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Mobile Telecommunication Self-commitment and German Mobile Telecommunication Research Programme

Rapporteurs Report „Acute Effects“

Mirjana Moser
Federal Office of Public Health,
Switzerland

Berlin, 17-18. Juni 2008



Studies on wellbeing, sleep and electrohypersensitivity conducted in the frame of German Mobile Telecommunication Research Programme

- Cross-sectional study on **adverse health effects** due to EMF from base stations [CS]
 - Addendum to the CS study on acute health effects due to EMF from BS
- Acute health effects** by mobile telecommunication among **children** [CS]
- Effects of EMF from mobile phones on **sleep** and cognitive functions [LS]
- Sleep** quality in persons living near a mobile base station [FS]
- Sleep** quality of **EHS** persons under residential conditions [FS]
- Investigation of the phenomenon of **EHS** [LS]
- Investigation of **EHS** persons [LS]



CS: cross-sectional study
LS: laboratory study
FS: experimental field study

Presented on the workshop (concluding stage)
“**Acute Health Effects**”, Munich, 12-13 December 2006

- Introductory lecture on possible exposures in everyday life and on personal dosimeters

<http://www.emf-forschungsprogramm.de>



Content

- ➔ **Short overview of the studies**
- ➔ **General remarks**
- ➔ **Summary of the results**
- ➔ **Conclusions**
- ➔ **Personal comments**



Cross-sectional study to record and evaluate possible adverse health effects due to electromagnetic fields from cell-phone base stations

Universities of Bielefeld* and Mainz, DKFZ Heidelberg, NFO Infratest Munich

(Gabriele Berg*)

QUEBEB Study

Study: stages I (pilot-study) and II (main survey)

Pilot-study

- Feasibility test for the cross-sectional study

Main survey

- Population based sample of ~30'000 persons (age 14–69) in Germany
(in the frame of nation-wide “health-care” survey on households in 2004)
- written questionnaire survey on concern, health complaints and EMF perception
link to
- location and technical data of ~50'000 sites with 280'000 BS
(→ distance and rough exposure assessment of the EMF from BS)



Cross-sectional study to record and evaluate possible adverse health effects due to electromagnetic fields from cell-phone base stations

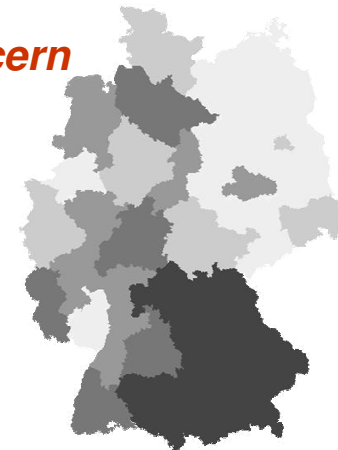
Universities of Bielefeld* and Mainz, DKFZ Heidelberg, NFO Infratest Munich

(Gabriele Berg*)

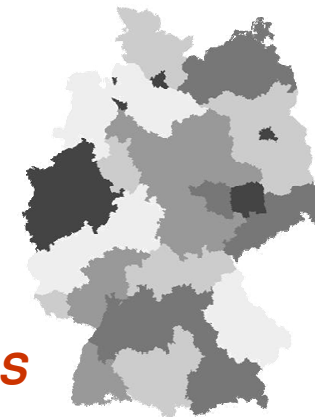
Results stage II

- sample represents German population living in private households
- 28% of the population is concerned about EMF from BS
- 11% attribute their health complains to the EMF from BS
- strong north-south gradient (the highest concern in Bavaria 35%)
- greater concern for: age 30-50, higher education, reporting living close to BS
- 53% of persons live in 500m distance to a BS (in 2004)
- crude modeling of EMF exposure from BS < 500m : median ~ 0.05 V/m
- no relationship between prevalence of living close to BS and concern

Concern



Vicinity to BS





Cross-sectional study to record and evaluate possible adverse health effects due to electromagnetic fields from cell-phone base stations

Universities of Bielefeld and Mainz, DKFZ Heidelberg, NFO Infratest Munich

(G. Berg, Uni Bielefeld)

Study: stage III (in depth study) and “Addendum to CS Study”

In depth study

- subset of 3'200 higher exposed persons (from stage II)
- validated questionnaire on:
 - health parameters (headache, sleep disturbances, general health complaints, physical and psychological quality of life)
 - confounders (age, sex, use of mobile phones, chronic stress, anxiety, depression)
 - concern (same as in the stage II)

Addendum to the CS study

- for ~1300 selected individuals measurements of EMF in the bedroom by means of “Antennesa” personal dosimeter
- CAPI on exposure, headache and sleep disturbances





Cross-sectional study to record and evaluate possible adverse health effects due to electromagnetic fields from cell-phone base stations

Universities of Bielefeld* and Mainz, DKFZ Heidelberg, NFO Infratest Munich
(Gabriele Berg*)

Results stage III (in depth study) and “Addendum to CS Study”

- **no association between measured EMF and 5 health complaints: headache, sleep disturbances, health complaints in general, physical and psychological quality of life**
- statistically significantly attributed to the BS are sleep disturbances and general health complaints; other 3 complaints not
- measured total EMF from BS in bedrooms at 90 percentile ~ 0.1 V/m (the highest value ~ 1.1 V/m)
- satisfactory agreement between exposure measurement and modeling, if necessary input parameters are given



Acute health effects by mobile telecommunication among children

[Mobile phone exposure and well-being in children and adolescents]

Ludwig-Maximilians-Universität, Institute for occupational and environmental medicine*, Munich (Katja Radon*)

Study

- population-based cross-sectional study
- 1'500 children (8-12 y) and 1'500 teenagers (13-17 y)
random selection out of the population registry in 4 cities (Munich, Augsburg, Rosenheim, landsberg)
- exposure assessment over 24 hours using “Maschek” personal dosimeters (worn on arm)
- CAPI before and after measurement on:
well-being (headache, stomach ache, back, neck and shoulder pain, nervousness, dizziness, anxiety, tiredness)
confounders (sociodemographic, mobile phone attitude, media consumption, environmental concern, school and family problems, social support)
personal factors (extraversion, demands, emotionality)
- symptom diary 3x daily
(headache, stomach ache, back pain, nervousness, dizziness, anxiety, tiredness, exhaustion)





Acute health effects by mobile telecommunication among children [Mobile phone exposure and well-being in children and adolescents]

**Ludwig-Maximilians-Universität, Institute for occupational and environmental medicine*,
Munich (Katja Radon*)**



Results will be available in 2008

Preliminary results (December 2006)

- Mean daytime exposure: 0.13% (detection limit) to 0.45% of ICNIRP limits (frequencies between 800-2400 MHz)
- The own use of mobile phone is not a major predictor of exposure over 24h
- average use of mobile phone is less than 10 minutes per day

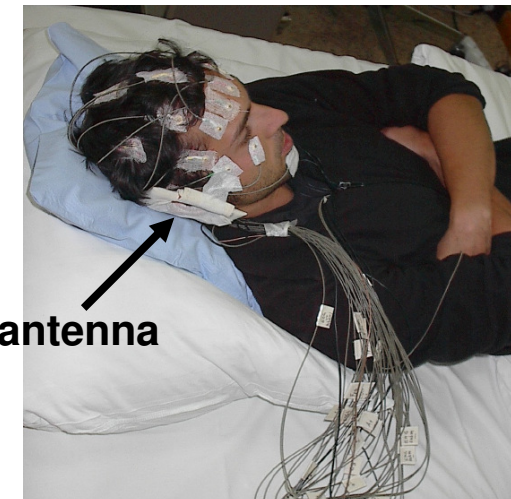


Studies of the effects of exposure to EMF emitted from mobile phones on volunteers

Charité – Universitätsmedizin, Berlin (Heidi Danker-Hopfe)

Study

- laboratory study, double-blind, randomized, cross-over, placebo-controlled design
- 30 healthy, male subjects (age 18-30)
- mobile phone exposure (8h) (antenna attached on ear)
9 nights, 9 days (alternating 1 per week)
20 weeks in laboratory (1 day/night per week)
balanced sham, GSM900 and UMTS
SAR 2W/kg
- night: EEG (recording with 19 electrodes)
macrostructure of sleep, spectral power, sleep spindels
- day: EEG and performance tests at 11am and at 4pm





Studies of the effects of exposure to EMF emitted from mobile phones on volunteers

Charité – Universitätsmedizin, Berlin (Heidi Danker-Hopfe)

Results

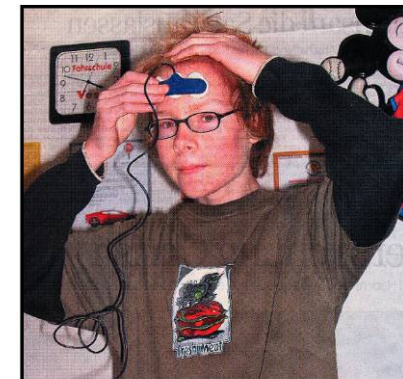
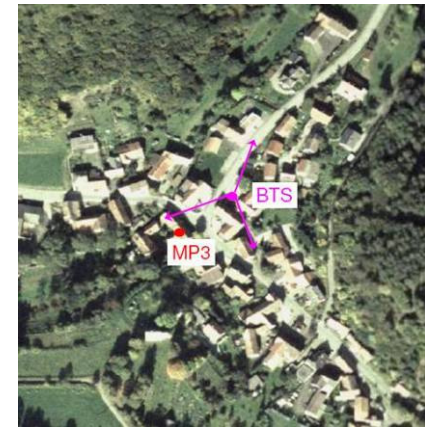
- some significant changes of sleep parameters, but as expected by chance in multiple testing
- no evidence of sleep disturbances
→ **no effects on sleep!**
- some significant changes of cognitive performances, but as expected by chance (predominant slight reduction of reaction time)
→ **no effects on performances!**
- significant **effect of time of the day** on the performances (better in the afternoon)!



Investigation of sleep quality in persons living near a mobile base station - experimental study on the evaluation of possible psychological and physiological effects under residential conditions Charité – Universitätsmedizin, Berlin (Heidi Danker-Hopfe)

Study

- experimental field-study, double-blind, cross-over, sham-controlled design
- transportable BS placed in 10 sites with no “regular” BS
- ~3000 volunteers; leaving <500m to BS, age>17y (~ 300 per site)
- 12 nights exposure (not on weekends and not during days, balanced sham, GSM900 and GSM1800 (generic signal, 6/8 pulsed))
- EEG during nights (frontally recorded, bipolar sleep EEG)
- questionnaire every evening and morning



Mit Elektroden ins Bett

6 Ostfriesen wollen wissen, ob ein Sendemast ihren Schlaf stört / Studie der FU Berlin



Investigation of sleep quality in persons living near a mobile base station - Experimental study on the evaluation of possible psychological and physiological effects under residential conditions Charité – Universitätsmedizin, Berlin (Heidi Danker-Hopfe)

Results

- no influence of EMF on subjective and objective sleep parameters in the whole group
- equal proportion of improved and worsened sleep quality under exposure
- distance from BS and visibility of BS have no influence on sleep parameters
- concern about health effects from BS influences sleep quality, but general concern about mobile communication does not (results from sham exposures)



Investigation of sleep quality of electrohypersensitive persons living near base stations under residential conditions

Technical University Graz (Norbert Leitgeb)

Study

- “inverse provocation study”, double-blind, cross-over design
- 44 volunteers with bad sleep quality “caused by EMF”
- 9 nights under shielding conditions (randomly, balanced):
 - “*verum*” - real shielding curtains (20dB)
 - *sham* - non shielding curtains
 - *control* - no curtains
- nights:
 - EMF measurement
 - polysomnographic recording (EEG, EOG, ECG, movement)
- days (evenings and mornings):
 - standardized questionnaire (well being, sleep)
 - sensitivity measurements (sensation measurements (50 Hz) on the forearm)





Investigation of sleep quality of electrohypersensitive persons living near base stations under residential conditions

Technical University Graz (Norbert Leitgeb)

Results

- sleep parameters:
 - 59% no change
 - 18% placebo-effect (subjective perception increases sleep-quality)
 - 7% rejected as checked the real shielding situation
 - 9% prolonged sleep onset latency (“worse” sleep quality) for lower HF
 - 7% inconsistent changes of individual parameters – no conclusions
 - ➔ no improvement of sleep quality due to shielding!
- volunteers more (measurably) sensitive than the general population
- measured EMF exposure lower than expected by volunteers
- measured exposure from TV-transmitters higher than from base stations



Investigation of the phenomenon of 'electromagnetic hypersensitivity' using an epidemiological study on 'electrosensitive' patients including the determination of clinical parameters

Psychiatric University Hospital, Regensburg (Ulrich Frick and Michael Landgrebe)

Study I

- Case-control laboratory study
- 89 EHS persons compared with 107 controls
(matched by age, sex, EMF exposure at home and at working place)

comparison by means of:

- questionnaire on health complaints
(symptoms, quality of life etc)
- clinical tests
(“allostatic load” – stress relevant clinical-medical parameters
genetic factors)
- stimulation measurements by TMS
(transcranial magnetic stimulation)

Singular transcranial magnetic pulses:
increasing intensity: 0 T to ~ 1.2 T (1.8 T max.)
Randomization: ABAB vs. BABA
subsequent measurement: motor threshold





Investigation of the phenomenon of 'electromagnetic hypersensitivity' using an epidemiological study on 'electrosensitive' patients including the determination of clinical parameters Psychiatric University Hospital, Regensburg (**Ulrich Frick and Michael Landgrebe**)

Results I

- EHS group has more health complaints, worse health status, than controls
- **no differences in allostatic load** (stress related clinical parameters)
- no differences in genetic equipment

TMS

- subjectively EHS less able to discriminate between verum and sham (because of higher false alarm rate)
- **no differences in objective resting and motor thresholds** (one pulse examination)
- **differences in cortical excitability – modified facilitation (anticipation)**
different age dependence (double pulls examination)



Investigation of the phenomenon of 'electromagnetic hypersensitivity' using an epidemiological study on 'electrosensitive' patients including the determination of clinical parameters

Psychiatric University Hospital, Regensburg (Ulrich Frick and Michael Landgrebe)

Study II (MRI-study)

- 15 EHS persons compared with 15 controls (subgroups from the part I)
- functional MRI (3T) examination - cortical activity
- exposure to:
 - thermal stimuli
 - pretended "mobile signal"





Investigation of the phenomenon of 'electromagnetic hypersensitivity' using an epidemiological study on 'electrosensitive' patients including the determination of clinical parameters Psychiatric University Hospital, Regensburg (Ulrich Frick and Michael Landgrebe)

Results

- no difference for thermal exposure
- differences for pretended "mobile signal"
 - ➔ activation of "anticipatory activities" at EHS persons, (some of EHS complaint that they perceived radiation)



Investigation of electrosensitive persons with regard to accompanying factors or diseases, such as allergies and increased exposure or sensitivity to heavy metals and chemicals

Johannes Gutenberg University of Mainz, Psychiatric Clinic (Norbert Dahmen)

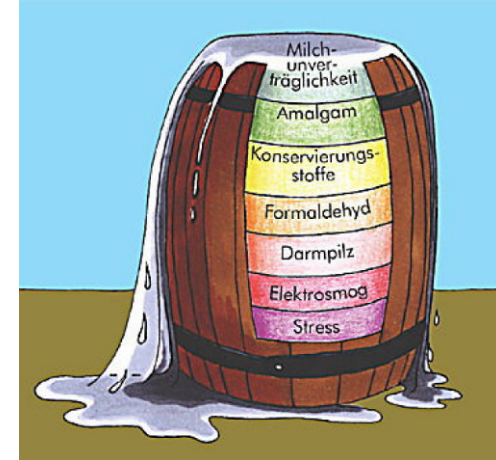
Study

- case-control study
- 130 EHS persons with severe EHS symptoms
101 controls (matched by age and sex)

comparison by means of:

- **standardized questionnaire** (symptoms, multiple chemical sensitivity somatic and psychiatric comorbidity, sleep quality, life satisfaction etc)
- **laboratory tests** (blood sample, heart rate, liver detoxification, “allergy chip” etc)

environmental ES disorder model





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Investigation of electrosensitive persons with regard to accompanying factors or diseases, such as allergies and increased exposure or sensitivity to heavy metals and chemicals

Johannes Gutenberg University of Mainz, Psychiatric Clinic (Norbert Dahmen)

Results

- EHS Persons are different than controls,
but **do not give a consistent disease model**



General remarks

- ❑ the studies treat key research, social and political questions on acute health effects
- ❑ very good study designs, sometimes very original
- ❑ appropriate methodology and very good quality of the studies (good statistics, taking care of confounders and blinding, data analysis)
- ❑ very careful exposure assessment
 - ➔ valuable data on everyday exposures
- ❑ mutually complementary studies ➔ increased significance of the results
- ❑ descriptive data are very valuable for risk management
- ❑ particularly profound contribution to the understanding of EHS



Summary of the results

Surveys (Germany)

- 28% of the population is concerned about EMF from BS
- 11% attribute health complains to the EMF from BS
- greater concern for: age 30-50, higher education, reporting living close to BS
- strong north-south gradient (the highest concern in Bavaria)

- prevalence of persons living in 500m distance to BS (in 2004): 53%
- no relationship between prevalence of living close to BS and concern



Summary of the results

wellbeing, sleep, cognitive functions

- no effects of HF-EMF on wellbeing
- no effects of HF-EMF on sleep
- no effects of HF-EMF on cognitive functions
- some significant changes of different parameters, but as expected by chance in multiple testing
- concern about health effects from BS influences sleep quality



Summary of the results

Electrohypersensitivity (EHS)

- EHS group has more health complaints than controls
- EHS persons are not more stressed than controls
- EHS persons are different, but do not give a consistent disease model
- EHS persons are more sensitive than general population - have lower perception threshold stimulated with 50 Hz
- no differences in resting and motor threshold measurements by TMS
- different cortical excitability measured by TMS (and different age dependence)
- for pretended (not real) “mobile signal” there is an activation of “anticipatory activities” in EHS subjects (measured in MRI)
- shielding of EMF does not improve sleep of EHS persons, although there is some placebo effect
- measured EMF exposure is lower than expected by EHS persons



Summary of the results

Exposure

- crude modeling of EMF exposure from BS:
median for households < 500m from BS : 0.05 V/m
90 percentile ~ 0.1 V/m (maximum ~1.1 V/m)
- mean daytime exposure of children (personal dosimeter on arm)
below 0.45% of ICNIRP limits
- use of personal dosimeters to assess exposure is desirable
- modeling is feasible, but under condition that sufficient input parameters are available



Conclusions

on acute health effects from HF-EMF

- ➔ **exposure from HF EMF in everyday life is quite low!**
- ➔ **it is very unlikely that this exposure might cause acute health effects!**
- ➔ **this is also true for EHS persons!**

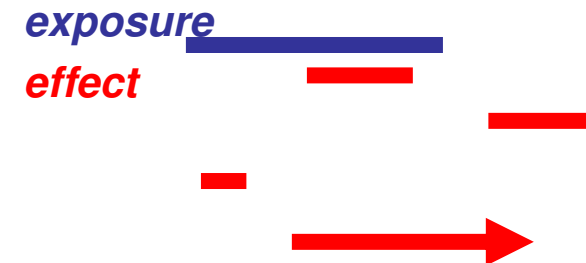
but
this is not an (happy) end



Open questions and personal remarks acute health effects from HF-EMF

- children?
- how acute “acute health effects” are?
- low-dose vs. high-dose investigations?
- selection of study/exposed population?

population-based samples – every day exposure,
healthy volunteers – higher exposure,
EHS?





Open questions and personal remarks

EHS

○ concern – anticipation – EHS? role of concern and anticipation?

real EMF \nrightarrow EHS

anticipated EMF \rightarrow EHS

real EMF \nrightarrow concern

anticipated EMF \rightarrow concern

concern \rightarrow EHS

○ sensitivity of EHS persons?



DMP - “acute effects” in the context of general EMF research

