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Advantages and limitations of EMF studies conducted in the everyday environment

Martin Röösli, PhD

Institute of Social and Preventive Medicine

University of Bern

Content

- Introduction
- Methodological challenges of studies in the everyday environment
- Overview and critical discussion of studies
- Conclusions

Human studies

- Intervention studies in the laboratory :
  - ⊕ controlled exposure conditions
    sophisticated outcome measurements
  - ⊖ short term effects
    no serious diseases due to ethical constraints
    small sample size

- Observational studies:
  - ⊕ real life exposure, large sample size
    long term effects, serious diseases
  - ⊖ uncertain exposure assessment
    outcome measurement restricted
    Bias: selection bias, information bias, confounding

Human studies

- Intervention studies in the laboratory :
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- Intervention studies in the everyday environment

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Studies in the everyday environment: methodological challenges

- Exposure assessment
- Selection bias
- Information bias
- Limited possibilities for objective outcome measurements
- Reverse causality
- Confounding by lifestyle

Neubauer et al., Bioelectromagnetics 2007, 28(3):224-30

Exposure assessment

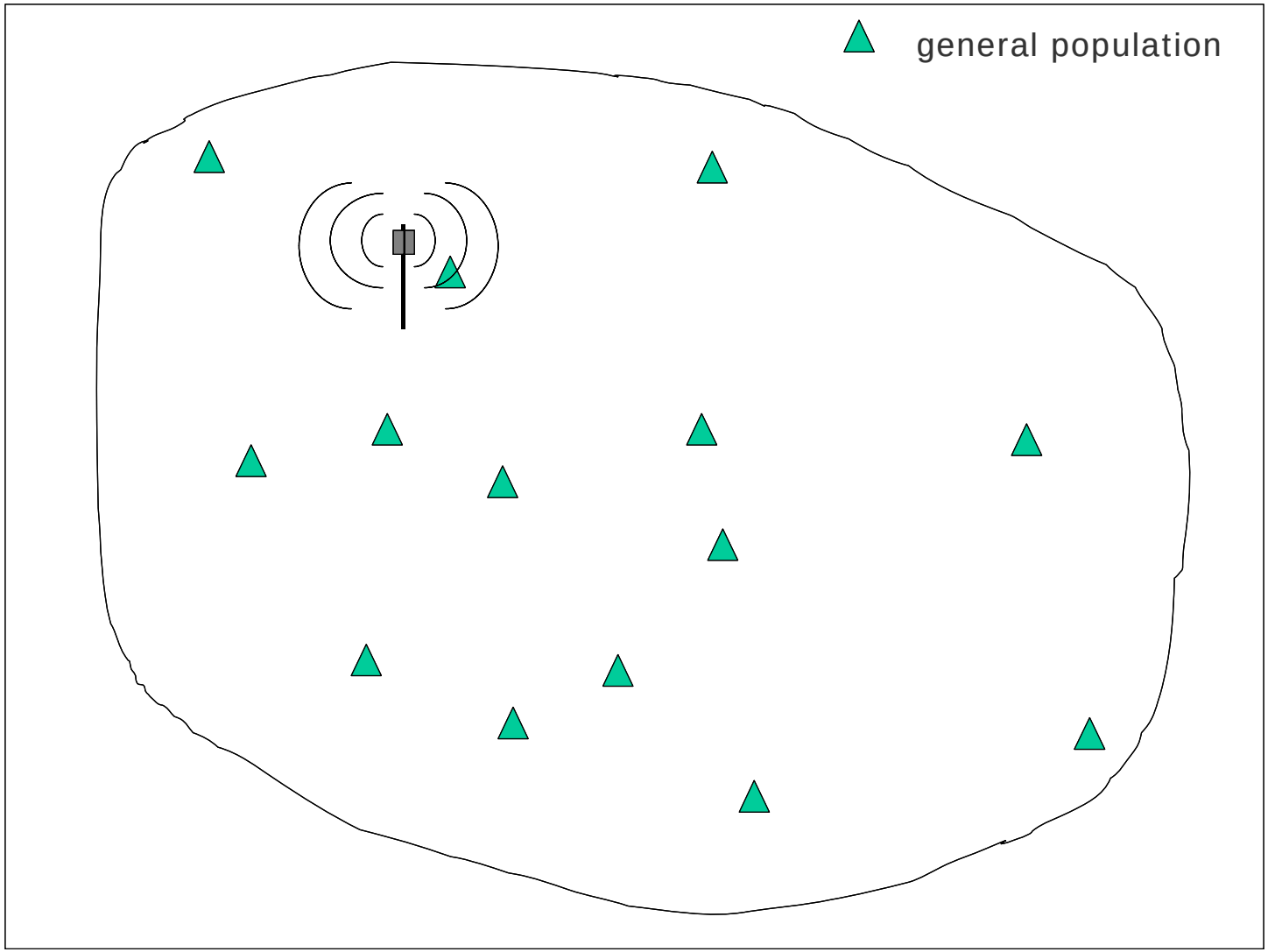
- Errors in exposure assessment are unavoidable
- error≠mistakes
- non-differential exposure misclassification leads generally to an underestimation of the true-exposure response association
- Differential exposure misclassification is a serious problem; results in bias; e.g. self estimated distance to base station.

  QUEBEB-study (Berg, GMDS-Meeting Leipzig, 2006):
  - subjectively perceived presence of a mobile phone base station in the living environment was correlated with self reported health complaints.
  - objective presence of a mobile phone base station was **not** correlated with self-reported health complaints.
- Studies with subjectively reported exposure are not discussed (mobile phone use, distance to base station)

Selection bias

- Selection bias can occur in case-control studies if controls are not completely representative for the source (general) population.
- Selection bias can occur in cross-sectional studies if participants are not selected randomly:
  - in a France study, participants were recruited using newspapers articles. Individuals attributing their symptoms to base station have to live in the vicinity of a base station. They are likely to have more symptoms than the rest of the population.

Selection bias



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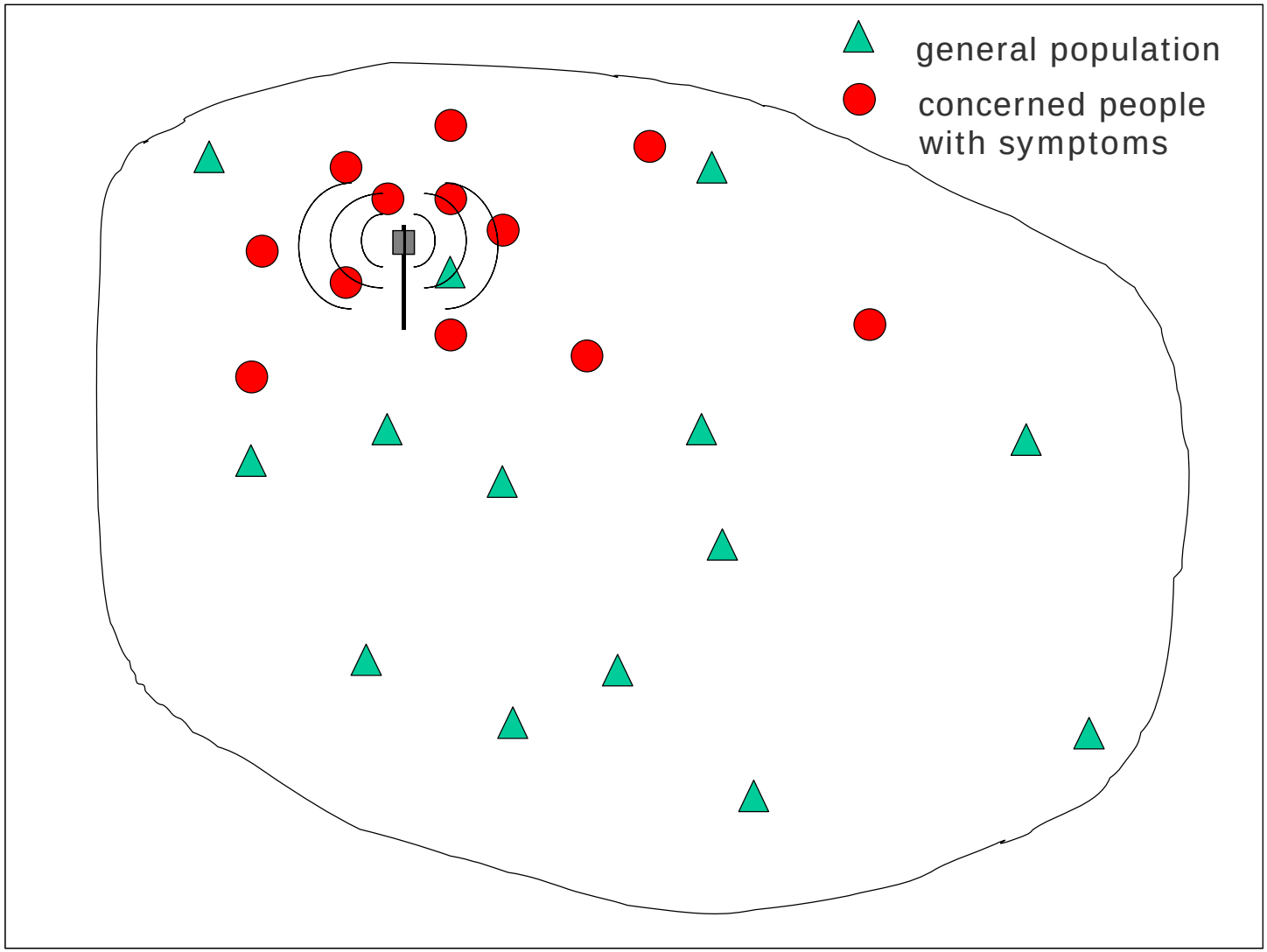


Information bias

- Awareness of exposure status may affect outcome measurements.
- Of particular concern for subjective health outcomes.
- (May also be considered as confounding by concern)

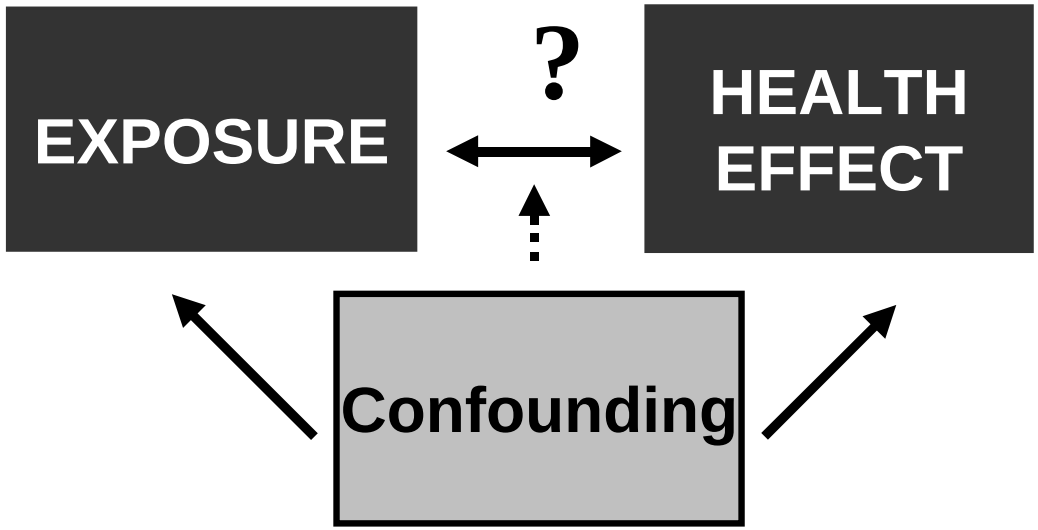
Objective outcome measurements

- Objective measurements are often limited; e.g. EEG, cognitive functions, etc.
- validated questionnaire guarantee a certain degree of objectivity.
- Nevertheless, they can be vulnerable to information bias.

Reverse causality

- Differences in exposure are a result of the health status (and not vice versa).
- Example 1: Self declared EHS study participants may tend to avoid exposure and to report more symptoms:
  -> would result in a negative correlation between exposure and health status
- Example 2: Morbid persons spend more time at home and may thus be less exposed.
- Of concern in pure observational studies, in particular cross-sectional studies.

Confounding



- Confounding by lifestyle, concerns and socio economic status is most crucial in this context.
- Lifestyle related EMF sources: mobile phone, W-LAN, etc.

Cognitive and sleep studies conducted in the everyday environment

- Cross-sectional survey on cognitive functions and use of mobile phone (Lee et al. 2001)
- Schwarzenburg study (Abelin et al. 2005; Altepeter, et al., 2006)
- Austrian cross-sectional survey (Hutter et al., 2006)
- Cyprus survey (Preece et al. 2007)
- QUEBEB (Berg, 2007)
- Bavarian UMTS intervention study (Heinrichs et al., 2007)
- Shielding sleep study (Leitgeb)
- Sleep field study (Dorn)
- Occupation study (Dabala)
- QUALIFEX (Röösli)

Lee et al, 2001

- Cross-sectional comparison
- Three measures of attention were administered to 72 teenagers, 37 of whom were mobile phone users.
- Mobile phone users performed better on one of the three measures of attention than the non-mobile phone users.

Lee et al, 2001

- Cross-sect
- Three mea … to 72 teenagers, …rs.
- Mobile pho … the three measures … e users.

Exposure assessment

Selection bias

Information bias

Objective outcome measurements

Reverse causality?

Confounding by lifestyle?

Schwarzenburg study

Reference	Study design	Collective	Association observed
Abelin, 2005	cross-sectional in 1992	404 residents of three differently exposed areas around shortwave transmitter (participation rate: 60%)	sleep disturbances, general weakness and tiredness, nervousness, restlessness, limb and joint pain
Abelin, 2005	Panel: interrupted during 3 days	65 residents of a shortwave transmitter (participation rate: 64%)	Decrease of awakening after transmission stopped
Abelin, 2005	cross-sectional survey in 1996	399 residents of four differently exposed areas around the shortwave transmitter (participation rate: 77%)	Sleep disturbances, nervousness, restlessness
Altpeter, 2006	Panel study in 1998: permanent shut down	54 residents of a shortwave transmitter	Self rated sleep quality Melatonin excretion in poor sleepers

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- Information bias?
- Objective outcome measurements?
- Reverse causality
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Austrian cross-sectional survey (Hutter et al., 2006).

- 365 random sample residents of mobile phone base station
- Participation rate: 60%
- Outcome: cognitive functions, Zerssen symptom scale, Pittsburgh Sleep Quality Index
- Measurements yielded field values in the high frequency range from 0.01 to 0.75 V/m
- 3 of 17 symptoms associated with exposure: Headache, cold hands or feet, difficulties to concentrate

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Cyprus survey (Preece et al. 2007)

- 1870 inhabitants from three differently exposed villages around a short wave military antenna system (participation rate: 87%)
- Participation rate: 87%
- Exposure levels: 0.57 V/m; 0.46 V/m and <0.01 V/m (most from mobile phone base stations)
- Observed associations: migraine, headache, dizziness, depression, SF-36-scores

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QUEBEB (Berg, 2007)

- Base survey of 30‘000 individuals in Germany about concerns, symptoms and self-estimated exposure.
- Modelled exposure using geo-coded data from base station site.
- Nested cross-sectional survey in 3‘500 individuals.
- Acute symptoms and exposure investigated in 1‘300 individuals
- Positive correlation between symptoms and self-estimated exposure (n=30‘000).
- No association between measured EMF and 5 symptoms: sleep disturbations, headache, somatic symptoms, somatic and psychic health related quality of life (n=1‘300)

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Bavarian intervention study (Heinrich et al. 2007)

- A newly installed UMTS mobile phone base station on an office building was randomly turned on and off over a period of 70 working days.
- Software was modified in a way that the operating state could not be retrieved from the own UMTS mobile phone.
- Maximum field level 0.53 V/m.
- 95 workers in the building filled in a symptom questionnaire every morning and evening.
- Slight tendency of an increase of self reported complaints on days when the mobile phone base station was operating ($p=0.08$).
- Evidence for nocebo phenomenom ($p<0.0001$).

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Conclusions

- The conduct of studies in the everyday environment are methodologically challenging.
- Methodological limitations hamper the interpretation of the studies available to date.
- There is not one single correct study design.
- There are research questions that cannot be answered with human laboratory studies.
- Intervention-type studies in the everyday environment are useful, however, cannot capture long term effects (~>1 year).
- Different studies used different approaches -> may result in comprehensive picture.

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Thanks for your attention!