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# **Mobile phones and health effects in children – epidemiology**

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# Few epidemiological studies on children and adolescents

- Well-being, cognition, behavioural problems
  - A few cross-sectional studies
  - Several cohort studies
  - Three cohort studies on maternal exposure
- Cancer
  - RF-exposure from transmitters and cancer risk (one on base-stations, a few on radio and TV transmitters)
  - Mobile phone use and cancer risk – two international studies ongoing, CEFALO and Mobi-Kids

# Well-being, symptoms, depression etc.

## Methodological considerations

- RF-exposure or life-style?
  - Need to distinguish between potential effects of radiofrequency exposure and a behavior or life-style associated with mobile phone use – reversed causality
- Psychosocial aspects of mobile phone use, e.g.
  - demands on availability
  - perceived stressfulness of accessibility
  - being awakened at night
- These are confounding factors in a study of RF exposure

# Cross-sectional studies

- Limitations inherited in the cross-sectional study design
  - Cannot determine temporality – did exposure precede outcome (disease)?
  - Risk of reversed causality – outcome (disease) affects exposure
- Cannot be used to draw conclusions about cause and effect

## Other limitations

- Risk of recall bias – prevalent disease affects self-reported exposure
  - Amount of mobile phone use
  - Distance to base station
- Disease is also self-reported
- Selection bias may be a problem
  - Concerned persons more likely to participate
  - and more likely to have located the nearest base station
  - and probably more likely to report symptoms or lower well-being

German study (Thomas et al. 2008) showed that 3% among participating adolescents answered "don't know" on question about distance to base station, compared to 17% among non-participants

German study (Thomas et al. 2008) showed that among participating adolescents in personal measurement study, 12% were concerned about mobile phones, compared to 8% among non-participants

# Well-being, symptoms, depression

## Cross-sectional studies, self-reported

- Various health outcomes more common among children and adolescents self-reporting frequent mobile phone and DECT phone use

Söderqvist F, et al. 2008, Heinrich et al. 2011, 2011,

- e.g. concentration problems, stress, tiredness, sleeping problems, irritation, asthma, hay fever, etc.
  - Generally higher effects in Swedish studies – residual confounding? German studies controlled for environmental worries
  - Recall bias and selection bias a problem – and confounding!
- Other studies have a different aim:
    - Behaviors associated with mobile phone use increase health problems (tiredness, depression, sleep problems)
    - Thomée et al. 2011, Punamäki et al. 2007

# Well-being, symptoms, depression

## Cross-sectional studies, measured exposure

- Heinrich et al. 2011, 2011: 1498 children (8-12 years) and 1524 adolescents (13-17 years) participated in an interview and measurement (52% of invited)
- Exposure assessment using personal dosimetry 24 h
- Cross-sectional design – two types of outcomes:
  - Chronic well-being – measured symptoms over the last 6 months: headache, irritation, nervousness, dizziness, fatigue, fear and sleeping problems
  - Acute symptoms – symptoms reported in a diary; exposure in the morning was related to symptoms at noon, exposure in afternoon to symptoms in the evening
- No consistent effects found with measured RF exposure



# Well-being, symptoms, depression

## Cohort studies

- Thomée et al. 2011: psychosocial aspects of mobile phone use and mental health symptoms
  - High frequency of mobile phone use at baseline was a risk factor for mental health outcomes at 1-year follow-up
    - Fewer and lower effects than in cross-sectional analyses
    - The risk for reporting mental health symptoms at follow-up was associated with other aspects of mobile phone use – e.g. being constantly accessible
- Bulck et al. 2007: Calling and text messages very common during nighttime
  - High frequency of mobile phone use and SMS associated with tiredness

# Cognitive function – cross-sectional MoRPhEUS, Australia

- Abramson MJ, et al. 2009: Mobile telephone use is associated with changes in cognitive function in young adolescents
  - Poorer accuracy, faster reaction time, associative learning response time shorter
  - Same results for calls as for SMS – unlikely to be RF

# Confounding

- The exposure of interest:
  - Radiofrequency fields
- i.e. **not** other aspects of mobile phone use that may cause changes in the outcome
  - e.g. cognitive function trained by frequent sending of text messages

” .... these cognitive changes were unlikely due to radiofrequency (RF) exposure. Overall, mobile phone use was associated with faster and less accurate responding to higher level cognitive tasks. These behaviours may have been learned through frequent use of a mobile phone.”

Abramson MJ, et al. Mobile telephone use is associated with changes in cognitive function in young adolescents. *Bioelectromagnetics* 2009;30:678-86.

# MoRPhEUS, cohort analysis

## Mobile phone use and cognitive function

- Thomas et al, 2010, one-year follow-up of 236 7<sup>th</sup> grade students
  - Cognitive function tests distributed at baseline and follow-up
    - Measured response times and accuracy
  - Students with more calls and SMS at baseline showed less reductions in response times at follow-up
  - Students with increased number of calls and SMS showed more reduction in response times at follow-up
    - Increased number of calls and SMS was mainly among students with low use at baseline
  - Changes over time may relate to statistical regression to the mean and not be the effect of mobile phone exposure

# Behavioral problems – cross-sectional

- Self-reported mobile phone use at age 7 increased risk of behavioral problems in Danish children  
→ Divan, et al. 2008, 2011
- Measured environmental RF increased risk of behavioral problems in children (conduct problems) and adolescents (conduct problems, hyperactivity)  
→ Thomas, et al. 2010

# Potential for reversed causality – behavioral problems

- Behavioral problems may be associated with a lifestyle
  - Likely to increase own mobile phone use
  - Likely to increase time spent in environments where mobile phone use is more common, e.g. cafés, clubs, public transportation – higher environmental exposure
  - Truancy more common – more time to spend on the phone
- May lead to false positive results – the outcome may increase exposure
- Difficult to determine when the condition started
  - Reversed causality potential problem also in cohort and case-control studies with insufficient latency period

# Maternal exposure during pregnancy

- Effects on behavioral problems at age 7, in two publications on Danish cohort study
  - Divan et al. 2010, Divan et al. 2011
  - Retrospective self-reported assessment of mobile phone use
- Both publications report increased risk
  - Highest risk with both prenatal and postnatal phone use – combined OR=1.5 (95% CI 1.4-1.7)
  - Strong hereditary component, over 80% heritability – mothers who were early mobile phone users possibly different
  - Extensive confounding control
  - Lower risks in more recent birth cohorts – residual confounding?

# Example of confounding

## Maternal smoking during pregnancy

- Lambe et al., 2006: Maternal smoking during pregnancy and school performance at age 15:
  - Increased risk of poor school performance related to maternal smoking, with dose-response
  - However, if mother smoked in her first pregnancy but not in her second, the sibling was also at increased risk
- Cnattingius et al., 2011: Maternal smoking during pregnancy and suicidal acts in young offspring
  - Increased risk of suicidal acts related to maternal smoking, with dose-response
  - With sibling controls discordant for the outcome – no association was found with maternal smoking during pregnancy



# Maternal exposure during pregnancy and child development

- Divan et al. 2011, in press, cohort study of 41,000 Danish children
  - No effect on developmental milestones at age 6 and 18 months
- Vrijheid et al. 2010, cohort study of 530 Spanish children
  - Little evidence of adverse effects on neurobehavioral development at age 14 months

# Transmitters and cancer risk

- Studies with individually predicted RF field strength from radio- and TV towers have not found increased risk of childhood leukemia  
(reviewed in Schuz J, Ahlbom A. Rad Prot Dosim, 2008)
- UK case-control study of exposure from mobile phone base stations during pregnancy and childhood cancer
  - Distance from nearest base station
  - Total power output
  - Modelled power density
- No associations were found for any cancer type  
Elliot et al. 2010

# Mobile phone use and childhood brain tumour risk

Two ongoing international case-control studies:

- CEFALO
- MOBI-KIDS

# CEFALO - An international case-control study on brain tumours in children and adolescents and mobile phone use

- Denmark, Norway, Sweden, Switzerland
- All cases of brain tumours in children aged 7-19 are identified during a 4 year period
  - Close collaboration with paediatric oncology and neurosurgery clinics
  - Regular search in population based Cancer registries
  - Study period: April/May 2004 to 2008
- 2 controls per case selected randomly from the general population

# Data collection

## Personal interviews with child and parent(s)

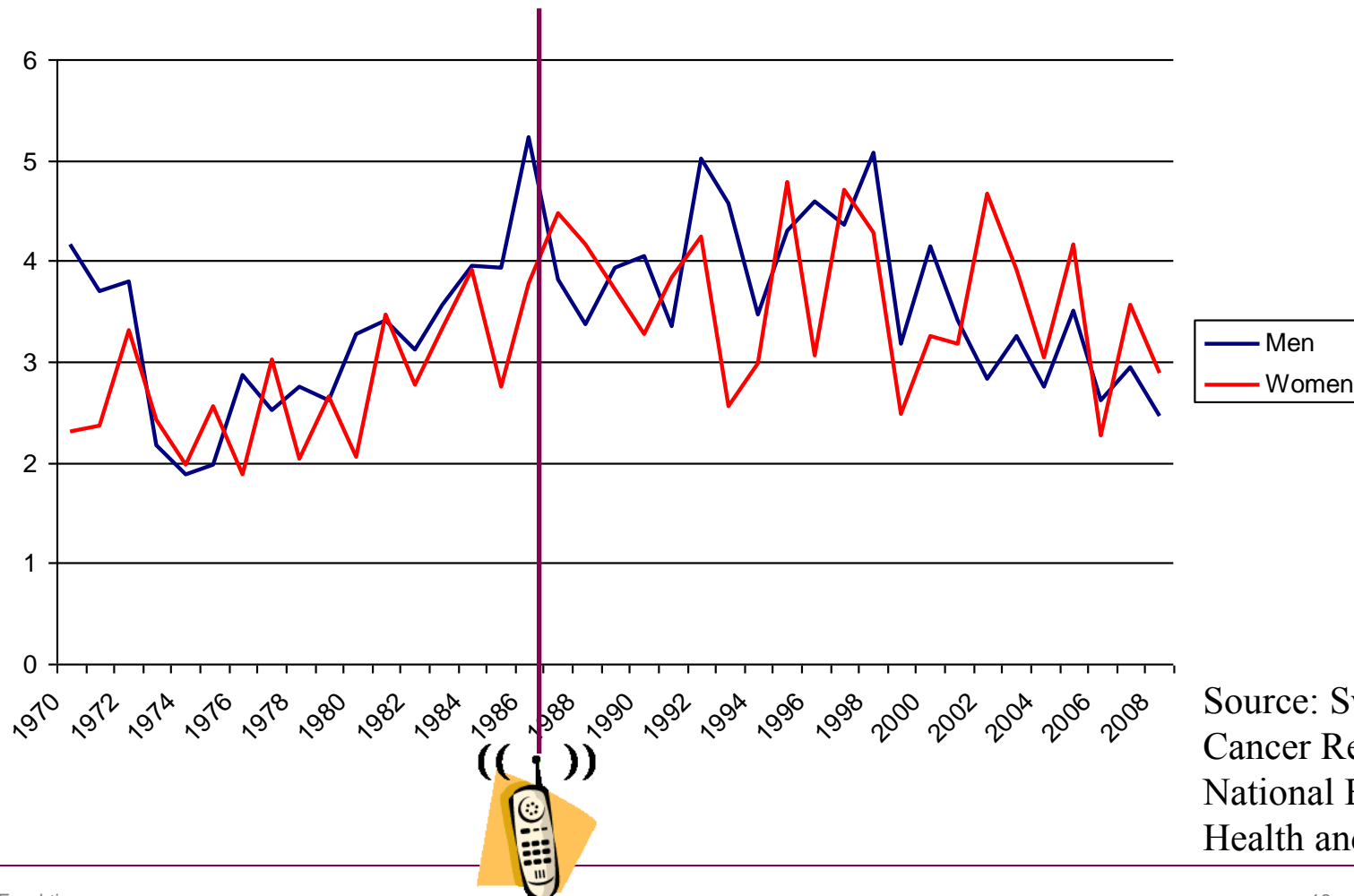
- Exposure information:
  - Detailed questions about mobile phone use: frequency, duration, laterality and type (voice or messaging), handsfree, and use of cordless phones
  - Questions about other potential risk factors
  - Information from registries (mobile phone operators, medical birth registries)
- Collection of saliva samples
  - Stored at Karolinska Biobank, Stockholm

# CEFALO

- In total, >400 cases of brain tumours and >900 population based controls are eligible for inclusion
- Participation rates are high, >80% among cases and >70% among controls
- Analyses have been finalized, manuscript submitted

# Brain tumour incidence in Sweden 1970-2008

Age 10-24 years, per 100 000, age standardized



Source: Swedish  
Cancer Registry  
National Board of  
Health and Welfare

# Research strategies

- Prospectively collected exposure information
  - To avoid recall bias
- Sufficient latency periods to avoid reversed causality
- Cross-sectional observational studies **not** recommended
  - Large, well-designed, well-controlled human experimental studies probably more informative for acute effects
  - Cohort studies with prospective data for long-term effects
    - For behavioral outcomes frequent follow-up needed
- Monitor brain tumour incidence time trends
  - Information from high quality cancer registers, international collaborations to minimize random fluctuations