Radiofrequency electromagnetic field exposure and non-specific symptoms of ill health

Martin Röösli
Outline

- Type of studies
- Results from human laboratory trials
- Results from observational studies on symptoms
- Electromagnetic hypersensitivity (EHS)
Type of research

- Provocation studies / randomized trials / human laboratory study:
  2. short term effects on symptoms

- Epidemiological/observational studies
  1. long term effect on symptoms
Provocation study

- Repeated tests with different exposure conditions (incl. sham): **randomised**

- Neither the study participants nor the study assistant know the exposure condition: **double blind**.

- Study participants state whether they perceive exposure or not (or symptoms).
Perceived field intensity

Perception – short term effects – long term effects

Regel et al, EHP, 2006
### Meta-analysis of provocation studies (correct field detection rate)

**Study**

<table>
<thead>
<tr>
<th>Study</th>
<th>ES (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Studies with non-EHS collective</strong></td>
<td></td>
</tr>
<tr>
<td>Loughran, 2005</td>
<td>0.23 (-0.09, 0.51)</td>
</tr>
<tr>
<td>Regel, 2006</td>
<td>-0.10 (-0.39, 0.20)</td>
</tr>
<tr>
<td>Rubin, 2006</td>
<td>-0.03 (-0.22, 0.18)</td>
</tr>
<tr>
<td>Wolf, 2006</td>
<td>0.09 (-0.26, 0.59)</td>
</tr>
<tr>
<td>Eltiti, 2007 (5’)*</td>
<td>0.02 (-0.12, 0.18)</td>
</tr>
<tr>
<td>Eltiti, 2007 (50’)</td>
<td>0.02 (-0.13, 0.18)</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>0.02 (-0.07, 0.10)</td>
</tr>
<tr>
<td><strong>Studies with EHS collective</strong></td>
<td></td>
</tr>
<tr>
<td>Radon, 1998</td>
<td>0.20 (-0.04, 0.45)</td>
</tr>
<tr>
<td>Regel, 2006</td>
<td>0.13 (-0.25, 0.49)</td>
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</tr>
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</tr>
<tr>
<td>Eltiti, 2007 (50’)</td>
<td>0.08 (-0.14, 0.35)</td>
</tr>
<tr>
<td>Oftedal, 2007</td>
<td>0.07 (-0.14, 0.28)</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>0.07 (-0.02, 0.17)</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>0.04 (-0.02, 0.11)</td>
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</tbody>
</table>

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*Note: Studies marked with an asterisk (*) indicate results that are worse than chance.*
Meta-analysis of provocation studies with base station exposure (correct field detection rate)

<table>
<thead>
<tr>
<th>Study</th>
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<tbody>
<tr>
<td>Studies with EHS populations:</td>
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<tr>
<td>Regel, 2006</td>
<td>0.13 (-0.25 to 0.49)</td>
</tr>
<tr>
<td>Eltiti, 2007 (5-min exposure)</td>
<td>-0.01 (-0.21 to 0.21)</td>
</tr>
<tr>
<td>Eltiti, 2007 (50-min exposure)</td>
<td>0.08 (-0.15 to 0.34)</td>
</tr>
<tr>
<td>Furubayashi, 2009</td>
<td>0.03 (-0.29 to 0.44)</td>
</tr>
<tr>
<td>Subtotalb</td>
<td>0.04 (-0.10 to 0.17)</td>
</tr>
<tr>
<td>Studies with non-EHS populations:</td>
<td></td>
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<tr>
<td>Regel, 2006</td>
<td>-0.10 (-0.39 to 0.20)</td>
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<tr>
<td>Riddervold, 2008</td>
<td>0.05 (-0.16 to 0.30)</td>
</tr>
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<td>Furubayashi, 2009</td>
<td>-0.02 (-0.19 to 0.16)</td>
</tr>
<tr>
<td>Subtotalb</td>
<td>0.00 (-0.08 to 0.09)</td>
</tr>
<tr>
<td>Overallb</td>
<td>0.01 (-0.06 to 0.08)</td>
</tr>
</tbody>
</table>

Röösli, WHO Bull, 2010
Short term effects:
Symptom score after exposure

Regel et al, EHP, 2006
Symptom score after exposure vs. perceived field intensity

Regel et al, EHP, 2006
Example: Scandinavian Headache study
(Oftedal et al, 2007)

- Open provocation with 38 persons, who report headache when using a mobile phone.
- 24 persons reacted with headache during the open provocation.
- 17 persons agreed to participate at a double blind experiment.
- Under double blind condition: no association between headache and exposure.
- Evidence for nocebo effect.
Nocebo

- contrary to placebo
- development of symptoms due to expectation (e.g. concern)
In line with short term effects from randomised blinded trials

Evidence for nocebo
Nocebo not considered

*) near field (mobile phone)

°) far field (base station)
Why observational studies?

- Effect of prolonged exposure
- Real life situation:
  1. Exposure
  2. Symptoms
- Large study population
Major Challenge I: Exposure assessment

Average EMF distribution in a Swiss sample (mean=0.22 V/m):

- FM radio broadcast: 29.1%
- TV broadcast: 32.0%
- Tetrapol: 5.8%
- Mobile phone handset: 22.7%
- Mobile phone base station: 5.9%
- Cordless phone (DECT): 4.1%
- Wireless LAN: 0.3%

Frei et al. EnvRes, 2009
Subjective reporting of symptoms \[\rightarrow\] Knowledge about exposure

**Consequences**: self-estimated exposure measures are particularly vulnerable to bias.
Major Challenge III

Exposure

Confounding by lifestyle related communication devices

Health Outcome

Perception – short term effects – long term effects
Cross-sectional studies

- 3 out of 17 Zerssen symptoms associated with exposure in 365 residents of mobile phone base stations (Hutter et al. OEM, 2006):
- No effect among 329 adults (Thomas et al. BioEM, 2008)
- No effect on symptoms among 3022 children and adolescents (Heinrich et al. EnvInt, 2010)
- Among adolescents (but not among children) behavioural problems were more common in the highest quartile of exposure (OR 2.2; 95% CI 1.1–4.5) (Thomas et al. Eur J Epidem, 2010)
- Symptom score was not associated with RF-EMF measurement in the bedroom among 1500 adults (Berg-Beckhoff et al. OEM, 2009)
Longitudinal study: Qualifex (Mohler et al. RadRes, 2010)

- Far field exposure:
  1. Residential exposure to fixed site transmitters (Bürgi et al., 2010)
  2. Total personal exposure (prediction model) (Frei et al., 2009)

- Close to body sources:
  1. Use of mobile phones (self-reported & operator data)
  2. Use of cordless phones
Symptom score (Zerssen) vs. total personal exposure

Cross-sectional analyses

Longitudinal analyses
Sleep disturbances vs. fixed site transmitter radiation

Cross-sectional analyses

Baseline survey (n=1163)

Follow-up survey (n=926)

Cohort analysis (n=926)

Change analysis (n=898)

Perception – short term effects – long term effects

Exposure groups

Change in Score

<median 50-90th perc. >90th perc.

-1.0 -0.5 0.0 0.5 1.0

Exposure groups

-1.0 -0.5 0.0 0.5 1.0

decrease no change increase

Exposure groups

Paris, 16. 12. 2010

Martin Rööslı
Mobile phone exposure
Headache (HIT-6) vs. mobile phone use (operator data)

Cross-sectional analyses

Baseline survey (n=523)

Follow-up survey (n=409)

Cohort analysis (n=523)

Change analysis (n=409)

Perception – short term effects – long term effects
Danish subscriber cohort (Schüz, PlosOne, 2009)

- Danish mobile phone subscriber Cohort: Comparison of hospital contacts in 420,000 early mobile phone subscribers (1982-1995) with the rest of the Danish population.
- Outcomes: first hospitalizations due to any central nervous system diseases.
- Follow-up: since subscription until end of 2003 (at the latest)
- Increased risk for migraine (RR=1.2; 95% CI 1.1-1.3) and for vertigo (1.1; 95% CI 1.1-1.2)
Conclusions

- The vast majority who claims to be able to perceive low level EMF is not able to perceive fields in a laboratory double blind setting.
- Nocebo effects occur.
- Strong evidence for absence of short term effects on symptoms.
- Investigating long term effect is a challenge and less firm conclusions can be drawn from the available studies:
  1. Objective exposure measures are a must
  2. In most studies no effect was observed
  3. Confounding by lifestyle is crucial
  4. Low exposure contrasts
  5. Few longitudinal studies
References


Systematic review on the health effects of exposure to radiofrequency electromagnetic fields from mobile phone base stations

Martin Röösli, Patrizia Frei, Evelyn Mohler & Kerstin Hug

Interactions between radiofrequencies signals and living organisms
Sense and sensibility in the context of radiofrequency electromagnetic field exposure

Mesure et perception des champs électromagnétiques radiofréquences : une étude de cohorte sur l’hypersensibilité électromagnétique

Martin Röösli, Patrizia Frei, Evelyn Mohler, & Kerstin Hug

Swiss Tropical and Public Health Institute, Switzerland
University of Basel, Switzerland
Paris, 16. 12. 2010
Martin Röösli
# EHS status

<table>
<thead>
<tr>
<th>EHS status 2008</th>
<th>nonsensitive</th>
<th>attributer</th>
<th>EHS</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>non- n</td>
<td>773</td>
<td>85</td>
<td>23</td>
<td>881</td>
</tr>
<tr>
<td>sensitive</td>
<td>(68.9%)</td>
<td>(7.6%)</td>
<td>(2.1%)</td>
<td>(78.5%)</td>
</tr>
<tr>
<td>attributer n</td>
<td>74</td>
<td>60</td>
<td>11</td>
<td>145</td>
</tr>
<tr>
<td>(6.6%)</td>
<td>(5.4%)</td>
<td>(1.0%)</td>
<td></td>
<td>(12.9%)</td>
</tr>
<tr>
<td>EHS n</td>
<td>28</td>
<td>16</td>
<td>52</td>
<td>96</td>
</tr>
<tr>
<td>(2.5%)</td>
<td>(1.4%)</td>
<td>(4.6%)</td>
<td></td>
<td>(8.6%)</td>
</tr>
<tr>
<td>Total</td>
<td>875</td>
<td>161</td>
<td>86</td>
<td>1,122</td>
</tr>
<tr>
<td>(78.0%)</td>
<td>(14.4%)</td>
<td>(7.7%)</td>
<td></td>
<td>(100%)</td>
</tr>
</tbody>
</table>

219 attributer; 130 EHS individuals

Röösli et al. Compt Phys, in press
Ownership of communication devices

![Chart showing ownership of mobile phones, cordless phones, and W-LAN](chart.png)

- **Mobile phone**
  - 2008: p=0.48
  - 2009: p=0.04

- **Cordless phone**
  - 2008: p=<0.01
  - 2009: p=<0.01

- **W-LAN**
  - 2008: p=0.24
  - 2009: p=0.33

Röösli et al. Compt Phys, in press
Health status

Röösli et al. Compt Phys, in press
Results: EHS and exposure to fixed site transmitter radiation

Zerssen symptom score and total exposure

Sleep disturbance score and fixed site transmitter