

*Acute
lymphoblastic
leukaemia*



Biological plausibility (3)

Promotion of leukaemia

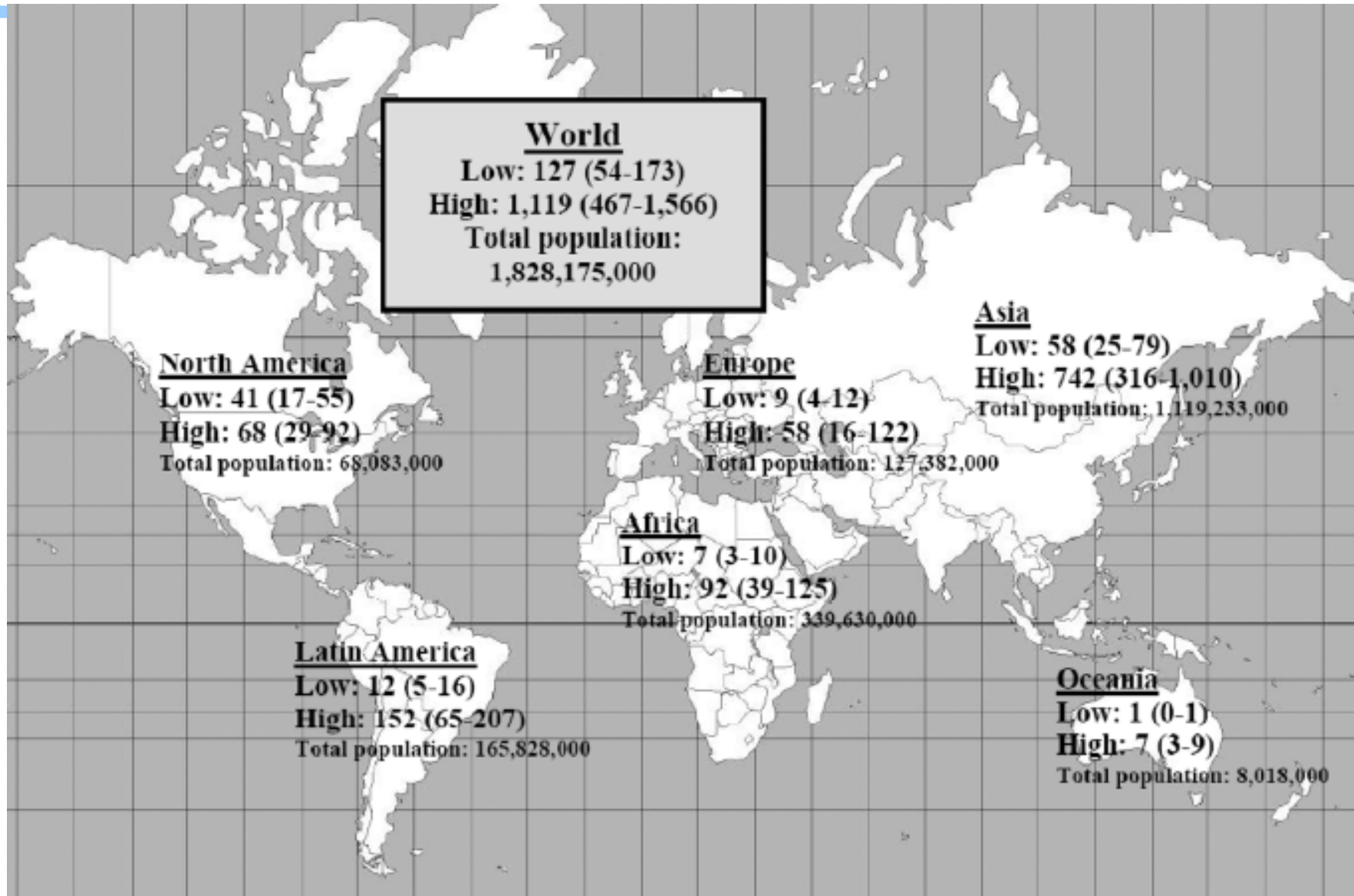
US Study:			Overall survival	
Exposure	Cases	Events	HR	95% CI
< 0.1 μ T	235	16	1.0	
0.1-0.2 μ T	89	7	1.2	0.5 – 2.8
0.2-0.3 μ T	19	1	0.9	0.1 – 6.4
\geq 0.3 μ T	18	4	4.5	1.5–13.8

Foliart et al., Br J Cancer, 2006

Replication using German data:				Overall survival	
Exposure	Cases	Events	PYRS	HR	95% CI
< 0.1 μ T	445	55	4016	1.0	
0.1-0.2 μ T	29	7	247	2.8	1.2 – 6.2
\geq 0.2 μ T	12	3	93	3.0	0.9 – 9.8
Per 0.1 μ T				1.4	1.0 – 1.8

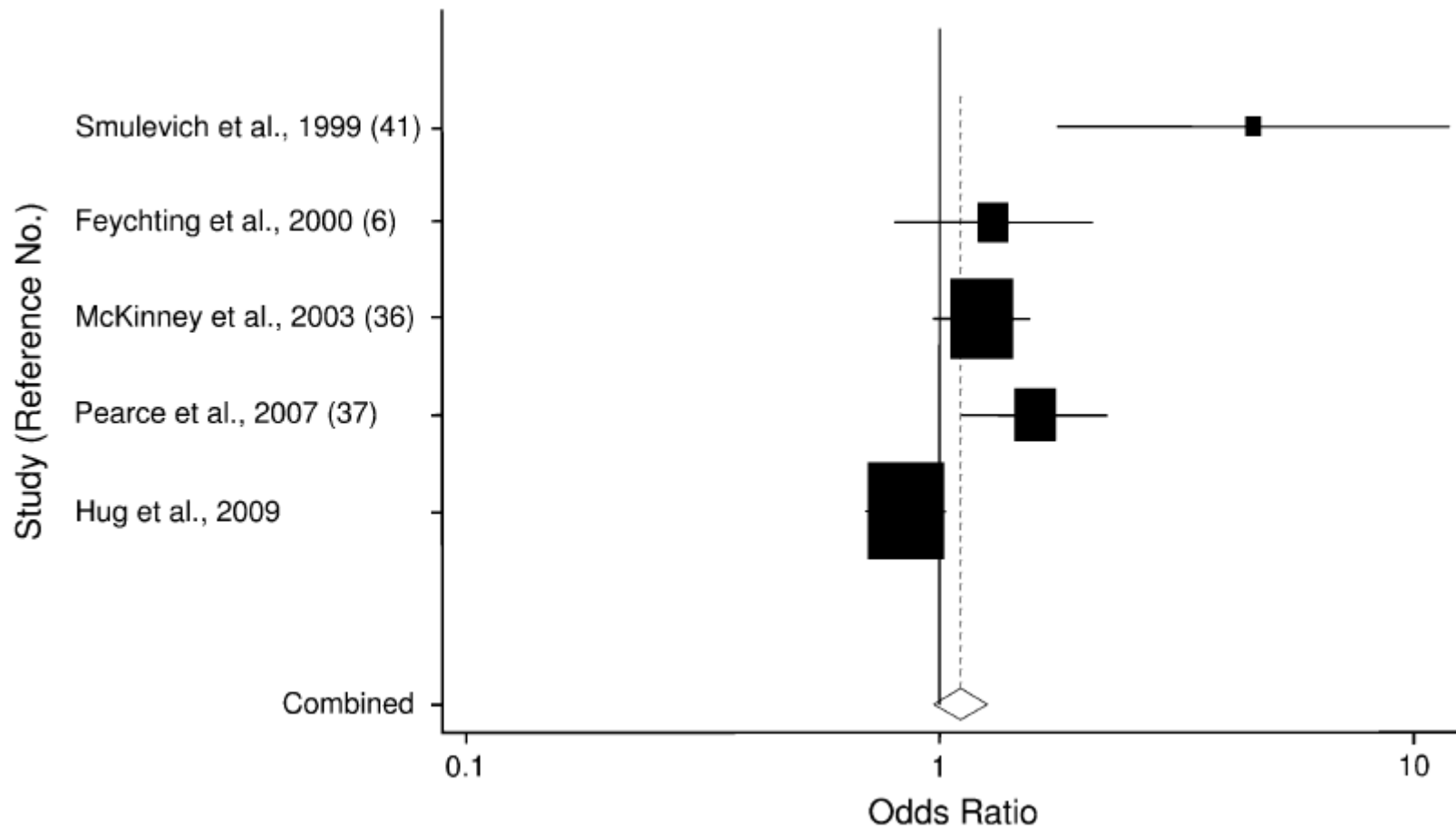
Svendsen et al., Cancer Epidemiol Biomarkers Prev, 2007

Effect on population level



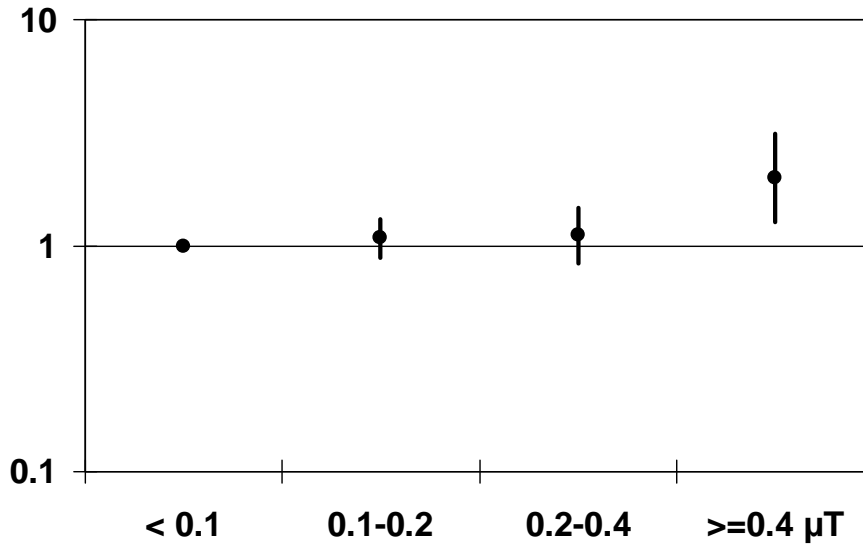
Parental exposures

Leukaemia



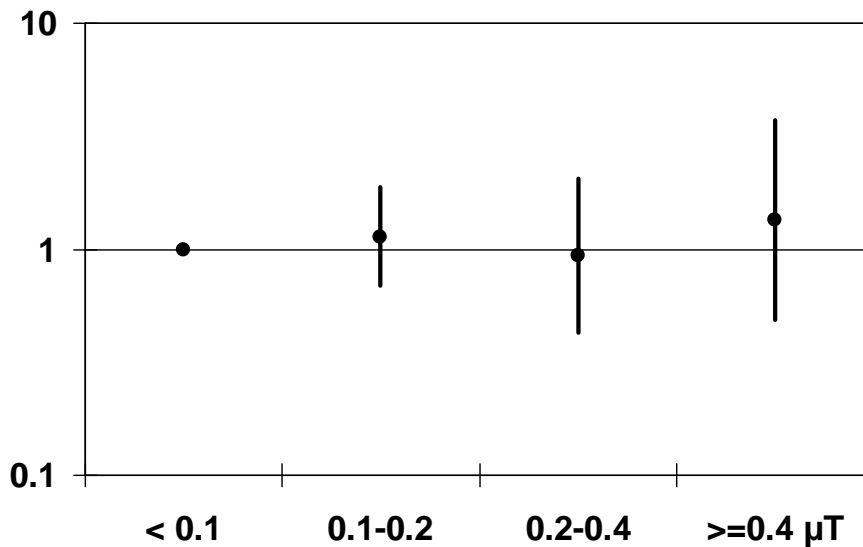
Hug et al., Am J Epidemiol, 2009

Childhood brain tumours



Ahlbom et al., Br J Cancer, 2000

Leukaemia



Kheifets et al, Am J Epidemiol, 2010

Brain Tumours (measurements)

Summary for Childhood Leukaemia

-
- ELF magnetic fields remain possible carcinogen
 - Selection bias in epidemiological studies lead to overestimation; does it explain the entire association?
 - Mechanism ?
 - If association is causal...
 - ... 0.4 μT should not be misused as a threshold for an effect
 - ... attributable risk fraction presumably small
 - Need for clarification

Pooled Analysis:

- Ahlbom A, Day N, Feychting M, et al. A pooled analysis of magnetic fields and childhood leukaemia. *Br J Cancer* 2000; 83: 692-8.
- Greenland S, Sheppard AR, Kaune WT, et al. A pooled analysis of magnetic fields, wire codes, and childhood leukemia. Childhood Leukemia-EMF Study Group. *Epidemiology* 2000; 11:624-34.
- Schüz J, Svendsen AL, Linet M, et al. Night-time exposure to electromagnetic fields and childhood leukemia: an extended pooled analysis. *Am J Epidemiol* 2007; 166: 263-9.
- Kheifets L, Ahlbom A, Crespi CM, et al. Pooled analysis of recent studies on magnetic fields and childhood leukaemia. *Br J Cancer* 2010; 103:1128-35
- Kheifets L, Ahlbom A, Crespi CM, et al. A Pooled Analysis of Magnetic Fields and Childhood Brain Tumors. *Am J Epidemiol* 2010; 172:752-61

Survival & parental exposure studies:

- Foliart DE, Pollock BH, Mezei G, et al. Magnetic field exposure and long-term survival among children with leukaemia. *Br J Cancer* 2006; 94: 161-4.
- Hug K, Grize L, Seidler A, et al. Parental Occupational Exposure to Extremely Low Frequency Magnetic Fields and Childhood Cancer: a German Case-Control Study. *Am J Epidemiol* 2010; 171:27-35.
- Svendsen AL, Weihkopf T, Kaatsch P, Schüz J. Exposure to magnetic fields and survival after diagnosis of childhood leukaemia - a German cohort study. *Cancer Epidemiol Biomarkers Prev* 2007; 16:1167-71.

Reviews:

- Greenland S, Kheifets L. Leukemia attributable to residential magnetic fields: results from analyses allowing for study biases. *Risk Anal* 2006; 26:471-82.
- Maslanyj M, Lightfoot T, Schüz J, Sienkiewicz Z, McKinlay A. A precautionary public health protection strategy for the possible risk of childhood leukaemia from exposure to power frequency magnetic fields. *BMC Public Health* 2010; 10:673.
- Schüz J, Ahlbom A. Exposure to electromagnetic fields and the risk of childhood leukaemia: a review. *Radiat Prot Dosimetry* 2008; 132:202-11.