Power Lines and Health: The Evidence and Public Policy

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Outline

- Background on power lines and EMF
- The evidence for health effects
- Power lines and public policy
- Case example of how to deal with public concerns
Background on Power Lines

- Power lines emit electromagnetic fields (EMF)
  - Magnetic fields
  - Electric fields

- Exposure to EMF
  - Multiple
  - Ubiquitous
EMF

- One type of non-ionizing, extremely low frequency (ELF) radiation
Evidence for Health Effects
<table>
<thead>
<tr>
<th>Health Outcome</th>
<th>The Scientific Evidence*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adulthood cancers</td>
<td>Inconsistent</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Inconsistent</td>
</tr>
<tr>
<td>Reproductive &amp; developmental</td>
<td>Inconsistent</td>
</tr>
<tr>
<td>Neuroendocrine disorders</td>
<td>Inconsistent</td>
</tr>
<tr>
<td>Neurodegenerative disorders</td>
<td>?</td>
</tr>
<tr>
<td><strong>Childhood Leukemia</strong></td>
<td><strong>Most consistent</strong></td>
</tr>
</tbody>
</table>

*Based on WHO Monograph No. 238 on ELF EMF (2007)*
International Agency for Research on Cancer (2002)

- ELF EMF possibly carcinogenic to humans (Group 2B)

- Limited evidence
  - in humans for the carcinogenicity of ELF magnetic fields in relation to childhood leukemia

- Inadequate evidence
  - in humans for carcinogenicity of ELF magnetic fields in relation to all other cancers

(http://monographs.iarc.fr/ENG/Monographs/vol80/volume80.pdf)
EMF & Childhood Leukemia

- A study by Wertheimer & Leeper (1979) was the first to suggest an association

- Since then, many studies have investigated this relationship
Methods of Exposure Assessment

- Magnetic field measurements within/around homes
- Distance between home and power lines
- Other proxy: wire codes classification, calculated field strengths (from historical data)
<table>
<thead>
<tr>
<th>Study</th>
<th>Exposure Metric</th>
<th>Cases/Controls</th>
<th>Exposure</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahlbom et al. (2000)</td>
<td>24/48 hr calculated magnetic field</td>
<td>233 / 332</td>
<td>0.1 to &lt;0.2μT</td>
<td>1.08 (0.89-1.31)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>104 / 147</td>
<td>0.2 to &lt;0.4μT</td>
<td>1.11 (0.84-1.47)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>44 / 62</td>
<td>≥0.4μT</td>
<td>2.00 (1.27-3.13)</td>
</tr>
<tr>
<td>Greenland et al. (2000)</td>
<td>Direct measures / calculated magnetic field / wire codes</td>
<td>302 / 410</td>
<td>0.1 to &lt;0.2μT</td>
<td>1.01 (0.84-1.21)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>89 / 126</td>
<td>0.2 to &lt;0.3μT</td>
<td>1.06 (0.78-1.44)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>99 / 121</td>
<td>≥0.3μT</td>
<td>1.7 (1.2-2.3)</td>
</tr>
<tr>
<td>Distance to line (metres)</td>
<td>Relative Risk (95% CI)</td>
<td></td>
<td></td>
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<tr>
<td>--------------------------</td>
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<td></td>
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<tr>
<td>0-49</td>
<td>1.67 (0.40 - 6.97)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>50-69</td>
<td>1.51 (0.48 - 4.79)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>70-99</td>
<td>2.02 (0.76 - 5.39)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>100-199</td>
<td>1.64 (1.00 - 2.71)</td>
<td></td>
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<tr>
<td>0-199</td>
<td>1.69 (1.13 - 2.53)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>200-599</td>
<td>1.23 (1.02-1.49)</td>
<td></td>
<td></td>
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<tr>
<td>≥600 (reference group)</td>
<td>1.00</td>
<td></td>
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</tbody>
</table>

*Draper et al. (2005)*
Some Problems with Interpretation

- What is the appropriate exposure measure?
  - Traditionally thought to be field strength but is there something we are missing?

(https://www.emfs.info/Sources+of+EMFs/Overhead+power+lines/)
Some Problems with Interpretation (2)

- Field strength alone may not provide all the information
  - Spot measurements may not take into account variability in exposures
  - Field strength will change with electrical load

- No known biological mechanism
  - Makes it difficult to know what to measure
Some Problems with Interpretation (3)

- Time period of exposure may differ between studies
  - Longest lived residence, time of study, at birth

- EMF exposures are ubiquitous and many
  - Difficult to assess exposure to a particular source

- Confounders may exist, although none have been adequately substantiated
  - Socioeconomic status, traffic density, residential mobility, population mixing
If the Relationship Between Distance & Childhood Leukemia is Real…

- There is some evidence to suggest a weak association between childhood leukemia & EMF exposure

- On a statistical basis*, this equates to:
  - 4 additional leukemia cases/year in Canada
  - (range between 1-9 cases/year)

* based on assumptions used by Draper et al. (2005)
Possible Solutions?

- Maintain a distance of >600 metres between susceptible population & major transmission lines
  - Extremely difficult to implement
  - Requires major shift in land use

- Bury power lines
  - Addresses property values & aesthetic concerns
  - But is it protective of health?
  - May not be economically feasible in many cases
Power Lines and Public Policy
Policy Approaches

- **Precautionary principle**
  - Taking action on a potentially serious risk in face of scientific uncertainty

- **Prudent policy**
  - Implementing risk reduction measures that are cost-efficient
    - Eg. re-routing power lines away from homes, schools, hospitals
Health Canada

- No exposure guidelines for the general public
- No action required at an individual level

  - “You do not need to take action regarding typical daily exposures to electric and magnetic fields at extremely low frequencies”

  - “For the most part, typical EMF exposures in Canadian homes, offices and other work sites, are far below… guidelines [issued by other organizations].”

Toronto Public Health

- Recommend that individuals reduce exposure

  - “increasing the distance between you and a source of EMFs (power lines or electrical appliances) will easily reduce your level of exposure to EMFs”

  - reduce exposures in homes, office, community

  - “prudent avoidance for exposures to EMFs in and next to hydro corridors”, “encourage developers… to reduce potential exposures”

(http://www.toronto.ca/health/emfs.htm, Nov 2009)
Other Jurisdictions

- California Dept of Education requires setback distances for new schools from overhead & underground transmission lines

- EU has adopted ICNIRP* exposure guidelines for the general public, while some European countries have taken additional precautions including:
  - Adopting limits or standards based on these guidelines
    - In Switzerland, new constructions which emit EMF at places of “sensitive use” (hospitals, schools, homes) must comply with additional installation limit values
  - Adopting setbacks from homes, schools, hospitals
    - Spain, Norway, Sweden prohibit construction of new power lines within 300 feet of homes

* International Commission on Non-Ionizing Radiation Protection
EMF exposures are ubiquitous and sources are many

There is no known biological mechanism for health effects

Field strength measurements may not provide all the information relating to exposure

Epidemiological studies suggest a weak association between EMF exposure and childhood cancer

Public policy on EMF exposure from power lines differs among jurisdictions
How To Deal With Public Concerns
Case Example

- School board held a public meeting with parents to discuss locating a school within 110 meters from a set of power lines

  108 meters away, magnetic field readings of 2 mG
Parent Lobby Derails School, Oct 26

School construction halted over health fears - Oct 27

School-Power Line Controversy
Dubious science, cancer fear win out - Oct 29

Let experts give high-voltage advice - Oct 31, Editorials

Voodoo science threatens safety of children - Letters, Oct 31
- Electrical Engineer from Calgary utility
- Possible carcinogen (limited data from human, insufficient data from animal)
- No health risk
- Technical studies
Exposure levels from power line 2 mG compared to 100-200 mG from appliances, therefore not a concern
Will you let your family live by power line?
Set up
Strategy

Health Professional

- Same organization that inspects restaurants, gives immunizations to protect their children
- To provide information and not to speak for or against locating school close to power lines
Terms

- Magnetic fields classified as Possible carcinogen!
  - Same category as coffee (urinary bladder cancer), pickled vegetables, dry cleaning
  - Solar radiation is a known carcinogen
- Unknown and uncertainties
Scenarios

- Staying at school for 8 hours at 2 mG would expose individuals to 960 mG
- Using hair dryer for 15 minutes at 70 mG would give 1,050 mG exposure
Per capita energy consumption:

- 1961 - 2.66 Megawatt-hour
- 1971 - 6.39 Mw-hr
- 1981 - 10.59 Mw-hr
- 1991 - 16.25 Mw-hr

Leukemia rate for 5-9 Mw-hr:

- 1984 - 4.35 /100,000
- 1998 - 2.77/100,000
Control

- Gave the public information on how to reduce EMF exposure in their home:
  - Electrical blanket
  - Digital clock by night table
  - Cell-phone base station by night table
  - Baby monitor in crib
Will I let my family live near a power line?
Summary

- Let the public express their view
- Gain their trust
- Show that you care and listen to their concerns
- Communicate using terms they understand and daily scenarios they can relate to
- Give them control
• Don’t be too technical
  ➢ (what is $10^{-4}$?)
• Don’t use math
• Don’t talk down
• Use examples public can understand
Don’t tell the public not to worry, tell them what to do
Explain risk-reducing steps (risk management)
Share power and responsibility – accept and involve the public
The public has to learn to live with uncertainty
Thank You!

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