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ORIGINAL ARTICLE

Determinants and stability over time of perception of health risks related to mobile phone base stations

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Abstract
Objective Perception of possible health risks related to mobile phone base stations (MPBS) is an important factor in citizens' opposition against MPBS and is associated with health complaints. The aim of the present study is to assess whether risk perception of MPBS is associated with concerns about other environmental and health risks, is associated with psychological strain, and is stable on the individual level over time.
Methods Self-administered questionnaires filled in by 3,253 persons aged 15–69 years in 2004 and 2006 in Germany.
Results Risk perception of MPBS was strongly associated with concerns about various other risks like side effects of medications, air pollution or electric power lines. Persons showing more anxiety, depression, or stress were more often concerned about MPBS and also more often attributed health complaints to MPBS. 46.7% of those concerned about MPBS in 2004 expressed these concerns again 2 years later, the corresponding figure for attribution of health complaints to MPBS was 31.3%.
Conclusion Risk perception of MPBS is strongly associated with general concern, anxiety, depression, and stress, and rather instable over time.

Keywords Mobile phone base stations · Electromagnetic fields · Risk perception · Attribution · Stress · Anxiety · Depression

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Introduction

In a recent systematic review of randomized trials and epidemiological studies, it was shown that there was no consistent association between exposure to radiofrequency electromagnetic fields (RF-EMF) from mobile phone base stations (MPBS) and various health outcomes (Röösli et al. 2010a). Especially in studies with detailed measurement of exposure, significant relationships were rarely found. In spite of these results, there are still many citizens' initiatives against the installation of MPBS in Germany (especially in Southern Germany) and in Austria. Therefore, it is not only important to assess associations between exposure to EMF from MPBS and health outcomes, but also to assess how health risks from RF-EMF are perceived. Risk perception might play a crucial role in citizens' opposition against the erection of MPBS especially in Southern Germany

(Wiedemann and Schütz 2002). Moreover, analyses showed that the perception of assumed risks of MPBS is related with health, in particular sleep disorders (Hutter et al. 2006; Berg-Beckhoff et al. 2009; Danker-Hopfe et al. 2010) and general health complaints (Heinrich et al. 2007; Thomas et al. 2008; Berg-Beckhoff et al. 2009), however, the direction of this association is not yet clarified.

So far, only little research has been done on perception of MPBS risks. In this paper, risk perception covers two cognitions, i.e. *concern* about health impacts of RF-EMF emitted by MPBS as well as *attribution* of health complaints to the RF-EMF of the MPBS. So far, there are only few studies about the predictors of risk perception of MPBS (Wiedemann and Schütz 2002; Hutter et al. 2004; Siegrist et al. 2005; INFAS 2006). The risk perception of RF-EMF appears to be stable in the population on an aggregate level (INFAS 2006), but so far, there are very few data for the individual level (Röösli et al. 2010b).

The aim of the present study is to look for predictors of perception of MPBS risks—particularly concerns about other environmental risks, and psychological factors like stress, anxiety, and depression—and to analyse the stability of risk perception of MPBS on the individual level.

Methods

Study design

The present investigation is part of the QUEBEB study which was carried out in two phases between 2004 and 2006 (Blettner et al. 2009; Berg-Beckhoff et al. 2009).

Phase 1, a German-wide cross-sectional study, was embedded in a large panel study which is carried out regularly by TPI Access Panel Institute in Germany. The panel consists of a sample which refers to the German population in the age range from 14 to 69 years. A total of 51,444 households were contacted between August and November 2004, and one person was selected per household. 30,161 (58.6%) persons sent back self-administered questionnaires. After exclusion of 114 incomplete questionnaires 30,047 (58.4%) questionnaires were available for analysis. Two items of the phase 1 questionnaire were used for the present analysis (apart from sociodemographic data): "Are you concerned about electromagnetic fields emitted by mobile phone base stations?" (in short: concerns) and "Do you feel compromised in your health because of these electromagnetic fields?" (in short: attribution). Possible answers were "yes" or "no". The distance between residence and nearest MPBS was computed based on geo-codes of MPBS and participants' addresses (cf. Blettner et al. 2009).

For phases 2 and 4,150 persons were chosen from eight mainly urban regions (Berlin, the Western part of the Ruhr district, Hamburg, Cologne/Bonn, Munich, Dresden, Hanover, Stuttgart) (for details, cf. Berg-Beckhoff et al. 2009). These participants had all participated in phase 1. They were sent questionnaires between February and April 2006. The questionnaires contained several psychometric scales. The "Hospital Anxiety and Depression Scale" (HADS-A and HADS-D) to measure anxiety and depression experienced in the week preceding the completion of the questionnaire (Hermann et al. 1995), the short form of the "Trierer Inventory for Chronic Stress" (TICS) to assess stress experienced in the preceding 3 months (Schulz et al. 2003), and the "SF 36" to assess the health related quality of life in a physical and psychological dimension experienced in the preceding 4 weeks (Bullinger et al. 1998). For these scales, the calculation of scores as well as handling of missing data was in line with the corresponding manuals. To assess risk perception of MPBS in phase 2, the same two questions were asked as in phase 1. In addition, participants were asked how concerned they were about their health because of different other environmental and health risks, like smoking, air pollution, and power lines. They were given a list of 13 sources of risks including MPBS as well as other sources of EMF, but also life style risks like smoking and excessive alcohol consumption. Participants had to judge their concerns on a 4-grade rating scale ranging from "strongly concerned" to "modestly concerned" and "little concerned" to "not concerned". Moreover, participants were asked whether they used mobile phones or not, they were shown photographs of MPBS, and were asked whether they could see a MPBS from at least one window of their apartment. In total, 3,526 persons (85.0%) filled in the questionnaire in phase 2. 76 questionnaires were excluded for further analyses because sociodemographic data from phase 1 and 2 were not identical and 197 questionnaires were excluded because of missing data in the corresponding variables. All analyses were carried out with an identical set of data of 3,253 persons who had participated in both phases of the study.

Statistical analyses

For analyses, a trichotomous variable for risk perception of MPBS was created from data of phase 2: (1) attribution, (2) concern but no attribution, (3) no concern or attribution. An analogous categorisation of risk perception of EMF had been used by Schreier et al. (2006).

Psychometric scores (TICS, HADS-A, HADS-D, SF-36 for the physical and for the psychological dimension) were calculated for the three categories of the risk perception variable, separately for men and women.

For analysis of predictors of risk perception of MPBS, the following multinomial logistic regressions were calculated with risk perception as dependent variable:

- Twelve regression analyses with concern about 1 of 12 single environmental and health risks as independent variable. All multinomial logistic regression models were adjusted for age, sex, level of school education and study regions as possible confounders.
- A regression analysis with "general concern" about environmental and health risks, use of mobile phones, visibility of MPBS from at least one of the windows of the participant's apartment, age, sex, school education and region as independent variables. "General concern" was calculated by adding up the ratings for the single environmental and health risks except for EMF sources and by building three categories of high, medium and low general concern according to the tertiles of the sum of the ratings. School education was dichotomized into acquiring a school leaving certificate enabling the individual to study at University (in German: Abitur) or not.
- Five regression analyses with each of the five psychometric scores as independent variables.

In additional logistic regression models, OR with 95% CI were calculated for the association between "distance between residency and the closest MPBS" (<100 m/≥100 m, <200 m/≥200 m, <400 m/≥400 m) and risk perception in phase 1 and 2. The models were adjusted for age, sex, education, and region.

Finally the stability of risk perception was analysed comparing both phases of the study. Using a cross tabulation it was calculated how many participants were concerned about MPBS and attributed health complaints to MPBS between 2004 (phase 1) and 2006 (phase 2). From these data, the proportion of participants with stable risk perception over time was calculated, i.e. the risk perception in 2006 was the same as in 2004. Cohen's Kappa was calculated to assess the stability of risk perception.

Statistical analyses were carried out with SAS 9.1. The level of significance was set at 5%.

Results

Table 1 shows basic characteristics of the study population. According to the selection of urban regions most subjects indeed lived in urban or suburban areas, and more than 40% had a high level of education.

In the first column of Table 2, 13 environmental and health risks are ranked following the proportions of those who are strongly or modestly concerned about these risks. MPBS were found on rank six: nearly 20% of participants were concerned about MPBS. The numbers in the third and fourth columns indicate to what degree concern about any of these risks is related to attribution of health complaints

Table 1 Sociodemographic characteristics and mobile phone use in the sample (Germany, the QUEBEB study, 2004–2006)

	N	%
Whole sample	3,253	100.0
Sex		
Male	1,461	44.9
Female	1,792	55.1
Age		
15–19	158	4.9
20–29	370	11.4
30–39	689	21.2
40–49	558	17.2
50–59	638	19.6
60–71	840	25.8
School education		
High[a]	1,357	41.7
Low[b]	1,764	54.2
Else[c]	132	4.1
Region		
Munich	224	6.9
Stuttgart	310	9.5
Cologne/Bonn	401	12.3
Ruhr area	585	18.0
Hannover	215	6.6
Hamburg	374	11.5
Berlin	1,016	31.2
Dresden	128	3.9
Residential area		
Rural	438	13.5
Semiurban	1,164	35.8
Urban	1,633	50.2
No answer	18	0.6
Mobile phone use		
Yes	2,911	89.5
No	342	10.5
General concern[d]		
High	1,040	32.0
Medium	1,201	36.9
Low	1,012	31.1
Visibility of a mobile phone base station[e]		
Yes	571	17.6
No	2,682	82.4

All data apply to phase 2

[a] School leaving certificate enabling to study at University (in German: Abitur)

[b] School leaving certificate not enabling to study at University (in German: Abitur)

[c] No exam, not answered

[d] Concern about environmental and health risks except for EMF sources (cf. "Methods")

[e] From at least one of the windows of the participant's apartment

Table 2 Proportion of persons concerned about environmental and health risks, and association of these concerns with risk perception of mobile phone base stations: results of multinomial regression analyses (Germany, the QUEBEB study, 2004–2006)

	Proportion of concerned persons (%)	Multinomial regression analyses[a,b]	
		Attribution of health complaints on mobile phone base stations OR (95% CI)	Concern related to mobile phone base stations without attribution OR (95% CI)
Heavy smoking	44.6	3.0 (2.3–4.0)	1.8 (1.5–2.2)
Consumption of meat of unknown origin	41.8	4.9 (3.6–6.6)	2.6 (2.1–3.1)
Air pollution	32.7	4.6 (3.5–6.2)	3.2 (2.7–3.9)
Excessive alcohol consumption	29.7	2.8 (2.1–3.6)	1.9 (1.6–2.3)
Side effects of medicaments	26.0	3.4 (2.5–4.5)	1.9 (1.6–2.3)
Mobile phone base stations	19.9	–	–
Traffic noise	18.2	5.7 (4.3–7.6)	2.7 (2.2–3.4)
Electric power lines	15.6	27.4 (19.8–37.9)	11.0 (8.6–14.0)
Fields from electric devices	15.0	36.6 (26.0–51.5)	14.5 (11.1–18.8)
Participation in road traffic	14.5	3.0 (2.2–4.1)	2.4 (1.9–3.1)
Mobile phone use	12.5	32.8 (23.0–46.7)	16.2 (12.1–21.7)
Transmitters for radio and television	11.3	39.3 (27.1–56.9)	16.7 (12.2–22.8)
Use of cordless telephone	7.8	39.1 (25.4–60.3)	17.2 (11.6–25.3)

[a] Categories of the dependent variable: (1) attribution of health complaints to mobile phone base stations, (2) concern about mobile phone base stations, but no attribution, (3) neither concern nor attribution (=reference group); independent variable: concern about a specific environmental or health risk, adjusted for age, sex, level of school education and region; all data apply to phase 2

[b] Example for reading the table: subjects who are strongly or modestly concerned about heavy smoking are more likely to attribute health complaints on mobile phone base stations than subjects with little or no concern about heavy smoking (OR = 3.0, 95% CI 2.3–4.0), and they are more likely to be concerned about base stations than subjects with little or no concern about heavy smoking (OR = 1.8, 95% CI 1.5–2.2)

to MPBS as well as to concern about MPBS. For example, subjects who are personally concerned about side effects of medications have an increased OR for attribution (3.4, 95% CI 2.5–4.5) and an increased OR for concern about MPBS (1.9, 95% CI 1.6–2.3). Without exception, concern about any of the environmental and health risks in the list is statistically significantly associated with risk perception related to MPBS. These associations are especially strong between concern about other EMF risks (power lines, mobile phone use, transmitters for radio and television, use of cordless telephone) and concern/attribution related to MPBS.

Table 3 describes further predictors of the risk perception of MPBS. Persons with high general concern about environmental and health risks were more likely to be concerned about MPBS than persons with low general concern, and, moreover, they were much more likely to attribute own health complaints to MPBS. For persons with medium general concern, there was also a statistically significant increase in the likelihood to be concerned about MPBS and to attribute health complaints to MPBS, respectively. Furthermore, persons who could see at least one MPBS from any window of their apartment expressed more concern/attribution with regard to MPBS. If persons did not use mobile phones, this had a significant influence on their concern about MPBS but not on their attribution. Men were less concerned about MPBS than women, persons with higher school education were more concerned than persons with lower school education, and in the Southern German region around Munich there was more concern compared to Berlin.

Distance between the subject's residency and the closest MPBS was not consistently associated with concern or attribution in phase 1 and 2 (Table 4). For small distances (<100 m), the likelihood of attribution was increased, albeit not significantly.

Concern/attribution with regard to MPBS is strongly associated with psychological strain (Table 5). Comparing subjects with no concern or attribution, subjects with concern but no attribution, and subjects with attribution, the first group showed the most favourable levels of stress, anxiety, depression, and psychological well-being whereas the latter scored worst on the corresponding psychological scales. These results were confirmed in multinomial logistic regression models with adjustment for age, sex, school education and study region.

Finally, the stability of risk perception over time is shown in Table 6. In phase 1 in the year 2004, among 3,253 participants 538 (16.5%) were concerned about MPBS, and 284 (8.7%) attributed own health complaints to MPBS. The agreement in the risk perception between both phases was rather high. In total, 73.0% ((89 + 251 + 2,034)/3,253)

Table 3 Predictors of risk perception of mobile phone base stations: results of multinomial logistic regression models (Germany, the QUEBEB study, 2004–2006)

	Attribution of health complaints on mobile phone base stations OR (95% CI)	Concern related to mobile phone base stations without attribution OR (95% CI)
General concern[a]		
High	**9.51 (6.08–14.87)**	**4.51 (3.52–5.78)**
Medium	**2.45 (1.51–3.96)**	**2.21 (1.73–2.81)**
Low	1	1
Visibility of a mobile phone base station[b]		
Yes	**2.43 (1.77–3.34)**	**1.61 (1.28–2.02)**
No	1	1
Mobile phone user		
No	1.34 (0.86–2.07)	**1.36 (1.01–1.82)**
Yes	1	1
Sex		
Male	1.15 (0.86–1.52)	**0.77 (0.64–0.92)**
Female	1	1
Age		
15–29	0.59 (0.34–1.02)	1.15 (0.85–1.56)
30–39	0.91 (0.59–1.42)	**1.50 (1.14–1.97)**
40–49	1.19 (0.79–1.79)	1.17 (0.88–1.58)
50–59	1.01 (0.68–1.48)	0.98 (0.74–1.30)
60–71	1	1
Region		
Munich	1.11 (0.61–2.03)	**1.73 (1.21–2.45)**
Stuttgart	1.36 (0.82–2.24)	1.19 (0.85–1.67)
Cologne/Bonn	0.88 (0.54–1.45)	1.24 (0.92–1.66)
Ruhr area	1.14 (0.76–1.70)	0.84 (0.63–1.11)
Hannover	0.83 (0.43–1.60)	1.13 (0.76–1.66)
Hamburg	1.04 (0.64–1.66)	1.32 (0.98–1.79)
Dresden	0.82 (0.38–1.81)	0.74 (0.43–1.28)
Berlin	1	1
School education		
High[c]	1.29 (0.95–1.74)	**1.69 (1.39–2.05)**
Low[d]	1	1
Else[e]	0.97 (0.61–1.56)	0.57 (0.24–1.37)

Categories of the dependent variable: (1) Attribution of health complaints to mobile phone base stations, (2) concern about mobile phone base stations, but no attribution, (3) neither concern nor attribution (=reference group); independent variables: predictors given in the left column; all data apply to phase 2

Example for reading the table: subjects who can see a mobile phone station from their windows are more likely to attribute health complaints to base stations (OR = 2.43, 95% CI 1.77–3.34), and they are more likely to be concerned about base stations (OR = 1.61, 95% CI 1.28–2.02) as compared to subjects who cannot see a mobile phone base station from their windows

Bold numbers are significant at 5% level

[a] For an explanation of "general concern" see "Methods"

[b] From at least one window of the subject's apartment

[c] School leaving certificate enabling to study at University (in German: Abitur)

[d] School leaving certificate not enabling to study at University (in German: Abitur)

[e] No exam, not answered

showed the same perception of supposed MPBS risks in 2004 and 2006. However, among the 538 persons concerned about MPBS in phase 1, only 251 persons (46.7%) still said that they were concerned about MPBS in phase 2. Among 284 persons attributing health complaints to MPBS in 2004 only 89 (31.3%) did so in 2006. Of the persons who

Table 4 Association of distance between subject's residency and the nearest mobile phone base station with concern and attribution, respectively, in phase 1 and 2 [logistic regression analyses, OR (95% CI)] (Germany, the QUEBEB study, 2004–2006)

	Distance <100 m	Distance ≥100 m, <200 m	Distance ≥200 m, <400 m	Distance ≥400 m
Phase 1				
Concern[a]	1.26 (0.91–1.74)	1.33 (1.02–1.74)	0.90 (0.70–1.16)	1
Attribution[b]	1.39 (0.93–2.07)	1.05 (0.74–1.49)	0.86 (0.63–1.19)	1
Phase 2				
Concern[a]	0.99 (0.73–1.35)	0.92 (0.71–1.19)	1.02 (0.81–1.27)	1
Attribution[b]	1.50 (0.97–2.32)	1.36 (0.93–1.97)	0.87 (0.60–1.25)	1

Adjusted for age, sex, school education and region

[a] Concern about mobile phone base stations but no attribution

[b] Attribution of health complaints to mobile phone base stations

attributed their own health complaints to MPBS in phase 1, 107 persons (37.7%) expressed neither concerns nor attribution in phase 2. Cohen's Kappa for Table 6 was 0.353 (95% CI 0.322–0.385).

In phase 2, concern about MPBS was asked twice—the first item was dichotomous (yes/no), the second included four categories. 4.6% of the 3,253 participants gave inconsistent answers on the two scales, i.e., that they either expressed modest or strong concern on the four-point scale but no concern on the two-point scale, or they expressed no concern on the four-point scale but expressed concern on the two-point scale.

Discussion

Although there is no clear evidence for an association between RF-EMF from MPBS and health outcomes (Rubin et al. 2005; Röösli et al. 2010a) almost 20% of the participants expressed concerns about MPBS.

Association between risk perception of MPBS and concern about other environmental and health risks

Concern about any of the environmental and health risks taken into account in the analyses led to a significant increase in the likelihood to be concerned about MPBS as well as in the likelihood to attribute health complaints to MPBS. This applied particularly to other sources of EMF. Obviously, perception of MPBS as risky is connected to a feeling that EMF are harmful to health in general. Associations between concern about MPBS and concerns about other risks were smallest in the case of risks which are beyond controversy like heavy smoking and excessive alcohol consumption. These results were in line with results of other studies. Siegrist et al. (2005) reported that persons who were convinced that most chemicals caused cancer were more concerned about risks related to EMF. The INFAS institute (2006) presented a multivariate model to predict concern about RF-EMF (not confined to fields of MPBS), and they found that health complaints about various other health risks like air pollution and cigarette smoking led to a higher probability of concerns about RF-EMF. Similar results were also reported for other risk factors: Bailer et al. (2000) showed that concern about amalgam fillings in teeth was related to general concern about environmental risks.

Association between risk perception of MPBS and psychological strain

Subjects who did not perceive MPBS as risky had the most favourable scores for stress, anxiety, depression and psychological well-being. For subjects with concern, and, even more, attribution, more adverse scores were observed (the direction of this association is discussed below). Similar relations between the perception of an environmental or health risk and psychological strain were also reported for other risks. Bailer et al. (2000) found that persons attributing their health complaints to amalgam fillings displayed significantly more psychological strain than persons without that attribution. However, the differences between these two groups were not yet of clinical importance. Bell et al. (1996) found similar results for persons attributing diseases to chemicals or to bad odours.

Further determinants of risk perception of MPBS

Visibility of a MPBS from at least one window of a subject's residency was associated with concern and attribution. However, distance between residency and closest MPBS was not consistently associated with concern about MPBS, and there was no significant association between distance and attribution of health complaints to MPBS. These results seem plausible because small distance per se does not mean that people are aware of the existence of a MPBS in their close vicinity whereas visibility of a MPBS increases the cognitive availability of this potential health risk. Participants in Munich were more

Table 5 Scores of psychometric scales according to categories of risk perception, separate for men and women, and multinomial logistic regressions with risk perception of electromagnetic fields of base stations as dependant variable (Germany, the QUEBEB study, 2004–2006)

	Attribution	Concern without attribution	No concern or attribution
N			
Men	116	259	1,086
Women	118	397	1,277
Stress (TICS)[a]			
Scores for men	13.52	11.17	9.41
Scores for women	15.74	13.07	11.97
Anxiety (HADS-A)[a]			
Scores for men	6.01	4.56	3.84
Scores for women	6.89	5.17	4.99
Depression (HADS-D)[a]			
Scores for men	5.43	4.32	3.72
Scores for women	5.44	4.17	4.16
Physical well-being (SF36)[b]			
Scores for men	46.97	50.46	50.36
Scores for women	45.47	50.42	48.93
Psychological well-being (SF36)[b]			
Scores for men	47.03	49.86	51.67
Scores for women	44.63	48.35	49.00
Results of multinomial logistic regression analyses (OR, 95% CI)[c,d]			
Stress (TICS)[a]	1.05 (1.04–1.07)	1.02 (1.01–1.03)	(ref.)
Anxiety (HADS-A)[a]	1.14 (1.10–1.18)	1.04 (1.01–1.06)	(ref.)
Depression (HADS-D)[a]	1.09 (1.05–1.12)	1.03 (1.00–1.05)	(ref.)
Physical well-being (SF36)[b]	0.98 (0.96–0.99)	1.01 (1.00–1.02)	(ref.)
Psychological well-being (SF36)[b]	0.96 (0.95–0.97)	0.99 (0.98–0.99)	(ref.)

[a] Higher scores mean more psychological strain

[b] Higher scores mean less physical or psychological strain

[c] Categories of the dependent variable: (1) Attribution of health complaints to mobile phone base stations, (2) concern about mobile phone base stations, but no attribution, (3) neither concern nor attribution (=reference group); independent variable: psychometric scores, adjusted for age, sex, level of school education and region; all data apply to phase 2.

[d] Example for reading the results of the regression analyses: an increase in anxiety of one score measured on the HADS-A scale goes together with a greater odds of attributing health complaints to mobile phone base stations (OR = 1.14, 95% CI 1.10–1.18) and with a greater odds of concern about base stations (OR = 1.04, 95% CI 1.01–1.06)

Table 6 Risk perception of mobile phone base stations in phase 1 (2004) and phase 2 (2006) (Germany, the QUEBEB study, 2004–2006)

Information from Phase 1 (2004)	Information from Phase 2 (2006) *N* (%)			
	Attribution[a,c]	Concern without attribution[b,c]	No concern or attribution	Total
Attribution[a,c]	89 (31.3)	88 (31.0)	107 (37.7)	284 (8.7)
Concern without attribution[b,c]	65 (12.1)	251 (46.7)	222 (41.3)	538 (16.5)
No concern or attribution	80 (3.3)	317 (13.0)	2,034 (83.7)	2,431 (74.7)
Total	234 (7.2)	656 (20.2)	2,363 (72.6)	3,253 (100)

[a] "Attribution" means attributing own health complaints to mobile phone base stations

[b] "Concern" means being concerned about electromagnetic fields of mobile phone base stations

[c] Subjects expressing concern and attribution fall into the category "attribution"

often concerned about MPBS which is in line with the fact that opposition against the erection of MPPS is larger in Southern Germany than in other parts of the country. Women and the higher educated were more concerned about MPBS which is in accordance with a recent publication showing that in Germany women and the better

educated are generally more often concerned about environmental problems and environmental protection (Federal Environment Agency 2010).

Stability of the risk perception of MPBS over time

In the present study, risk perception of MPBS is stable on an aggregate level as found by the panel studies of INFAS (2006). In the present study, in 2004, 25.2% of the participants were concerned about MPBS, or attributed health complaints to MPBS. Two years later, this figure was 27.4%. However, results were different on an individual level. Only 46.7% of those who had been concerned about MPBS in phase 1 in 2004 expressed such a concern 2 years later. Moreover, only 31.3% of those who had attributed health complaints to MPBS in 2004 did so again in 2006. These results including a very low value of Cohen's Kappa demonstrate that the perception of the risks of MPBS is not a stable cognition. A similar result was reported in a Swiss cohort study with a follow-up of 12 months (Röösli et al. 2010b) where subjects were asked whether they attributed detrimental health symptoms to electromagnetic pollution: of all the participants who had been attributers at least in one survey, only 27% attributed their symptoms to electromagnetic fields in both surveys. As an explanation one might assume that participants were asked to assess a risk about which they had not thought much before.

Does the risk perception of MPBS cause psychological strain or is it the other way round?

As the perception of risks of MPBS was rather volatile, and as the psychological variables taken into account in this study are affected by many other influences, it is unlikely that the risk perception of MPBS is a crucial reason for the differences in anxiety, depression, stress and life quality between persons with concern/attribution and persons without concern/attribution. It is more plausible that persons who are more anxious, more depressive and who have more stress and less quality of life tend to give other answers to questions about risk perception compared to persons with less psychological problems, i.e. the first show stronger tendencies to express concern and to see relations between risk factors and their health status.

Limitation and strengths

The present study has some limitations. First, the sample was not representative for the German population because participants were selected mainly from different urban regions. This had for consequence that the level of education and the proportion of mobile phone users were larger than in the general population. However, close distances between residencies and MPBS are more often found in urban regions, so that the focus on an urban population is reasonable for our study. Second, concern and attribution were only assessed on a two-point scale. However, an additional use of a four-point scale to measure concern in phase 2 led to consistent answers compared to the two-point scale. Third, the analyses presented in this study did not cover all variables which might be significant predictors of the risk perception of MPBS. Apart from psychological strain, concern about other risk factors, visibility of MPBS, mobile phone use and sociodemographic characteristics, further variables like occupational factors (McMahan et al. 2002), media consumption and knowledge about EMF (INFAS 2006) were not taken into account. Fourth, some significant effects might be due to multiple testing. However, in all the eighteen logistic regression models, significant associations were found, and this is far more than findings expected by chance. Finally, some further questions related to risk perception of MPBS were not covered in our study. We suggest further analyses should be done which look into concerns about specific health outcomes and about possible hidden reasons for fears about MPBS (for example financial or aesthetical reasons). The strengths of the study include the longitudinal design, the large size of the study group, and the comprehensive analyses of factors which are meaningful for risk perception.

Conclusion

In view of the results of the present study, it is recommended to interpret results about risk perception of MPBS with caution. First, general concern about environmental and health risks is a strong predictor for risk perception of MPBS. Second, psychological strain is strongly related to the risk perception of MPBS. Third, risk perception of MPBS is a rather volatile cognition. The conclusion can be drawn that risk perception of MPBS reflects to a large extent general personal characteristics.

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Conflict of interest None.

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