

Appendix TABLE to the BRIEF REPORT on the EHS provocation studies

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***Note: This is not a comprehensive list of all EHS provocations studies.
The Table is based on the information extracted from the EMF-Portal database.***

TABLE listing the 77 EHS provocation studies with some details on experimental groups, exposures, methods, outcomes and funding.

No. 1-77	Reference	Study type Study group Observation period Location	End points	Exposure parameters	Results & Conclusions (according to Authors)	Funding
1	Hocking B, Occup Med (Lond) 1998; 48 (6): 357-360	survey; pilot study men, women 1996 Australia	cranial symptoms, neurological symptoms, atypical symptoms, waist symptoms	mobile communications, analog mobile phone, digital mobile phone, personal	40 respondents described symptoms such as unpleasant warmth or a dull ache in the head, mostly occurring minutes after beginning a call. The symptoms did not occur when using an ordinary handset, and were different from ordinary headaches. 75 % of the cases were associated with digital mobile phones. Three respondents reported local symptoms associated with wearing their mobile phone on their belts. The author concluded that further work is needed to determine the range of symptoms and their mechanisms.	?
2	Oftedal G et al. Occup Med (Lond) 2000; 50 (4): 237-245	cross-sectional study men, women 1996 Sweden, Norway	subjective symptoms: dizziness, feelings of discomfort, difficulties concentrating, memory loss, unusual fatigue, headaches, sensations of warmth behind/ around/ on the ear, burning sensations in the facial skin, tingling/tightness sensations in the facial skin and other symptoms, details of symptom experience (e.g. duration of symptoms, medical consultation and sick leave), conditions under which the symptoms are experienced (e.g. long duration mobile phone calls), measures to reduce the symptoms	mobile communications, GSM, NMT, PC/TV monitor, occupational, personal	Overall, 31 % of Norwegian respondents and 13 % of Swedish respondents had experienced at least one symptom in connection with mobile phone use, mainly warmth on the ear, burning sensations in facial skin, and headaches. Relatively few had consulted a physician or been on sick leave because of the symptoms but about 45 % had taken steps to reduce the mobile phone attributed symptoms, mainly in reducing the calling time and using hands-free equipment. The authors concluded that the results suggest an awareness of the mobile phone attributed symptoms, but not necessarily a serious health problem.	Norwegian Post and Telecommunication Authority (NPT), Norway; Swedish Mobile Telecommunications Industry (MTB; MobilTeleBranschen); Work Environment Fund of the Confederation of Norwegian Business and Industry; Telenor, Norway
3	Sandström M et al. Occup Med (Lond) 2001; 51 (1): 25-35	cross-sectional study men, women 1996 Sweden, Norway	subjective symptoms: dizziness, discomfort, concentration, memory loss, fatigue, headaches, warmth behind ear, warmth on ear, burning skin, tingling/tightness	mobile communications, analog mobile phone, digital mobile phone, GSM, NMT, occupational, personal	No increased risk for subjective symptoms for GSM users compared with NMT users was observed. A lower risk for sensations of warmth on the ear was found for GSM users compared with NMT users. The hypothesis that GSM users experience more self-reported symptoms while using mobile phones than NMT users was nullified.	Norwegian Post and Telecommunication Authority (NPT), Norway; Swedish Mobile Telecommunications Industry (MTB; MobilTeleBranschen); Work Environment Fund of the Confederation of Norwegian Business and Industry; Telenor, Norway

No.	Reference	Study type Study group Observation period Location	End points	Exposure parameters	Results & Conclusions (according to Authors)	Funding
4	Santini R et al. Electromagn Biol Med 2002; 21 (1): 81-88	survey men, women not given France	general symptoms (headache, concentration difficulties, loss of memory, tiredness, sleep disturbance); symptoms during use (discomfort, burning sensation of the face, pricking sensation on the ear, warmth of the ear)	mobile communications, digital mobile phone, GSM, PC/TV monitor, personal	78 respondents (48.5 %) owned a cellular phone, 83 subjects (51.5 %) had no cellular phone. No significant difference was observed for general symptoms (headache, concentration difficulties, loss of memory, tiredness, sleep disturbances) between users and nonusers of digital cellular phones. The results showed that cellular phone users more often complained of discomfort, warmth, and pricking on the ear while using the phone as a function of calling duration and number of calls per day. Users of phones operating on 1800 MHz complained significantly more often of concentration difficulties than users of 900 MHz cellular phone. The combined use of cellular phones and video display terminals significantly increased concentration difficulties. Female cellular phone users had significantly more sleep disturbances than male users.	?
5	Santini R et al. Electromagn Biol Med 2003; 22 (1): 41-49	survey men, women not given France	symptoms of discomfort, sleep disturbances, fatigue, irritability, headaches, nausea, loss of appetite, depressive tendency, concentration difficulties, memory loss, skin problems, visual + hearing disturbances, dizziness, movement diff, cardiovasc. problems, libido lowering	mobile phone base station, mobile communications, residential	20.7 % of the subjects lived more than 300 m away from base station. The complaints nausea, loss of appetite, and visual disturbances were experienced only in the immediate vicinity of cellular phone base stations (up to 10 m). Irritability, depressive tendencies and lowering of libido were experienced up to 100 m whereas headaches, sleep disturbances and feeling of discomfort were noticed in the distance up to 200 m to base stations. Only the complaint of fatigue was experienced in vicinity of 200 to 300 m to base stations. The occurrence of complaints was for seven of the reported symptoms and for the distance up to 300 m significantly higher for women compared to men. No difference in the frequency of complaints was observed according to length of time living in the vicinity of base stations.	?
6	Navarro EA et al. Electromagn Biol Med 2003; 22 (2-3): 161-169	preliminary study men, women, ≥ 15 years January 2001 Spain	microwave sickness: fatigue, irritability, headache, nausea, appetite loss, insomnia, depression, discomfort, difficulty in concentration, memory loss, skin alterations, visual + auditory dysfunction, dizziness, gait difficulty, cardiovascular alterations	mobile phone base station, GSM, mobile communications, residential	The results showed significant correlation between reported severity of the symptoms and the measured power density.	?
7	Al-Khlaiwi T et al. Saudi Med J 2004; 25 (6): 732-736	- men, women, 18–42 years 2002 - 2003 Saudi-Arabia	sleep disturbances, fatigue, headache, dizziness, tension	mobile communications, mobile phone, personal	The overall mean percentage of findings in all groups were headache (21.6 %), sleep disturbance (4 %), tension (3.9 %), fatigue (3 %), and dizziness (2.4 %). The authors concluded that the use of mobile phones is a risk factor and suggested that long term use should be avoided by health promotion activities.	?

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8	Salama OE et al. J Egypt Public Health Assoc 2004; 79 (3-4): 197-223	cross-sectional study men, women, 20–60 years not stated Egypt	headache, earache, burning sensation of the face, fatigue, concentration difficulty, sleep disturbances	mobile communications, mobile phone, personal	193 out of 267 participants (72.3 %) used a mobile phone. 140 of the mobile phone users (72.5 %) reported adverse health symptoms. The main symptoms were headache (43 %), earache (38.3 %), sense of fatigue (31.6 %), sleep disturbance (29.5 %), concentration difficulty (28.5 %) and face burning sensation (19.2 %). The authors recommended to restrict the call duration to four minutes and to make less than seven calls/day with total duration of exposure less than 22 min/day.	?
9	Balikci K et al. Pathol Biol (Paris) 2005; 53 (1): 30-34	survey men, women not given Turkey	headache, dizziness, extreme irritation, shaking in the hands, speaking falteringly, forgetfulness, neuro-psychological discomfort, increase in the carelessness, decrease of the reflex and clicking sound in the ears	mobile communications, mobile phone, personal	No evidence was found that the use of mobile phone caused dizziness, shaking in hands, speaking falteringly and neuro-psychological discomfort. Headache, forgetfulness, increase in the carelessness, decrease of reflex and clicking sound in the ears could be caused by the use of mobile phones.	?
10	Balik HH et al. Pathol Biol (Paris) 2005; 53 (2): 88-91	survey men, women not given Turkey	blurring of vision, redness on the eyes, vision disturbance, secretion of the eyes, inflammation in the eyes and lacrimation of the eyes	mobile communications, mobile phone, personal	No effect on redness of the eyes and vision disturbance was observed. There was some evidence that the use of mobile phones might cause blurring of vision, secretion of eyes, inflammation in the eyes, and lacrimation of the eyes.	?
11	Meo SA & Al-Drees AM. Saudi Med J 2005; 26 (5): 882-883	preliminary study men, women, 18–42 years 2002 - 2004 Saudi-Arabia	hearing and vision complaints: earache, heating around the ear, decreased hearing, decreased or blurred vision	mobile communications, mobile phone, personal	The results showed a relationship between mobile phone use and hearing complaints (34.5%) as well vision complaints (4.8%).	?
12	Meo SA & Al-Drees AM. Int J Occup Med Environ Health 2005; 18 (1): 53-57	survey men, women, 18–46 years not given Saudi-Arabia	hearing and vision complaints: impaired hearing, ear ache and/or warmth of the ear; decreased vision and/or blurred vision	mobile communications, mobile phone, personal	The results showed a relationship between mobile phone use and hearing complaints (34,6%) as well vision complaints (5%). Differences between duration of calls and complaints were not statistically significant.	?
13	Schüz J et al. Bioelectromagnetics 27 (4): 280-287	survey men, women October 2003 - March 2005 Germany	headache, tiredness, concentration difficulties, increased heartbeat, vertigo, impaired vision, loss of appetite, anxiety, and other symptoms, sleep disturbances, self-classified hypersensitivity	mobile communications, analog mobile phone, digital mobile phone, mobile phone base station, cordless phone, electric field, magnetic field, 50/60 Hz, power transmission line, electrical substation, 16 2/3 Hz (train), other domestic appliance, residential, personal	EH subjects reported a high degree of suffering, 77% of whom had already sought advice from physicians. An Internet-based standardized questionnaire is an economic way of offering affected persons a direct link to scientific institutions to establish contact. However, the study base obtained by such an approach is not representative to estimate a population-based prevalence. As a large number of subjects did not classify themselves as EH and reported very specific links between exposure and symptoms, they may provide a very distinct and interesting group for future research.	Ministry for the Environment of the federal state of Rhineland-Palatinate, Mainz, Germany

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14	Schreier N et al. <i>Soz Praventivmed</i> 2006; 51 (4): 202-209	cross-sectional study men, women, ≥ 14 years May - July 2004 Switzerland	sleep disorders, headache, concentration difficulties, nervousness, rheumatism/muscle pain, respiratory problems, dizziness	mobile communications, digital mobile phone, mobile phone base station, cordless phone, Radio/TV transmitter, microwave oven/heating device, magnetic field, 50/60 Hz, power transmission line, PC/TV monitor, other domestic appliance, residential, personal, non-EMF	A prevalence of 5 % for electromagnetic hypersensitivity was found in the study sample. The most common complaints were sleep disorders and headaches which were mostly attributed to powerlines and mobile phone handsets. 53 % of the study participants worried about adverse health effects from EMF, without attributing their own health symptoms to them. A causal relationship between electromagnetic fields and adverse health effects cannot be concluded from a cross-sectional study such as this one.	Federal Office of the Environment (FOEN; Bundesamt für Umwelt), Switzerland
15	Mortazavi SM et al. <i>Bioelectromagnetics</i> 2007; 28 (4): 326-330	cross-sectional study men, women spring 2005 Iran	headache, vertigo/dizziness, myalgia, palpitation, fatigue, tinnitus, difference in concentration, attention disorder, nervousness, and low back pain	mobile communications, digital mobile phone, PC/TV monitor, personal	30 % of the students were users of mobile phones, 36 % of cordless phones, and 56 % of cathode ray tube monitors. Headache was the most frequent complaint (53.5 %) among the self-reported symptoms. No association between subjective symptoms and the use of mobile phones, cordless phones or cathode ray tube monitors was observed. The authors concluded that mass-media's lack of interest in health effects of electromagnetic fields in developing countries could explain the difference observed between the results in this study and those of other studies in some developed countries.	?
16	Schüz J et al. <i>PLoS One</i> 2007; 2 (10): e4389	cohort study men, women, ≥ 18 years January 1982 - December 1995, followed up through 2003 Denmark	Alzheimer disease, dementia, Parkinson disease, amyotrophic lateral sclerosis, multiple sclerosis, epilepsy, migraine, vertigo	mobile communications, analog mobile phone, digital mobile phone, personal	A small but significantly increased standardized hospitalisation ratio for migraine and vertigo was observed in the study population whereas the standardized hospitalisation ratios for Alzheimer disease, dementia, and Parkinson disease were all statistically significantly decreased. No associations were seen for amyotrophic lateral sclerosis, multiple sclerosis and epilepsy. The authors concluded that the excesses of migraine and vertigo deserve further attention.	Danish Strategic Research Council, Denmark
17	Davidson HC & Lutman ME. <i>Int J Audiol</i> 2007; 46 (3): 113-118	survey men, women, 18–30 years period not given United Kingdom	hearing, tinnitus, and balance difficulties	mobile communications, mobile phone, personal	94 % of the participants were current mobile phone users, only 2 % have never used a mobile phone. Duration of ownership and daily usage among the participants ranged from 0 to 7 years and 0 to 45 minutes per day. High or long-term users reported no worse hearing, tinnitus, or balance problems than low or short-term users.	?
18	Thomas S et al. <i>Bioelectromagnetics</i> 2008; 29 (6): 463-470	cross-sectional study men, women, 18–65 years January 2005 - August 2006 Germany	headache, neurological symptoms (e.g., tinnitus), cardiovascular symptoms (e.g., tachycardia), concentration problems, fatigue, sleep disturbances	mobile communications, digital mobile phone, mobile phone base station, GSM, UMTS, DECT, W-LAN/WiFi, personal	Exposure levels were far below the ICNIRP reference level in a range from 0.13 % to 0.56 % of the ICNIRP reference level during waking hours. The mostly reported chronic symptoms were sleeping disorders (58 %) and fatigue (21 %), the mostly reported acute symptom was fatigue in the evening (43 %). No statistically significant association between personal exposure to mobile phone frequencies and chronic or acute symptoms was found. The sample size was relatively small. The bedtime exposure levels has to be excluded from analyses because the valid measurements of the dosimeter can only be obtained if the dosimeter is moved.	Bayerisches Staatsministerium für Umwelt, Gesundheit und Verbraucherschutz (StMUGV; Bavarian Ministry of the Environment, Public Health and Consumer Protection), Germany

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19	Söderqvist F et al. Environ Health 2008; 7 (1): 18-1-18-10	cross-sectional study men, women, 15–19 years October 2005 Sweden	sleep disturbances, health symptoms such as tiredness, stress, headache, anxiety, and concentration difficulties	mobile communications, digital mobile phone, GSM, UMTS, NMT, DECT, W-LAN/WiFi, personal, non-EMF	The use of mobile phones and DECT telephones increased with age so that almost all adolescents used wireless phones. Girls reported use of mobile phones and DECT telephones significantly more than boys. Significantly increased ORs for mobile phone use were observed for asthmatic symptoms, concentration difficulties, and headache. The results showed that perceived health and certain health symptoms seemed to be related with the use of wireless phones. The findings should be interpreted with caution because the investigation was explorative and bias and confounding cannot be excluded.	Cancer och Allergifonden (Cancer and Allergy Foundation), Sweden; Örebro Cancer Fund, Sweden; Örebro County Council Research Committee, Sweden
20	Khan MM. Int J Occup Med Environ Health 2008; 21 (4): 289-293	survey men, women not given Saudi-Arabia	chronic headache, impaired concentration, impaired memory, fatigue, hearing problem, skin disease, warmth around the ear, sleeplessness, self-rated health condition, relation of symptoms to mobile phone use	mobile communications, mobile phone, personal	56 % of the medical students reported a daily mobile phone use of less than 30 min, 28 % of 30 to 60 min, 11.5 % of 60 to 90 min, and 4.5 % of more than 90 min. 30.8 % of the students reported their health status as very good, 62.2 % as good and 7 % as fair. The mostly reported symptoms among mobile phone users were memory disturbances (40.6 %), sleeplessness (38.8 %), and hearing problems (23.1%). 44.4 % of the students related their symptoms to mobile phone use. The author concluded that the results showed that mobile phones play a great part in the daily life of medical students, and therefore the impact on psychology and health should be discussed to prevent harmful effects of mobile phone use.	?
21	Blettner M et al. Occup Environ Med 2009; 66 (2): 118-123	cross-sectional study men, women, 14–69 years 2004 Germany	concerns; health complaints e.g. cognition problems, pain, sleeping problems, skin reactions, gastrointestinal affections, visual problems	mobile communications, mobile phone base station, residential	51.5 % of the participants lived within 500 m from a mobile phone base station according to geo-coding information. 41.6 % of the participants had correctly classified the distance as less or more than 500 m. 18.7 % of the participants were concerned about health effects from mobile phone base stations and 10.3 % attributed adverse health effects to the radiofrequent electromagnetic fields emitted by base stations. Participants who were concerned about or attribute adverse health effects to base stations and those living in the vicinity of a base station reported slightly more health complaints than others. This finding can however not be fully explained by concerns or attributions.	Deutsches Mobilfunk Forschungsprogramm (DMF; German Mobile Phone Research Programme) at Federal Office for Radiation Protection (Bfs)
22	Berg-Beckhoff G et al. Occup Environ Med 2009; 66 (2): 124-130	cross-sectional study men, women, 15–71 years March - August 2006 Germany	headaches, health complaints, mental, and physical health, sleep disturbances, risk perception (not concerned, concerned, attributed own adverse health effects to base stations)	mobile communications, mobile phone base station, GSM, UMTS, TETRA/TETRAPOL, Bluetooth, DECT, W-LAN/WiFi, TV broadcast (VHF/UHF), FM broadcast (UKW), DVB-T, residential	Overall, the measurements of radiofrequency electromagnetic fields emitted by mobile phone base stations were far below the guidelines for limiting exposure of the public to time-varying electromagnetic fields. For all five health scores, no differences in their medians were observed for exposed versus non-exposed participants. However, differences across the three groups of risk perception were seen: participants attributing adverse health effects to base stations reported significantly more sleep disturbances and health complaints than non-concerned individuals. The authors concluded that measured radiofrequency electromagnetic fields emitted by mobile phone base stations were not associated with adverse health effects.	Deutsches Mobilfunk Forschungsprogramm (DMF; German Mobile Phone Research Programme) at Federal Office for Radiation Protection (Bfs)

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23	Korpinen LH & Pääkkönen R. Bioelectromagnetics 2009; 30 (6): 431-437	survey men, women, 18–65 years October 2002 Finland	pain in several joints and back, sleep disturbances, self-reported physical symptoms: headache, earache, warmth sensations, skin symptoms, depression, exhaustion at work, substance addiction, anxiety or fear situations	mobile phone, mobile communications, personal	1300 out of 6121 participants answered the open-ended question "other observations concerning technology and health". Three categories were identified: 1) respondents with different self-reported symptoms in association with using mobile phones, 2) respondents with skin symptoms when they stayed in front of a computer screen for a long period, and 3) respondents who somehow mentioned physical symptoms associated with the use of mobile phones or other electrical devices. The prevalence of self-reported symptoms in association with the use of mobile phones and other electrical devices was 0.7 %.	?
24	Augner C & Hacker GW. Indian J Occup Environ Med 2009; 13 (3): 141-145	survey men, women, 18–67 years not stated Austria	electromagnetic hypersensitivity, EMF-health concerns; biological parameters alpha-amylase, cortisol, immunoglobulin A, and substance P	mobile phone base station, mobile communications, residential	8 participants (14 %) stated no base station close to their homes, 14 participants (24,6 %) rated the distance of a known base station between 100 and 300 m, 11 participants (19,3 %) between 10 and 100 m, 3 participants (5,3 %) 10 m or less, and 21 participants (36,7 %) did not know. Participants rating the distance between a base station and their residence less than 100 m had statistically significant higher concentrations of alpha-amylase in the saliva, higher rates in the symptom checklist subscales somatization, obsessive compulsive, anxiety, phobic anxiety and global strain index as well as state anxiety. No significant differences were found in EMF health concerns. No association between mobile phone use and investigated parameters was observed. The authors concluded that self-declared neighbors of base stations were more strained than others. These findings can't be explained by EMF-health concerns.	Land Salzburg Federal Government, Austria; Mr. Daniell Porsche, Chairman of the Paracelsus-School at St. Jakob am Thurn, Salzburg, Austria
25	Johansson A et al. J Psychosom Res 2010; 68 (1): 37-45	cross-sectional study men, women December 2005 - April 2006 Sweden	sleep disturbances, dizziness, discomfort, concentration, memory loss, fatigue, headaches, warmth behind/around ear, warmth on ear, burning skin, tingling/tightness, tinnitus, numbness, anxiety, depression, somatization, exhaustion and stress	mobile phone, mobile communications, magnetic field, 50/60 Hz, PC/TV monitor, other domestic appliance, personal	The electromagnetic hypersensitivity group reported more symptoms than the group with mobile phone-related symptoms, both electromagnetic field related and not electromagnetic field related. The MP group reported more somatosensory symptoms whereas the EHS group reported more neurasthenic symptoms. Compared to the reference groups the MP group showed increased levels of exhaustion and depression but not of anxiety, somatization, and stress. The EHS group showed increased levels for all conditions except for stress. The authors concluded that there are differences between people with mobile phone related symptoms and people with electromagnetic hypersensitivity with respect to symptoms and anxiety, depression, somatization, exhaustion, and stress.	Center for Environmental Research (CMF), Umea University, Sweden; Swedish Insurance Society (SFF), Sweden
26	Milde-Busch A et al. BMC Neurol 2010; 10 (1): 12	cross-sectional study children, 13–17 years not stated Germany	headache (migraine, tension-type headache, miscellaneous headache)	mobile communications, digital mobile phone, personal	77 % of the adolescents reported no or little (< 5 min/day) mobile phone use. 489 out of 1025 subjects reported headache. No association between mobile phone use and headache was observed. The authors concluded that (apart from an association between listening to music and overall headache) no consistent associations between the use of electronic media and different types of headache were observed.	Deutsches Mobilfunk Forschungsprogramm (DMF; German Mobile Phone Research Programme) at Federal Office for Radiation Protection (Bfs)

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27	Mohler E et al. Radiat Res 2010; 174 (3): 347-356	cross-sectional study men, women, 30–60 years May 2008 Switzerland	sleep disturbances and daytime sleepiness	mobile communications, mobile phone, mobile phone base station, GSM, TETRA/TETRAPOL, RF field, DECT, cordless phone, W-LAN/WiFi, TV broadcast (VHF/UHF), FM broadcast (UKW), residential, personal	78 % of the study participants believed that there are people who develop adverse health effects due to radiofrequency electromagnetic field exposure, 18.2 % assigned their own adverse health effects as being due to exposure and 8.1 % reported themselves as electrosensitive. The prevalence of excessive daytime sleepiness was 29.5 %. Problematic sleeping disturbances were reported by 9.8 % of the participants. No statistically significant associations between excessive daytime sleepiness as well as sleeping disturbances and various exposure surrogates were observed. The authors concluded that the results did not indicate an impairment of subjective sleep quality due to various exposure sources of radiofrequency electromagnetic fields (RF EMFs) in the everyday environment.	Swiss National Science Foundation (SNF); Nationales Forschungsprogramm NFP 57 (National Research Programme NRP 57), Switzerland
28	Breckenkamp J et al. Umweltmed Forsch Prax 2010; 15 (3): 159-166	cross-sectional study men, women, 15–71 years March - August 2006 Germany	headache, health complaints, mental, and physical health, sleep disturbances, risk perception (not concerned, concerned, attributed own adverse health effects to base stations)	mobile communications, digital mobile phone, mobile phone base station, GSM, UMTS, TETRA/TETRAPOL, DECT, W-LAN/WiFi, TV broadcast (VHF/UHF), FM broadcast (UKW), residential	The measurements of electromagnetic fields in the bedrooms showed in most cases very low exposure values, most often below sensitivity limit of the dosimeter. An association between the exposure to mobile phone base stations and the occurrence of health complaints was not found, but an association between the attribution of adverse health effects to base stations and the occurrence of health complaints. The authors conclude that concerns about health and the attribution of adverse health effects should be taken serious and require risk communication with concerned persons.	?
29	Hutter HP et al. Occup Environ Med 2010; 67 (12): 804-808	case-control study men, women, 16–80 years Nov 2003 - Nov 2004 Austria	tinnitus	mobile communications, mobile phone, personal	Overall, no statistically significant increased risk for mobile phone use and tinnitus was observed in subgroups, except for the subgroup of ipsilateral use for 4 years and longer (OR 1.95; CI 1.00-3.80). The authors concluded that high intensity and long duration of mobile phone use might be associated with tinnitus.	Ear, Nose and Throat Department, Medical University of Vienna, Austria; Institute of Environmental Health, Medical University of Vienna, Austria
30	Eger H & Jahn M. Umwelt-Medizin-Gesellschaft 2010; 23 (2): 130-139	survey men, women, ≥ 18 years January 2009 Germany	depression, headache, cerebral symptoms, joint illnesses, infections, skin changes, dizziness, cardiovascular symptoms, disorders of the optical and acoustic sensory systems, nosebleed, hormonal disorders, gain and loss of weight, disorders of the gastrointestinal tract, sleep disturbances	mobile communications, mobile phone base station, DECT, residential	A significant correlation was found dependent on dose-effects for sleep disturbances, depressions, cerebral symptoms, joint illnesses, infections, skin changes, cardiovascular disorders, and disorders of the optical and acoustic sensory systems and the gastro-intestinal tract with the residential proximity to the base station. The authors explain this relationship with the influence of microwaves on the human nervous system.	?

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31	Heinrich S et al. Environ Health 2010; 9 (1): 75-1-75-9	cross-sectional study children, 8–17 years 2006 - 2008 Germany	headache, irritation, nervousness, dizziness, fatigue and concentration problems	mobile phone, mobile phone base station, GSM, UMTS, mobile communications, RF field, DECT, W-LAN/WiFi, residential, personal	The overall measured exposure to RF was very low and ranged from a mean of 0.13 % to a mean of 0.92 % of the ICNIRP reference level during waking hours. 2 % of the children and 14 % of adolescents used their mobile phones more than 5 minutes in the afternoon. Only few of the large number of investigated associations were found to be statistically significant, however not consistent over the two time points. At noon, adolescents with a measured exposure in the highest quartile during morning hours reported a statistically significant higher intensity of headache (OR 1.50, CI 1.03-2.19). At bedtime, adolescents with a measured exposure in the highest quartile during afternoon hours reported a statistically significant higher intensity of irritation in the evening (OR 1.79, CI 1.23-2.61), while children reported a statistically significant higher intensity of concentration problems (OR 1.55, CI 1.02- 2.33). In the subgroup analysis of 10 % of the participants with the highest exposure, the significant results of the main analysis could not be confirmed. The authors assume that the few observed significant association are not causal but rather occurred by chance.	Deutsches Mobilfunk Forschungsprogramm (DMF; German Mobile Phone Research Programme) at Federal Office for Radiation Protection (Bfs)
32	Röögli M et al. CR physique 2010; 11 (9-10): 576-584	cohort study, prospective cohort study men, women, 30–60 years 2008, follow-up in 2009 Switzerland	daytime sleepiness, electromagnetic hypersensitivity, headache, tinnitus	mobile communications, mobile phone, mobile phone base station, cordless phone, W-LAN/WiFi, Radio/TV transmitter, residential, personal	8.1 % of the study population declared to be electromagnetic hypersensitive (EHS) in 2008 (2009: 7.3 %); and 13% attributed own symptoms to radiofrequency electromagnetic field exposure in 2008 (2009: 14.3 %) but did not declare to be hypersensitive (called attributers). However, only a minority of the EHS individuals and the attributers made the same declaration in 2008 and 2009. The radiofrequency exposure situation of EHS individuals was comparable to the rest of the population except ownership of cordless phones. Health disturbances were considerably more prevalent in the EHS group than in the attributer group and even more than in the rest of the population. Most importantly, the authors did not find evidence that various symptom scores were associated with radiofrequency electromagnetic field exposure in the electromagnetic hypersensitive group. The authors concluded that they could not confirm an association between radiofrequency electromagnetic field exposure in the everyday environment and health disturbances for EHS individuals or for people attributing own symptoms to radiofrequency electromagnetic field exposure.	Swiss National Science Foundation (SNF)
33	Heinrich S et al. Environ Int 2011; 37 (1): 26-30	cross-sectional study children, 8–17 years 2006 - 2007 Germany	chronic symptoms over the last 6 months: headache, irritation, nervousness, dizziness, fatigue, and fear, sleep disturbances	mobile phone, digital mobile phone, mobile phone base station, GSM, UMTS, mobile communications, RF field, DECT, W-LAN/WiFi, residential, personal	Measured exposure to radiofrequency electromagnetic fields was far below the current ICNIRP reference levels (0.13 - 0.92 %). The most reported chronic symptom in children and adolescents was fatigue. No statistically significant association between measured exposure to radiofrequency electromagnetic fields and chronic symptoms was observed among children and adolescents.	Deutsches Mobilfunk Forschungsprogramm (DMF; German Mobile Phone Research Programme) at Federal Office for Radiation Protection (Bfs)

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34	Baliatsas C et al. BMC Public Health 2011; 11: 421	cross-sectional study men, women, ≥ 18 years 2006 The Netherlands	non-specific physical symptoms	mobile phone base station, mobile communications, power transmission line, residential	No significant association was observed between the occurrence of non-specific physical symptoms and the actual distance to mobile phone base stations or power lines while sociodemographic and psychological factors have a significant effect on symptom report. Higher self-reported environmental sensitivity, perceived proximity to base stations and power lines, lower perceived control, increased avoidance, living in a rented home, female gender, lower educational level and incapacity for work were significantly associated with increased report of non-specific physical symptoms.	ZonMw, The Netherlands
35	Tseng MMC et al. Formos Med Assoc 2011; 110 (10): 634-641	cross-sectional study men, ≥ 18 years August 2007 Taiwan	electromagnetic hypersensitivity	mobile communications, mobile phone, mobile phone base station, 50/60 Hz, power transmission line, EMF general	The prevalence of people with self-reported EHS in Taiwan was 13.3%. Following factors were associated with higher risk of reporting hypersensitivity: a very poor self-reported health status, unable to work, and psychiatric morbidity. The authors conclude that the prevalence of self-reported electromagnetic hypersensitivity in the general population of Taiwan is higher than the prevalence reported in western countries. People with psychiatric morbidity are more likely to report electromagnetic hypersensitivity. The authors note that the cross-sectional design precludes the causal inference of all identified factors and electromagnetic hypersensitivity.	National Science Council, Taiwan
36	Chu MK et al. BMC Neurol 2011; 11: 115	cross-sectional study men, women, 21–25 years 2005 Korea	headache	mobile phone, CDMA, mobile communications, personal	Among the 212 study participants, the mean daily duration of mobile phone use was 33.4 ± 34.5 minutes, the mean daily frequency of mobile phone use was 7.4 ± 6.3 calls, and the mean duration of mobile use was 5.5 ± 4.0 years. 40 out of 212 participants indicated that they experienced headache associated with mobile phone use more than 10 times during the last 1 year. The authors found that headache associated with mobile phone use usually showed stereotyped clinical features including mild intensity, a dull or pressing quality, localisation ipsilateral to the side of mobile phone use, provocation by prolonged mobile phone use and often accompanied by a burning sensation.	?
37	Alazawi SA Diyala Journal of Medicine 2011; 1 (1): 44-52	cross-sectional study men, women, 18–66 years May - June 2010 Iraq	headaches, fatigue, depressive tendencies, irritability, feeling of discomfort, loss of appetite, nausea, difficulties in concentration, memory loss, visual disturbances, hearing disturbances, dizziness, cardiovascular problems, lowering of libido, nervousness, sleep disturbances	mobile phone base station, mobile communications, residential	Most of the health complaints such as headache, irritability, nausea, appetite loss, discomfort, sleep disturbance, depressive tendencies, memory loss, difficulty in concentration, dizziness and lowering of libido were statistically significantly more often reported by residents living in a distance of less than 300 m to a base station compared to those living in a distance of more than 300 m to a base station. Significant differences were observed up to 100 m to a base station for symptoms such as: headaches sleep disturbances, irritability, depressive tendencies, feeling of discomfort, difficulties in concentration, memory loss and lowering of libido. The authors suggested that mobile phone base stations should not be sited closer than 300 m to residences to minimize exposure of the residents.	?

No.	Reference	Study type Study group Observation period Location	End points	Exposure parameters	Results & Conclusions (according to Authors)	Funding
38	Mortazavi SM et al. Iran J Med Sci 2011; 36 (2): 96-103	cross-sectional study children, 6–16 years not stated Iran	headache, myalgia, palpitation, fatigue, tinnitus, concentration problems, attention problems, nervousness	mobile phone, mobile communications, cordless phone, PC/TV monitor	Overall, 254 (54.2%) students had used cathode ray tubes, 262 (55.9%) students had used cordless phones, and 142 (31.4%) students had used mobile phones. Significant associations were found between the duration of mobile phone use and the self-reported symptoms headache, myalgia, palpitation, fatigue, tinnitus, concentration problems, attention problems and nervousness among elementary and junior high school students. The symptoms were self-reported by the students. Furthermore, given the age and knowledge of the study participants, their understandings about the exact definitions of the symptoms might have affected their answers to the questions asked.	Center for Research in Radiation Science (CRRS), Iran
39	Frei P et al. Environ Int 2012; 38 (1): 29-36	cohort study, prospective cohort study men, women, 30–60 years 2008, follow-up in 2009 Switzerland	non-specific health symptoms (e.g., headache, fatigue, loss of appetite, lack of energy or concentration) and tinnitus	mobile communications, mobile phone, mobile phone base station, DECT, cordless phone, W-LAN/WiFi, Radio/TV transmitter, personal	No evidence was found that exposure to radiofrequency electromagnetic fields in everyday life is associated with the development of non-specific health symptoms or tinnitus.	Swiss National Science Foundation (SNF)
40	Bortkiewicz A et al. Int J Occup Med Environ Health 2012; 25 (1): 31-40	cross-sectional study men, women, ≥ 18 years not stated Poland	headache, impaired memory, dermal changes, depression, fatigue, irritation, circulatory systems, vertigo, mental discomfort, visual disorders, hearing problems, loss of appetite, nausea, sleep disturbances, health status	mobile communications, mobile phone base station, cordless phone, microw. oven/heating device, 50/60 Hz, inhouse wiring, other domestic appliance, occupational, residential, personal, non-EMF	Electric field strength above 0.8 V/m (sensitivity of measuring set) was recorded in 12% of flats (23 out of 195 flats), the admissible value specified by Polish standards of 7 V/m was not exceeded. There was no significant correlation between electric field strength and distance of examined flats from the mobile phone base stations. Headache was reported by 57 % of the subjects, mostly (36.4%) living 100-150 m away from the mobile phone base station compared to subjects living at longer distances. People living at a distance above 150 m away from the mobile phone base station reported more often impaired memory than subjects living 50-150 m away to the base station. No statistically significant differences between the four different groups were observed for all other investigated subjective symptoms and health status. The authors conclude that further studies are needed to find an explanation why they did not find any correlation between the electric field strength and subjective symptoms but found a correlation between distance from mobile phone base station and subjective symptoms.	National Committee for Scientific Research (KBN), Poland
41	Kato Y et al. Pathophysiology 2012; 19 (2): 95-100	survey men, women, 19–81 years June - October 2009 Japan	sleep disturbances, 43 symptoms, e.g. headache, fatigue, concentration difficulties, dizziness, stiff neck or back, irritation, anxiety, skin problems	mobile communications, digital mobile phone, mobile phone base station, PHS, cordless phone, magnetic field, 50/60 Hz, power transmission line, LF therap./med. device, induction cooker, other domestic appliance, MRI, residential, personal	34 out of 75 persons (45.3%) reported a medically diagnosed electrosensitivity, 37 persons (49.3%) were self-diagnosed as electrosensitive. 37 persons (49.3%) had a medically diagnosed multiple chemical sensitivity (MCS) and 20 subjects (26.7%) reported self-diagnosed MCS. The most common reported subjective complaints were fatigue (85%), headache (81%), concentration difficulty (81%), and sleep disorders (76%). The most common suspected sources causing electrosensitivity were mobile phone base stations (71%), other persons' mobile phones (64%), personal computers (63%), power lines (60%) and TV (56%).	Cancer och Allergifonden (Cancer and Allergy Foundation), Sweden; Karolinska Institute, Sweden; Mr. Einar Rasmussen, Kristiansand, Norway

No.	Reference	Study type Study group Observation period Location	End points	Exposure parameters	Results & Conclusions (according to Authors)	Funding
42	Mohler E et al. PLoS One 2012; 7 (5): e37455	cohort study men, women, 30–60 years May 2008, follow-up in May 2009 Switzerland	sleep quality and daytime sleepiness	mobile phone, mobile phone base station, mobile communications, RF field, cordless phone, W-LAN/WiFi, Radio/TV transmitter, residential, personal	No association between exposure to radiofrequency electromagnetic fields in an everyday environment and self-reported sleep disturbances or excessive daytime sleepiness was found during an exposure period of one year. These results were confirmed in the nested sleep study with objectively recorded exposure and measured sleep behavior data. The authors concluded that they found no evidence for adverse effects on sleep quality from radiofrequency electromagnetic field exposure in an everyday environment.	Swiss National Science Foundation (SNF); Swiss School of Public Health + (SSPH+), Switzerland
43	Sudan M et al. Open Pediatri Med Journal 2012; 6: 46-52	cohort study children, children in utero, ≥ 7 years until April 2010 Denmark	migraine, headaches, headache-related symptoms (stomach aches or sickness)	mobile phone, mobile communications, personal	According to mothers' reports, 39% out of 52,680 children were exposed prenatally, and 36% used a mobile phone at age seven years (postnatal exposure), but less than 1% used it more than one hour per week. Twenty percent of children were exposed only prenatally, 16% only postnatally, 19% both prenatally and postnatally, and 40% had no reported mobile phone exposure. Children with mobile phone exposure had an increased risk of migraines and headache-related symptoms than children with no exposure (OR for migraine 1.30 (CI 1.01-1.68); OR for headache-related symptoms 1.32 (CI 1.23-1.40) for children with both prenatal and postnatal exposure). The authors concluded that in this study mobile phone exposure was associated with headaches in children, but the association may not be causal given the potential for uncontrolled confounding and misclassification in observational studies such as the present study. The results should be interpreted with caution due to limitations in exposure and outcome assessment. Additional possible confounders such as watching television, playing video games, and use of computers were not covered by the questionnaire.	National Institutes of Health (NIH), Maryland, USA; Danish Medical Research Council (DMRC), Denmark; Lundbeck Foundation, Denmark; Netherlands Organisation for Scientific Research (NWO; Nederlandse organisatie voor Wetenschappelijk Onderzoek); The Netherlands
44	Guxens M et al. J Epidemiol Community Health 2013; 67 (5): 432- 438	cohort study children, ≥ 5 years 2003 - 2011 The Netherlands	behavior problems	mobile phone, GSM, mobile communications, cordless phone, personal	Among all mothers, 6.1% reported not using a cell phone, 38.4% less than 1 call/day, 38.5% 1-4 calls/day and 17% 5 or more calls/day during pregnancy. Regarding cordless phone use, 13% reported not using a cordless phone, 46% less than 1 call/day, 33.5% 1-4 calls/day and 7.5% 5 or more calls/day during pregnancy. Overall, 9.6% of the children were classified as having overall behavior problems based on the teacher reports, compared with only 3.3% based on the maternal reports. Children with prenatal exposure to mobile phones showed an increased but non-significant association of having teacher-reported overall behavior problems, although without dose-response relationship with the number of calls (OR 2.12, CI 0.95-4.74 for < 1 call/day; OR 1.58, CI 0.69-3.60 for 1-4 calls/day; OR 2.04 CI 0.86-4.80 for ≥ 5 calls/day). No association between teacher-reported overall behavior problems and cordless phone use was found. Associations of maternal mobile phone and cordless phone use with maternal-reported overall behavior problems remained non-significant. The authors conclude that the results do not suggest that maternal mobile phone or cordless phone use during pregnancy increases the risk of behavior problems in their children.	ZonMw, The Netherlands

No.	Reference	Study type Study group Observation period Location	End points	Exposure parameters	Results & Conclusions (according to Authors)	Funding
45	Byun YH et al. PLoS One 2013; 8 (3): e59742	cohort study children, 8–11 years 2005 - 2006, follow-up 2009 - 2010 Korea	attention deficit hyperactivity disorder (ADHD)	mobile phone, mobile communications	Ownership of a mobile phone (22.7 % in 2008 vs. 64.5 % in 2010) increased almost three times and the cumulative time spent for voice call use (1.36 hours in 2008 vs. 2.33 hours in 2010) increased almost two times over 2 years. The geometric mean level of blood lead (1.64 µg/dl in 2008 vs. 1.60 µg/dl in 2010) decreased slightly for the 2 years. The prevalence of ADHD symptoms in the present study was 10.4% in 2008 and 8.4% in 2010. The ADHD symptom risk associated with mobile phone use for voice calls but the association was limited to children exposed to relatively high lead. The authors concluded that simultaneous exposure to lead and RF from mobile phone use was associated with increased ADHD symptom risk, although possible reverse causality could not be ruled out.	Ministry of Knowledge Economy (MKE), Korea Ministry of Environment (MOE), Korea
46	Hagström M et al. Pathophysiology 2013; 20 (2): 117-122	survey men, women, 27–98 years July 2011 - January 2012 Finland	68 different symptoms, e.g. stress, sleep disorder, fatigue, concentration problems, memory problems, anxiety, muscle tension, skin problems, heart complaints	mobile phone, mobile phone base station, GSM, mobile communications, microwave oven/heating device, electric field, magnetic field, 50/60 Hz, power transmission line, PC/TV monitor, other domestic appliance, EMF general, residential, personal, non-EMF	157 of 194 (80.9%) respondents of the survey were women. Before the onset of EHS, the most common health complaints were different types of allergies (35.1%). During the acute phase of EHS the most common symptoms were nervous system related: stress (60.3%), sleep disorders (59.3%), and fatigue (57.2%). The sources that were most often reported to have triggered EHS were: personal computers (50.8%) and mobile phones (47.0%). The most common devices that were claimed to cause the most symptoms during the acute phase were: mobile phones (63.4%) and personal computer displays (61.3%). According to 76% of 157 respondents the reduction or avoidance of electromagnetic fields helped in their full or partial recovery. The best treatments for EHS were given as: dietary change (efficacy: 69.4%), nutritional supplements (67.8%) and increased physical exercise (61.6%). The official treatment recommendations of psychotherapy (2.6%) and medication (-4.2%) were not helpful. The authors conclude that according to the present results the official treatment protocols should take better account the EHS person's own experiences. The avoidance of electromagnetic fields effectively removed or lessened the symptoms in EHS persons.	Kone Foundation, Finland
47	Sudan M et al. Paediatr Perinat Epidemiol 2013; 27 (3): 247-257	cohort study children, 0–7 years 1996 - 2002 Denmark	hearing loss	mobile phone, mobile communications, personal	Permanent hearing loss at the age of 7 years was reported in 836 (1.6%) children. While 1405 (2.7%) children reportedly had a diagnosis of reduced hearing at age 18 months, only 6% (n=82) of them also had permanent hearing loss at age 7 years according to mothers' reports. Approximately 36% (n=18,935) of children used a mobile phone at the age of 7 years, but less than 1% used it more than 1 hour per week. Weak associations between mobile phone use and hearing loss at age 7 were observed (traditional logistic regression: OR 1.21, CI 0.99-1.46; MSM model: OR 1.23, CI 1.01-1.49; DRE model: OR 1.22, CI 1.00-1.49). No association between reduced hearing at the age of 18 months and mobile phone use at the age of 7 years was found. The authors stated that their findings could have been affected by various biases and are not sufficient to conclude that mobile phone exposures have an effect on hearing.	National Institute of Environmental Health Sciences/National Institute of Health (NIEHS/NIH), USA; Danish Medical Research Council (DMRC), Denmark; Lundbeck Foundation, Denmark; Netherlands Organisation for Scientific Research (NWO); Nederlandse organisatie voor Wetenschappelijk Onderzoek); The Netherlands

No.	Reference	Study type Study group Observation period Location	End points	Exposure parameters	Results & Conclusions (according to Authors)	Funding
48	Gomez-Perretta C et al. BMJ Open 2013; 3 (12): e003836	cross-sectional study men, women, 15–81 years January 2001 Spain	fatigue, irritability, headache, nausea, lack of appetite, depression, lack of concentration, memory loss, skin alterations, visual disturbances, vertigo, vascular alterations, hearing problems, walking difficulty, sleep disturbances	mobile phone base station, GSM, mobile communications, residential	A total of 13.6% participants regularly used computers and 23.9% used mobile phones in 2001. The symptoms most related to exposure to mobile phone base stations were lack of appetite (OR 1.58, CI 1.23-2.03), lack of concentration (OR 1.54, CI 1.25-1.89), irritability (OR 1.51, CI 1.23-1.85); and trouble sleeping (OR 1.49, CI 1.20-1.84). Concerns about the base stations were strongly related with trouble sleeping (OR 3.12, CI 1.10-8.86). The authors conclude that this study confirms their preliminary results published by Navarro et al (2003).	Ministerio Espanol de Ciencia y Tecnologia (Ministry of Science and Technology), Spain
49	Kücer N & Pamukcu T. Electromagn Biol Med 2014; 33 (1): 15-17	survey men, women, children, 9–80 years 2011 Turkey	headache, vertigo/dizziness, fatigue, forgetfulness, insomnia, tension-anxiety, joint and bone pain, lacrimation of the eyes, hearing loss and tinnitus, insomnia	mobile phone, mobile communications, personal	A significant increase in headache, hearing loss and joint and bone pain was observed in people who reported a daily mobile phone use of more than 16 min compared to participants with daily mobile phone use of less than 16 min. A significant increase in headache, vertigo/dizziness and tension-anxiety was reported by participants with daily computer use of more than 16 min compared to participants with less than 16 min computer use. Women reported significantly more headache, vertigo/dizziness, fatigue, forgetfulness and tension-anxiety than men.	?
50	Shahbazi-Gahrouei D et al. Electromagn Biol Med 2014; 33 (3): 206-210	cross-sectional study men, women, ≥ 18 years October 2012 - November 2012 Iran	headaches, fatigue, depressive tendencies, irritability, feeling of discomfort, loss of appetite, nausea, memory loss, visual disturbances, hearing disturbances, dizziness, cardiovascular problems, lowering of libido, nervousness, sleep disturbances	mobile phone base station, mobile communications	Most of the health complaints such as nausea, headache, dizziness, irritability, discomfort, nervousness, depression, sleep disturbance, memory loss and lowering of libido were statistically significantly more often reported by residents living near a base station (≤ 300 m distance) compared to those living in a distance of more than 300 m to a base station. The authors suggested that mobile phone base stations should not be sited closer than 300 m to residences to minimize exposure of the residents.	?
51	van Dongen D et al. Perspect Public Health 2014; 134 (3): 160-168	cross-sectional study men, women, 18–87 years - Netherlands	self-reported non-specific symptoms (e.g., headache, fatigue, back pain, nausea, dizziness, tingling, palpitation), risk perception of EMF in general and of different EMF sources, attribution of symptoms to possible causes, including EMF	mobile phone, mobile phone base station, GSM, UMTS, mobile communications, DECT, microwave oven/heating device, magnetic field, 50/60 Hz, power transmission line, residential, personal, non-EMF	The general population sensitive group was more similar to the non-sensitive group in personal characteristics than to the NGO sensitive group. They experienced more - and more frequent - non-specific symptoms, reported higher perceived risk of EMF, and attributed their symptoms more to EMF than the non-sensitive group, but less than the NGO sensitive group. There was a positive association between attribution of symptoms to EMF and reported intensity of non-specific symptoms, which was stronger for the NGO sensitive subjects than for the general population. People sensitive to EMF and recruited via an internet panel differ from people sensitive to EMF and recruited via an NGO, who reported a higher frequency of non-specific symptoms. Attribution of symptoms to EMF is one of the predictors of the intensity of physical symptoms. Changing the perceived association between EMF and health problems in individuals with IEI-EMF might contribute to a better health experience.	ZonMw, The Netherlands

No.	Reference	Study type Study group Observation period Location	End points	Exposure parameters	Results & Conclusions (according to Authors)	Funding
52	Baliatsas C et al. J Psychosom Res 2014; 76 (5): 405-413	cross-sectional study men, women, ≥ 18 years January 2011 - June 2011 Netherlands	23 symptoms such as headache, fatigue, dizziness, memory or concentration problems, skin symptoms, heart palpitations, ear symptoms, neck or shoulder symptoms, back pain, muscular pain, abdominal/stomach pain, sleep disturbances, electromagnetic hypersensitivity	mobile phone, mobile phone base station, mobile communications, W-LAN/WiFi, 50/60 Hz, other domestic appliance, residential, personal, non-EMF	Overall, 202 (3.5%) participants and 514 (8.8%) participants met the criteria for the IEI-EMF and GES group respectively, while the rest of the participants (n=5073) formed the control group. Seventy-seven (38%) of participants in the IEI-EMF group also met the criteria for GES. There was a higher prevalence of symptoms and medication prescriptions and longer symptom duration among people with sensitivities. Moreover, participants with GES were about twice as likely to consult alternative therapy compared to the control group; those with IEI-EMF were more than three times as likely. Increasing number and duration of self-reported non-specific physical symptoms were associated with functional impairment, illness behavior, negative symptom perceptions and prevalence of GP-registered non-specific physical symptoms in the examined groups. Even after adjustment for medical and psychiatric morbidity, environmentally sensitive individuals experienced poorer health, increased illness behavior and more severe non-specific physical symptoms. The number and duration of self-reported non-specific physical symptoms are important components of symptom severity and are associated with characteristics similar to those of non-specific physical symptoms in primary care. The authors conclude that the substantial overlap between the sensitive groups strengthens the notion that different types of sensitivities might be part of one, broader environmental illness.	ZonMw, The Netherlands
53	Szyjkowska A et al. Int J Occup Med Environ Health 2014; 27 (2): 293-303	survey men, women, 22–44 years 2005 Poland	headaches, dizziness, fatigue, concentration difficulties, memory loss, warmth behind ear/on ear, burning skin	mobile phone, mobile communications	As many as 1800 questionnaires were sent. The response was obtained from 587 subjects aged 32.6 ± 11.3 (48.9% women, 51.1% men); the age did not differ significantly between men and women. The subjects owned a cell phone for an average of 3 years. Majority of the respondents used the phone intensively, i.e. daily (74%) or almost daily (20%). Headaches were reported significantly more often by the people who talked frequently and long in comparison with other users (63.2% of the subjects, $p = 0.0029$), just like the symptoms of fatigue (45%, $p = 0.013$). Also, the feeling of warmth around the ear and directly to the auricle was reported significantly more frequently by the intensive mobile phone users, compared with other mobile phone users (47.3%, $p = 0.00004$ vs. 44.6%, $p = 0.00063$, respectively). Most symptoms appeared during or immediately after a call and disappeared within 2 h after the call. Continuous headache, persisting for longer than 6 h since the end of a call, was reported by 26% of the subjects. Our results show that the mobile phone users may experience subjective symptoms, the intensity of which depends on the intensity of use of mobile phones.	?

No.	Reference	Study type Study group Observation period Location	End points	Exposure parameters	Results & Conclusions (according to Authors)	Funding
54	Suleiman A et al. J Geosci Envir Protect 2014; 2: 77- 83	survey men, women, 16–77 years September 2013 Malaysia	headache, giddiness, loss of memory, diarrhea, mental slowness, reduction in reaction time, depression, mood swing, fatigue, somnia, vomiting, palpitation, feverish, insomnia	mobile phone base station, mobile communications, residential	Comparison of symptoms frequencies and its significance (Chi-square test) between the exposed and not exposed residents from the TELCO tower showed statistical significance ($p < 0.05$) for headache, giddiness, insomnia, loss of memory, diarrhea, mental slowness, reduced reaction time and mood swing. The odds ratio for the development of the NSHS scored > 1 for all that gave a conclusion that respondents who were exposed were more likely to suffer symptoms as compared to the respondents who were not exposed to EMR. This outcome showed that the existence of TELCO tower in these communities has detrimental health effects towards the residents who were exposed to the electromagnetic fields radiation that was emitted. Measures to be taken to minimize adverse health effects on residents should include imposing more stringent guidelines in terms of safety distance and radiation intensity, practicing of WHO precautionary approach, encouraging electromagnetic fields radiation related conference, researches and public awareness, sharing of transceivers by TELCO companies and using protective barriers. These steps will ultimately promote a healthier, harmonious and sustainable living environment.	?
55	Zheng F et al. BMC Public Health 2014; 14: 1022-1- 1022-7	cross-sectional study men, women, children, 12–20 years not stated China	inattention	mobile phone, mobile communications, personal	Overall, 5668 (79.8%) participants owned mobile phones at the time of the survey and had been using a mobile phone for a mean of 3.50 ± 2.48 years. Participants spent 57.36 ± 71.96 minutes on entertainment and 8.64 ± 15.48 minutes on making calls daily. The overall prevalence of inattention was 69.8% out of the 7102 valid questionnaires. Inattention was significantly associated with mobile ownership (OR 2.92, CI 2.51-3.39) and time spent on entertainment daily (more than 60 min: OR 1.87, CI 1.28-2.73). Compared to students, who did not carry their mobile phones, a significant reduced risk for inattention was observed among students who hung their mobile phones in front of the chest (OR 0.44, CI 0.19-0.99) and a significant increased risk was found for students who put their mobile phones in trouser pockets (OR 1.34, CI 1.10-1.62). Furthermore, participants who powered off their mobile phones at night showed significantly less inattention than those students who left their mobile phones on at night (OR 0.75, CI 0.63-0.90). The authors conclude that mobile phone ownership, the time spent on entertainment on the mobile phone, the position during the day and the mode of the MP at night were all significantly associated with inattention in Chinese adolescents. Decreasing mobile phone use for entertainment to less than 60 minutes per day and turning off during sleep may help adolescents to stay focused and centered.	National Basic Research Program of China

No.	Reference	Study type Study group Observation period Location	End points	Exposure parameters	Results & Conclusions (according to Authors)	Funding
56	Liu H et al. PLoS One 2014; 9 (10): e110825	cross-sectional study men, women, 22–60 years August - September 2011 China	sleep quality and sleep duration	mobile phone, mobile communications, electric field, magnetic field, 50/60 Hz, occupational, personal	The measured electric field strength was 316.3 ± 1212.3 V/m and magnetic field strength was 6.17 ± 14.71 μ T in the exposure group, which far outstripped the values in the non-exposure group (3.9 ± 0.3 V/m and 0.061 ± 0.017 μ T, respectively). Subjects with long daily exposure time had a significantly higher risk of poor sleep quality (group 2: OR 1.68, CI 1.18-2.39; group 3: OR 1.57, CI 1.10-2.24) in comparison to those with short daily exposure time (group 1). Additionally, among the subjects with long-term occupational exposure, the longer daily occupational exposure time apparently increased the risk of poor sleep quality (> 1.5 - \leq 4 hours/day: OR 2.12 CI 1.23-3.66; > 4 hours/day: OR 1.83, CI 1.07-3.15). There was no significant association of long-term occupational exposure duration, monthly electric fee or years of mobile-phone use with sleep quality or sleep duration. The authors conclude that the results showed an association between daily occupational power frequency magnetic field exposure and poor sleep quality. It implies that power frequency magnetic field exposure may damage human sleep quality rather than sleep duration.	National Basic Research Program of China; National Natural Science Foundation (NSFC), China
57	Saxena Y et al. Indian J Physiol Pharmacol 2014; 58 (1): 100-103	survey men, women, 16–22 years not given India	sleep efficiency, sleep duration, sleep disturbance, sleep latency, daytime dysfunction	mobile phone, GSM, mobile communications, personal	Overall 57% of the medical students were using the mobile phones for more than 2 hours per day. Sleep disturbance, sleep latency and day dysfunction was higher among students using their mobile phone more than 2 hours/day, especially among females. A significant difference in sleep disturbance was observed among students using their mobile phone more than 2 hours/day compared to students with less than 2 hours/day use. Evening usage of mobile phone in students using their mobile phone more than 2 hours/day showed a statistically significant negative correlation with sleep quality. The authors conclude that students using mobile for > 2 hours/day may cause sleep deprivation and day sleepiness affecting cognitive and learning abilities of medical students.	Himalayan Institute Hospital Trust (HIHT) University, India
58	Islam SMS. Adv Public Health 2014: 952832	cross-sectional study men, women, \geq 18 years 2009 Bangladesh	headache, dizziness, mood change, anxiety, depression and palpitation, sleep disturbances	mobile phone base station, mobile communications, residential	A cross-sectional study was conducted among 220 respondents living around BTS in Dhaka city. Data was collected on sociodemographic characteristics, mobile phone use, BTS and EMW awareness, and self-reported health problems. The majority of respondents (92.7%) reported to have seen a BTS but only 29.5% knows how it works and 74.5% had no knowledge about the EMW. 49% respondents experienced sleeping disturbances while recent episodes of headache or dizziness were reported by 47% and mood change or anxiety or depression by 41%. About 22% complained about other physical or mental symptoms. Awareness about the possible health hazards from EMW of BTS is low among the inhabitants of Dhaka city. A number of respondents mentioned recent health effects but the association with BTS could not be established.	?

No.	Reference	Study type Study group Observation period Location	End points	Exposure parameters	Results & Conclusions (according to Authors)	Funding
59	Chiu CT et al. J Formos Med Assoc 2015; 114 (7): 598-604	cross-sectional study children, 11–15 years May 2010 - September 2010 Taiwan	headaches/migraine and skin itches, insomnia, excess daytime sleepiness	mobile phone, mobile communications, personal	<p>About 63.2% of the Taiwanese children aged 11 to 15 years used mobile phones.</p> <p>Mobile phone use was associated with a significantly increased risk for headaches and migraine (OR 1.42, CI 1.12-1.81) and skin itches (OR 1.84, CI 1.47-2.29). No significant association was observed with sleep disturbances. Children who regularly used mobile phones were also considered to have a health status worse than it was 1 year ago. The authors conclude that their study tended to suggest a need for more cautious use of mobile phones in children, although the cross-sectional design precludes the causal inference for the observed association.</p> <p>Other risk factors for the selected health symptoms, such as lifestyle, physical activities, and stress at schools, were not included in the study which might have biased the results.</p>	Bureau of Health Promotion, Department of Health, Taiwan
60	Baliatsas C et al. Int J Hyg Environ Health 2015; 218 (3): 331-344	survey men, women, ≥ 18 years January 2011 - June 2011 Netherlands	23 symptoms such as headache, fatigue, dizziness, memory or concentration problems, skin symptoms, heart palpitations, ear symptoms, neck or shoulder symptoms, back pain, muscular pain, sleep disturbances, electromagnetic hypersensitivity	mobile phone base station, GSM, UMTS, mobile communications, DECT, Radio/TV transmitter, magnetic field, 50/60 Hz, power transmission line, electric blanket, other domestic appliance, residential, personal	<p>The most prevalent self-reported symptoms in the study population were fatigue (54%), neck or shoulder symptoms (39%), headache (38%) and back pain (36%). Among the respondents 202 (3.5%) were considered as hypersensitive to EMF.</p> <p>Perceived exposure by study participants had a poor correlation with the actual exposure estimates. No significant association was observed between modeled radiofrequency electromagnetic field exposure and the investigated outcomes. Associations with non-specific physical symptoms were found for use of an electric blanket and close distance to an electric charger during sleep. Perceived exposure, perceived control and avoidance behavior were associated with the examined outcomes. The association between perceived exposure was stronger for self-reported than for general practitioners-registered non-specific physical symptoms. There was some indication, but no consistent pattern for an interaction between idiopathic environmental intolerance (IEI-EMF) and the association between actual exposure and non-specific physical symptoms.</p> <p>The authors conclude that there is no convincing evidence for an association between everyday life radiofrequency electromagnetic field exposure and non-specific physical symptoms and sleep quality in the population. Better exposure characterization, in particular with respect to sources of extremely low frequency magnetic fields is needed to draw more solid conclusions. The authors argue that perceived exposure is an independent determinant of non-specific physical symptoms.</p>	ZonMw, The Netherlands

No.	Reference	Study type Study group Observation period Location	End points	Exposure parameters	Results & Conclusions (according to Authors)	Funding
61	Zheng F et al. BMJ Open 2015; 5 (5): e007302	cross-sectional study children, 9–12 years October 2011 - May 2012 China	headache, dizziness, fatigue, feeling low, heart beating fast, sleep disturbances	mobile phone, mobile communications	A total of 544 (72.9 %) participants owned mobile phones. The average duration of mobile phone usage was 1.3±1.5 years. More than half (53.4 %) of the participants spent fewer than 10 min on calls daily. The most frequently reported physical symptoms were sleeping problems (17.8 %), fatigue (13.9 %) and dizziness (12.7 %). Fatigue was significantly associated with the years of mobile phone use (group 3: OR 1.85, CI 1.07-3.22) and the daily duration of mobile phone calls (group7: OR 2.98, CI 1.46-6.12). There was no significant association between headache, dizziness, feeling low as well as heart beating fast and mobile phone use in children. The authors concluded that there was a significant association between mobile phone use and fatigue in children.	National Basic Research Program of China; National Natural Science Foundation (NSFC), China
62	Huss A et al. PLoS One 2015; 10 (10): e0139869	cohort study children, 6–8 years 2003 - 2011 The Netherlands	sleep-onset delay, sleep duration, night waking, parasomnia, daytime sleepiness	mobile phone, mobile phone base station, GSM, UMTS, mobile communications, cordless phone, W-LAN/WiFi, residential, personal	Sleep onset delay, night waking, parasomnia and daytime sleepiness were not associated with residential exposure to radiofrequency electromagnetic fields from mobile phone base stations. Sleep duration scores were associated with radiofrequency electromagnetic fields levels from base stations (group 3). Higher mobile phone use was associated with less favorable sleep duration, night waking and parasomnia, and also with bedtime resistance (control sleep parameter). Cordless phone use was not related to any of the sleeping scores. Based on the different results across the evaluated radiofrequency electromagnetic fields exposure sources and the observed association between mobile phone use and the negative control sleep scale, the authors concluded that sleep quality in 7-year old children is not associated with the exposure to radiofrequency electromagnetic fields, but potentially with other factors that are related to mobile phone usage.	FIS (Fondo de Investigaciones Sanitarias, Health Research Fund) (Instituto de Salud Carlos III, Ministerio de Sanidad y Consumo) (Carlos III Health Institute, Ministry of Health and Consumption), Spain; ZonMw, The Netherlands
63	Silva DF et al. Cad Saude Publica 2015; 31 (10): 2110-2126	cross-sectional study men, women, 18–87 years not stated Brazil	irritability, anxiety, decreased libido, palpitation, depression, depressive tendency, depressive symptoms	mobile phone, mobile phone base station, mobile communications	Overall, there were no significant differences of mental symptoms between individuals living up to 300 m (group 4) versus individuals living more than 300 m (group 3) from the mobile phone base stations. An association was observed between living 100 to 200 m from the base stations (group 2) and anxiety (OR 2.39; 90% CI 1.09-5.26) or depression (OR 3.25; 90% CI 1.63-6.45). For individuals living up to 300 m from the base stations, a reduced risk for depressive symptoms was observed (OR 0.50; 90% CI 0.32-0.80). Living up to 400 m from the base stations was associated with depressive tendency (OR 1.55; 90% CI 1.04-2.33) and depressive symptoms (OR 1.66; 90% CI 1.08-2.55). The authors concluded that exposure to electromagnetic fields from mobile phone base stations and other electronic devices was associated with mental symptoms, independently of gender, education, and smoking status.	Fundacao Coordenacao de Aperfeicoamento de Pessoal de Nivel Superior (Brazilian Federal Agency for the Support and Evaluation of Graduate Education; CAPES; at Ministry of Education), Brazil

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64	Stalin P et al. J Clin Diagn Res 2016; 10 (1): LC14-LC16	cross-sectional study men, women, ≥ 18 years January 2014 India	headache, earache, neck pain, tinnitus, painful fingers, restlessness, morning tiredness, tingling fingers, fatigue, eye symptoms, sleep disturbance, hypertension	mobile phone, mobile communications	69.8% of the participants reported to use mobile phones. Most of them were using calling facility (94.2%), followed by SMS facility (67.6%). Health problems positively associated with mobile phone usage were headache, earache, neck pain, tinnitus, painful fingers, morning tiredness, fatigue, eye symptoms, sleep disturbance and restlessness. Hypertension was more uncommon among mobile phone users compared to non-users. An association between selected health symptoms and mobile phone use was observed.	?
65	Eyvazlou M et al. Chronobiol Int 2016; 33 (3): 293-300	cross-sectional study men, women, 18–28 years 2014 Iran	general health status, somatic symptoms, social dysfunction, anxiety and severe depression, insomnia	mobile phone, mobile communications	Half of the students reported a poor sleep quality and 68% of them reported an unhealthy general health status. 21 out of 450 students (4,6%) were over-users of mobile phones. An association between the excessive use of mobile phones and the total score and the four subscales of general health (somatic symptoms, social dysfunction, anxiety, and severe depression) and the quality of sleep was observed. Furthermore, the quality of sleep has a simultaneous effect on each of the four scales of the general health.	?
66	Singh K et al. J Int Soc Prev Community Dent 2016; 6 (1): 54-59	cross-sectional study, preliminary study men, women, ≥ 18 years 2013 India	hypertension, headache, dizziness, sleep disturbances, salivary function (unstimulated and stimulated salivary flow rates, level of hydration, saliva consistency and pH)	mobile phone base station, mobile communications, residential	Some health disturbances (e.g. sleep disturbances, headache, dizziness and hypertension) were more often observed in the exposed group residing less than 1 km to a mobile phone base station in comparison to the control group living at a distance of more than 1 km to a base station (remark EMF-Portal: both groups differ in sex and age distributions). Exposed subjects had significantly lower stimulated salivary secretion as compared to the control subjects. Other parameters showed no significant differences between the two groups. The authors concluded that effects of exposure to radiofrequency electromagnetic fields from mobile phone base stations on the health and well-being of the general population cannot be ruled out.	?
67	Baliatsas C et al. Sci Total Environ 2016; 565: 714-720	cohort study men, women, ≥ 18 years January - December 2004, follow-up July 2010 - June 2011 Netherlands	23 symptoms such as headache, fatigue, dizziness, memory or concentration problems, skin symptoms, heart palpitations, ear symptoms, neck or shoulder symptoms, back pain, muscular pain, sleep disturbances, electromagnetic hypersensitivity	mobile phone base station, GSM, UMTS, mobile communications, residential	55 participants reported to be EHS to mobile phone base stations in 2011. There was an increase in the total number of antennas at mobile phone base stations of 30% in the period 2004-2011. Mean total calculated electric field strength was 0.10 (±0.15) V/m in 2004 and 0.104 (±0.15) in 2011 for the EHS group; for the rest of the sample mean exposure levels were 0.11 (±0.23) V/m and 0.12 (±0.23) V/m respectively. A higher prevalence for most non-specific symptoms was observed in the EHS group in 2011 compared to baseline. Exposure estimates were not associated with general practitioner registered non-specific symptoms in the total sample. Significant interactions were observed between EHS and exposure estimates on risk of symptoms. By using clinically defined outcomes and a time difference of 6 years it was shown that RF exposure to base stations was not associated with the development of non-specific symptoms. There was indication for a higher risk of non-specific symptoms for the EHS group, mainly in relation to exposure to UMTS, but this should be interpreted with caution.	ZonMw, The Netherlands

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68	Schoeni A et al. Environ Health 2016; 15 (1): 77	cohort study men, women, children, 12–17 years 2012 - 2013, follow-up 1 year later Switzerland	headache, tiredness, lack of concentration, exhaustibility, lack of energy and physical ill- being	mobile phone base station, mobile communications, Radio/TV transmitter, residential	Mean exposure (median, 75th percentile) for broadcast transmitters, mobile phone base stations and total exposure at baseline were 1.9 $\mu\text{W}/\text{m}^2$ (1.0 $\mu\text{W}/\text{m}^2$; 2.8 $\mu\text{W}/\text{m}^2$), 14.4 $\mu\text{W}/\text{m}^2$ (3.8 $\mu\text{W}/\text{m}^2$; 11.0 $\mu\text{W}/\text{m}^2$) and 16.3 $\mu\text{W}/\text{m}^2$ (5.8 $\mu\text{W}/\text{m}^2$; 13.4 $\mu\text{W}/\text{m}^2$), respectively. 1.) In the combined cross-sectional analyses of the baseline and follow-up data, no associations were observed between any symptom and exposure to radiofrequency electromagnetic fields from fixed site transmitters. 2.) In the cohort analyses, only a few significant associations were found including an increased odds ratio of 2.94 for tiredness (CI 1.43-6.05) for participants in group 9 in comparison to reference group 7. 3.) In the change analyses, a decreased odds ratio of 0.50 was observed for exhaustibility (CI 0.27-0.93) for participants with an exposure increase between baseline and follow-up. The authors concluded that exposure to radiofrequency electromagnetic fields from fixed site transmitters was not consistently associated with self-reported symptoms in Swiss adolescents. The few observed associations have to be interpreted with caution and might represent chance findings.	Swiss National Science Foundation (SNF)
69	Roser K et al. Int J Hyg Environ Health 2016; 219 (8): 759-769	cohort study men, women, children, 12–17 years 2012 - 2013, follow-up 2014 Switzerland	behavioral problems (emotional problems, conduct problems, hyperactivity/inattention, peer relationship problems and prosocial behavior) and concentration capacity (homogeneity, power and accuracy)	mobile phone, mobile phone base station, GSM, UMTS, mobile communications, cordless phone, W-LAN/WiFi, Radio/TV transmitter, residential, personal	In the cross-sectional analyses, an association between behavioral problems of adolescents and the use of several self-reported wireless communication devices or exposure measures was observed, but not with operator-recorded mobile phone use. Concentration capacity in adolescents was associated with several self-reported and operator-recorded exposure measures. The longitudinal analyses point towards absence of associations. The authors conclude that the lack of consistent exposure-response patterns in the longitudinal analyses suggests that behavioral problems and concentration capacity in adolescents are not affected by the use of wireless communication devices or exposure to radiofrequency electromagnetic fields. Information bias and reverse causality are likely explanations for the observed cross-sectional findings.	Swiss National Science Foundation (SNF); Forschungsstiftung Mobilkommunikation (FSM; Research Foundation on Mobile Communication; at the Swiss Federal Institute of Technology Zurich (ETH)), Switzerland
70	Cho YM et al. Environ Health Toxicol 2016; 31: e2016022	cross-sectional study men, women 2012 - 2013 Korea	sleep quality, headache, psychosocial well-being, depression, cognitive function, stress, physical and mental health	mobile phone, mobile communications	The median daily average number of mobile phone calls was five and the median of the average duration of one phone call was 1.5 minutes among the study participants. The average daily number mobile phone calls showed a significant correlation with stress scores in women. Increased severity of headaches was observed in the group of subjects with an average duration of a mobile phone call of 5 minutes or longer (group 2) compared to group with an average duration of less 5 minutes (group 1). Mobile phone use was not significantly associated with stress, sleep, cognitive function, or depression. The authors concluded that mobile phone call duration was associated with the severity of headaches.	ICT R&D program of MSIP/IITP (Ministry of Science, ICT and Future Planning/Institute for Information & Communications Technology Promotion), Korea; Ministry of Science, ICT and Future Planning (MSIP), Korea; Centers for Disease Control & Prevention (CDC), Korea

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71	Nagarjunakonda S et al. Postgrad Med J 2017; 93 (1095): 25-28	cross-sectional study men, women, 16–65 years 2014 - 2015 India	epilepsy	mobile phone, mobile communications, non-EMF	In total, 107 patients did not use mobile phones, 3 patients only at home and 68 used mobile phones. No significant difference in the number of seizures in the past year between mobile phone users (group 3) and non-users (group 1) were found. A significant lower proportion of patients with drug-resistant epilepsy was observed among mobile phone users (group 3) compared to non-users (group 1). Exposure assessment did not quantify the amount of exposure to mobile phones.	?
72	Schoeni A et al. Environ Res 2017; 154: 275-283	cohort study men, women, children, 12–17 years 2012 - 2013, follow-up 2013 - 2014 Switzerland	headache, tiredness, lack of concentration, exhaustibility, lack of energy and physical ill-being	mobile phone, UMTS, GSM, mobile phone base station, mobile communications, cordless phone, Radio/TV transmitter, W-LAN/WiFi, personal, residential	In the cross-sectional and cohort analyses, various symptoms tended to be mostly associated with usage measures that are only marginally related to exposure to radiofrequency electromagnetic fields such as the number of text messages sent per day (e.g. tiredness: OR 1.81, CI 1.20-2.74 for cross-sectional analyses and OR 1.87, CI 1.04-3.38 for cohort analyses). Outcomes were generally less strongly or not associated with mobile phone call duration and RF-EMF dose measures. The authors concluded that stronger associations between symptoms of ill health in Swiss adolescents and wireless communication device use than for radiofrequency electromagnetic fields dose measures were observed. Such a result pattern does not support a causal association between exposure to radiofrequency electromagnetic fields and health symptoms of adolescents but rather suggests that other aspects of extensive media use are related to symptoms.	Swiss National Science Foundation (SNF)
73	Cho YM et al. Environ Health Toxicol 2017; 32: e2017001	cohort study men, women 2012 - 2013, follow-up 2014 - 2015 Korea	headache, psychosocial well-being, depression, dementia (daily activities), stress, physical and mental health, sleep quality	mobile phone, mobile communications, personal	The average duration per mobile phone call decreased significantly between baseline and follow-up (median: 1.5 min, 1.3 min respectively). A significant correlation was observed between the reduction in the average call duration and a decrease in headache among women only. Severity of headaches in the follow-up survey significantly decreased compared to those in the baseline survey (groups 1-3). Mobile phone use was not significantly associated with stress, sleep, cognitive function, or depression. The authors conclude that an increased mobile phone call duration is a greater risk factor for increases in headache than any other type of adverse health effect, and that this effect could be chronic. Exposure assessment was based on self-reported data of the study participants. There are a lot of factors that may affect headache symptom which were not included in the study.	IT R&D program of MIC/IITA (Ministry of Information and Communication/Institute of Information Technology Assessment), Korea; Ministry of Science, ICT and Future Planning (MSIP), Korea; Centers for Disease Control & Prevention (CDC), Korea

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74	Martens AL et al. Am J Epidemiol 2017; 186 (2): 210-219	Cohort study Men, women period: 2011 - 2012, follow-up 2013 - 2014 The Netherlands	symptoms of discomfort: non-specific symptoms (e.g. headaches, dizziness, pain in muscles, fainting, neck pain, back pain, excessive sweating, palpitations, bloated feeling in abdomen, blurred vision, shortness of breath, nausea, pain abdomen, tingling fingers, tight feeling in chest, chest pain) sleep disturbances	mobile communications, mobile phone base station, residential	Small correlations between modeled and perceived exposures to radiofrequency electromagnetic fields from mobile phone base stations were observed in study participants at baseline. For 222 follow-up participants, modeled exposure increased substantially (> 0.030 mW/m ²) between 2011/2012 and 2013. This increase in modeled exposure was associated with an increase in perceived exposure during the same time period. No association between modeled exposure from mobile phone base stations and health outcomes was found. On contrary, perceived exposure was associated with higher symptom reporting scores in both cross-sectional and longitudinal analyses, as well as with sleep disturbances in cross-sectional analyses. The authors conclude that the robust study design adds to the body of evidence that there seems to be no substantial adverse effect of everyday residential exposure to radiofrequency electromagnetic fields from mobile phone base stations on the development of nonspecific symptoms and sleep disturbances in the general public. Awareness of the presence of mobile phone base stations in the home environment may play an indirect role in symptom reporting, through effects on perceived exposure.	ZonMw, The Netherlands
75	Durusoy R et al. Environ Health 2017; 16 (1): 51	cross-sectional study men, women, 14–16 years 2009 - 2010 Turkey	health symptoms: fatigue, headache, nervousness, irritability, concentration difficulties, forgetfulness, depressive symptoms, dizziness, tremor, nausea, visual disturbances, dryness of the throat, arrhythmia, loss of appetite, sensitivity towards sounds, hearing difficulties, allergy, warming of the ear, discomfort during calls, numbness in the head or face, prickling in the ear, flushing, sleep disturbances	mobile communications, mobile phone, mobile phone base station, GSM, UMTS, DECT, RF field	Among the study participants, 2021 (94.0%) were using mobile phones. Among users, 49.4% were speaking less than 10 min per day and 52.2% were sending/receiving 75 or more messages per day. Fatigue was the most commonly reported symptom, followed by headache and irritability. Headache, fatigue and sleep disturbances were observed more often among mobile phone users (group 2) compared to nonusers (group 1) (OR 1.90, CI 1.30–2.77; OR 1.78, CI 1.21–2.63 and OR 1.53, CI 1.05–2.21, resp.). Many statistically significant associations were found which cannot be expected by chance alone. Some of the observed associations showed dose-response relationships. Limited associations were observed between vicinity to base stations and some general symptoms. No association was found with exposure at school. The authors conclude that their findings suggest an association between mobile phone use and some subjective symptoms.	The Scientific and Technical Research Council of Turkey (TÜBİTAK), Turkey
76	Verrender et al. Bioelectromagnetics. 2017 Nov 10. doi: 10.1002/bem.22095	Three (2 male, 1 female) subjects with self-diagnosed electromagnetic hypersensitivity were included. The tests were conducted in the home environments of the participants.	Whether RF causes EHS symptoms and whether EHS persons detect active RF Measured EHS/subjective complaints: demographic data and health status, subject's symptom history, quality of life (WHOQOL-BREF), symptom (visual analog scale) and exposure status (field perception)	902–928 MHz RF exposure duration: 30 min each exposure (6 x in double-blind study) GSM UMTS W-LAN/WiFi	Experimental double-blind study. No significant difference in symptom severity or exposure detection was found for any of the subjects between the two conditions (exposure and sham exposure). Belief of exposure strongly predicted symptom severity score for all subjects.	National Health and Medical Research Council (NHMRC), Australia

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77	van Moorselaar et al. Environ Int 2017; 99: 255-262	42 adults (76% women) participated in the study. Subjects were eligible if they reported to sense one of the available experimental EMF signals (GSM 900, GSM 1800, DECT, UMTS and WiFi) or extremely low-frequency magnetic fields (50 Hz sine signal or four different types of signals with other frequency components added, so called dirty electricity) within minutes of being exposed, or developing acute and transient health complaints.	Hypersensitivity/subjective complaints: sensing of exposure, questionnaire on self-rated level of electromagnetic sensibility/sensitivity, certainty regarding being electromagnetic sensible/sensitive, certainty of reacting to EMF within minutes, number and type of symptoms, burden of each symptom, certainty that the symptom was linked to EMF exposure	RF: 925–960 MHz; 1,805–1,880 MHz; 1,880–1,900 MHz; 2,110–2,170 MHz; 2,400–2,500 MHz RF exposure duration: maximum of 15 min per condition (individually defined during pretests) 50 Hz–2,500 MHz 50/60 Hz magnetic field Magnetic flux density min. 0.15 μ T max 6.6 μ T	Double-blind study. None of the participants was able to correctly identify when they were being exposed better than chance. There were no significant differences in the self-reported level of electromagnetic hypersensitivity after 2 and 4 months compared to before the test but after 2 and 4 months, participants reported significantly reduced certainty in reacting within minutes to exposure, significantly fewer symptoms compared to before the test and significantly reduced severity of symptoms. The authors conclude that there was no indication for a sensing ability of radio-frequency or extremely low-frequency fields in subjects. However, the results indicate that a subgroup of persons with electromagnetic hypersensitivity might profit from participation in such a personalized testing procedure regarding their symptoms.	ZonMw, The Netherlands