

High Voltage Transmission Lines & Haematological malignancy

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Acknowledgement of Conflict of Interest



No 1; Alternatives exist

- Never assume the person or people before you have done their job properly

No 2; HV Lines are Class 2b (possible) Carcinogens¹

- Epidemiological studies of childhood leukemia
- Lines built within the ICNIRP guidelines
- Subsequent data not reviewed by IARC
 - Draper et al BMJ 2005
 - Lowenthal et al Internal Medicine Journal 2007

¹ International Agency for Research on Cancer 2001

Lack of animal data

- No consistent enhancement of tumours in experimental animals
- Note; number of drugs later withdrawn from market for toxicity not evident in experimental animals

Mechanism for carcinogenesis unknown

- Most studies have found no effect of EMF on wide range of biological processes
- A few studies have shown magnetic fields to;
 - change flow of Ca into and out of cells
 - change hormone production
 - Alter cell growth

Mechanism of Carcinogenesis of High Voltage Lines

- ?EMF
 - Induced currents from EMF weaker than those occurring naturally in the nervous system
 - Effects extend beyond the EMF
- ?Ionised particles
 - National (UK) Radiological Protection Board 2004 conceded this as a plausible mechanism.

Epidemiological Studies

- Randomized Case-Control Studies
- Observational Case-Control Studies
 - What can practically be obtained
 - Consistent findings of many studies despite different methodologies

5 Papers

- Lowenthal et al Internal Medicine Journal September 2007
- Draper et al British Medical Journal June 2005
- Ahlbom et al British Journal of Cancer 2000
- Feychting et al American Journal of Epidemiology 1993
- Greenland et al Epidemiology 2000

Paper 1 September 2007

Internal Medicine Journal 37 (2007) 644-647

ORIGINAL ARTICLE

Residential exposure to electric power transmission lines and risk of lymphoproliferative and myeloproliferative disorders: a case-control study

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Lowenthal et al

- Database of all MPD and LPD diagnosed in Tasmania between 1972 and 1980
- Controls from electoral roll matched for;
 - Age (within 5 years)
 - Sex
 - Socioeconomic status (coding of jobs)
 - Occupational exposure

Lowenthal et al

- Established residential history via (interview with cases and written postal survey for controls)
- Hydro-Electric Commission for location and voltage of lines
- Max lines 230kV

Lowenthal et al

- 854 patients on data base
- Establish residential histories on 768
- More controls than cases had resided outside of Tasmania
 - subgroup analysis of 201 case-controls who had lived only in Tasmania

Table 2 Number of patients and controls at the closest distance ever lived to a power transmission line

Distance (m)	Patients <i>n</i> = 854 (%)	Controls <i>n</i> = 854 (%)	Total <i>n</i> = 1708 (%)
0-50	19 (2.2)	9 (1.1)	28 (1.6)
51-300	75 (8.8)	55 (6.5)	130 (7.6)
>300	760 (89.0)	790 (92.4)	1550 (90.8)

Table 3 Risk associated with ever having lived 0-50 m or 51-300 m from a power line compared with 'never' and per year of residence (based on 768 adult case-control pairs and restricted to 201 Tasmanian pairs)

	Distance (m)	Ever having lived		Per year of residence	
		OR [†]	95%CI	OR [†]	95%CI
All pairs	0-50	2.06	0.87-4.91	1.07	0.99-1.17
	51-300	1.3	0.88-1.91	1.01	0.99-1.04
	>300	1	NA	1	NA
Tasmanian pairs only	0-50	2.93	0.22-38.40	1.37	0.81-2.32
	51-300	1.69	0.77-3.69	1.03	0.98-1.08
	>300	1	NA	1	NA

[†]Adjusted for socioeconomic status and occupational exposure. CI, confidence interval.

Table 5 Risk associated with first having lived 0-300 m from a power line at 0-5 years or 6-17 years compared with '≥18 years or never' (based on 768 adult case-control pairs and restricted to 201 Tasmanian pairs)

	Age at exposure (years)	OR [†]	95%CI
All pairs	0-5	4.74	0.98-22.9
	6-17	2.31	0.83-6.43
	≥18 or never	1	NA
Tasmanian pairs only	0-5	9.41	0.87-101.42
	6-17	4.54	0.22-92.20
	≥18 or never	1	NA

[†]Adjusted for socioeconomic status and occupational exposure. CI, confidence interval.

Table 6 Risk associated with having lived 0-300 m from a power line at different stages of life: three separate models comparing exposure at (i) 0-15 years of age, (ii) 15 years before diagnosis and (iii) ever with 'never' for LPD (based on 538 adult case-control pairs) and MPD (based on 230 adult case-control pairs)

Diagnosis	Time of exposure	OR [†]	95%CI
LPD	0-15 years of age	6.18	1.37-27.90
	15 years before diagnosis	1.18	0.76-1.84
	Ever	1.33	0.89-1.99
MPD	0-15 years of age	1.69	0.45-6.37
	15 years before diagnosis	2.29	0.80-6.59
	Ever	1.67	0.77-3.61

[†]Adjusted for socioeconomic status and occupational exposure. CI, confidence interval; LPD, lymphoproliferative disorders; MPD, myelo-

Lowenthal et al conclusion

- Greatest risk for those exposed to EMF at age <5 developing MPD/LPD in adulthood

MPD OR 4.7 (1.0-22.9)
LPD OR 6.2 (1.4-27.9)

Dosage with distance, time and voltage

Paper Number 2

- Childhood cancer in relation to distance from high voltage power lines in England and Wales: a case control Study

Draper et al BMJ June 2005

Draper et Al BMJ 2005

- Cancer registry 29,081 children with cancer aged 0-14yr born England/Wales
- Controls from Birth Register matched sex, DOB, birth in registration district
- Distance from home address to nearest high voltage overhead line 132-400kV

Daper et al BMJ 2005

	Relative Risk leukemia	95% CI
<200m	1.69	1.13-2.53
200-600m	1.23	1.02-1.49
>600m	1.0	

Draper et al BMJ 2005

- $P < 0.01$ trend in risk in relation to the reciprocal of distance from the line
- No excess risk was found for other childhood cancers
- Note the effect extends to at least 200m – where magnetic field would be $< 0.1 \mu\text{T}$ and often $< 0.01 \mu\text{T}$

Daper et al BMJ 2005

- If this association real, 1% of childhood leukaemia in UK would be attributable to high voltage lines
 - 400-420 cases childhood leukaemia annually
 - 5 cases annually due to HV lines

Paper # 3

- A pooled analysis of magnetic fields and childhood leukemia
 - A Ahlbom et al British Journal of Cancer 2000

Ahlbom et al British Journal of Cancer 2000

- Pooled analysis of 9 studies
- Children 0-14yrs of age
- 24/48hr magnetic field measurement
- In the year prior to their diagnosis
- 3203 cases of leukaemia and 10,338 control children

Ahlbom et al...

	0.1-0.2uT	0.2-<0.4uT	>0.4uT (0.8%)
Measurement Studies	1.05 (0.86-1.28)	1.15 (0.85-1.54)	1.87 (1.10-3.18)
Calculated Studies	1.58 (0.77-3.25)	0.79 (0.27-2.28)	2.13 (0.93-4.88)
All Studies	1.08 (0.89-1.31)	1.11 (0.84-1.47)	2.00 (1.27-3.13)

Paper # 5

- Magnetic Fields and Cancer in Children Residing Near Swedish High-voltage Power Lines
 - American Journal of Epidemiology 1993

Feychting et al

- Case-control
- Study base - everyone <16yrs who had lived on a property <300m from 220-400kV line from 1960-1985
- Each case approximately 4 controls selected from the study base
- Controls matched for age, gender, parish
- Population registry as source of info to identify individuals who had lived on listed property

Feychting et al

- Calculated historical magnetic fields (for the year the case was diagnosed)
- Also contemporary spot measures of magnetic field (only obtained for 2/3rds of the population)
- Also reviewed socioeconomic status (obtained from census data) and air pollution using traffic nitrogen dioxide as an index

Feychting et al

- No association for all childhood cancer, CNS tumors or lymphoma
- Association with leukemia and calculated magnetic field p=0.005

	<0.1uT	>0.2uT	>0.3uT
RR 1		RR2.7 95% CI 1-6.3	RR 3.8 95%CI 1.4-9.3

Paper #5

- A Pooled Analysis of Magnetic Fields, Wire Codes and Childhood Leukemia
 - Greenland et al Epidemiology 2000

Greenland et al

- Meta analysis of 15 studies looking at magnetic fields and wire codes and childhood leukemia (850 cases)

Field uT	Odds ratio	95% CI
0.1-0.2	1.08	0.86-1.35
0.2-0.3	1.10	0.76-1.6
>0.3	1.52	0.99-2.33

Summary

- Despite no animal data or a biologically plausible explanation ...
- A number of well conducted case control trials show a increased risk of childhood leukaemia (1xstudy adult myeloid and lymphoproliferative disorders)
- HV lines (within ICNIRP guidelines) are possible carcinogens
- Much remains unknown (?in utero effects)

Summary

- Where alternatives exist, I do not believe the exposure of the public to the possible carcinogenic effects of a 400kV line can be justified.