Health Effects of Microwave Radio Exposures

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The current FCC Limits for Microwave RF Exposure were published in 1999.

These guidelines are only designed to protect the public against the thermal effects of microwave RF.

The FCC has explicitly stated that they do not make any regulations or assurances whatsoever regarding the "nonthermal" biological effects of lower level microwave RF exposures (other physiologic effect besides heat damage).

Many statements from industry spokesmen state that "not enough is known" about these exposures to identify risk, or that there is "insufficient" or "incomplete" evidence regarding such risks, or that there is "no scientific consensus" on this risk.

This implies that there isn't much scientific information on this subject. But actually, there is a great deal of research documenting adverse biological effects from low level RF exposures.

Acute Symptoms from RF Exposure:

"EHS"

In this presentation, we're going to take a look at the current scientific evidence for adverse effects of RF exposures.

First, we'll look at the evidence that RF exposures can produce acute symptoms in many individuals.

Then we'll look at the evidence that RF exposures alter hormone physiology and increase oxidative stress in living systems.

Then we'll review the evidence that such alterations in physiology can damage DNA, increase the incidence of some forms of cancer, and decrease fertility in animals and in human beings.

U.S. Embassy, Moscow (1953-1978)

Acute symptoms provoked by microwave radiation were first described by Russian medical researchers in the 1950's. They described a constellation of symptoms including headache, ocular dysfunction, fatigue, dizziness, sleep disorders, dermatographism, cardiovascular abnormalities, depression, irritability, and memory impairment.

In the years **between 1953 and 1978** the Russian government harrassed the U.S. Embassy in Moscow by targeting it with radiation from a microwave transmitter positioned on the roof of a nearby building.

Exposed embassy staff experienced a statistically significant excess of several problems, including: depression, irritability, difficulty in concentrating, memory loss, ear problems, skin problems, vascular problems, and other health problems. Symptom incidence increased significantly with accrued years of exposure.

Exposure levels inside the building were in the order of **2 to 28 μW/cm² (FCC Guidelines: 600 μW/cm²)**

U.S. Embassy, Moscow (1953-1978)

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2.	3. Recipient's Accession No. PB288163
4. Title and Subtitle: Evaluation of Health Status of Foreign Service and other Employees from Selected Eastern European Posts			5. Report Date: July 31, 1978
7. Author(s): Abraham M. Lilienfeld, M.D. Principal Investigator			8. Performing Organization Rept. No.
9. Performing Organization Name and Address: Department of Epidemiology, School of Hygiene and Public Health, The Johns Hopkins University			10. Project/Task/Work Unit No.
			11. Contract(C) or Grant(G) No. (C) 6025 619073 (G)
12. Sponsoring Organization Name and Address: Medical Director, Office of Medical Services, Department of State, Washington, D C			13. Type of Report & Period Covered: Final 1953 - 1976
			14.

15. Supplementary Notes

Released publicly November 20 simultaneously by Department of State and The Johns Hopkins University.

16. Abstract (Limit: 200 words)

This is a biostatistical study of 1827 Department of State employees and their dependents at the Moscow Embassy and 2561 employees and their dependents from other Eastern European Embassies. Health records, health questionnaires and death certificates were the basic information sources. The study is the impact of the Moscow environment including microwave exposure on the health status and mortality of the employees. It was concluded that personnel working at the American Embassy in Moscow from 1953 to 1976 suffered no ill effects from the microwaves beamed at the Chancery.

Concern about health effects among Embassy personnel led to a detailed study by A.M. Lilienfeld, an epidemiologist at Johns Hopkins University. The abnormalities found in this study were an embarrassment to the U.S. government, since the levels of exposure experienced by embassy staff inside the building were in the order of **2 to 28 microwatts/cm2**, a level dramatically below the described U.S. safety standards for microwave exposure. It appears that the conclusions of the study were altered to soft-pedal any abnormal findings.

Lilienfeld AM LGM, Cauthen J, Tonascia S, Tonascia J. Evaluation of health status of foreign service and other employees from selected eastern European embassies. *Foreign Service Health Status Study, Final Report; Contract No. 6025-619037 (NTIS publication P8-288 163/9)* (1979); 1-447.

Liakouris AG. Radiofrequency (RF) Sickness in the Lilienfeld Study: An Effect of Modulated Microwaves? Archives of Environmental Health (1998); 53(3):236-238.

Goldsmith JR. Where the trail leads. Ethical problems arising when the trail of professional work leads to evidence of a cover-up of serious risk and mis-representation of scientific judgement concerning human exposures to radar. *Eubios Journal of Asian and International Bioethics* (1995b); 5(4):92-94.

Cherry N. Evidence of Health Effects of Electromagnetic Radiation, To the Australian Senate Inquiry into Electromagnetic Radiation (2000): 1-84. *http://www.neil- cherry.com/documents 90_m1_EMR_Australian_Senate_Evidence_8-9-2000.pdf*

Norway (1998)

From:
Mild, K.H., Oftedal, G., Sandstrom, M., Wilen, J., Tynes, T., Haugsdal, B. and Hauger E., 1998: "Comparison of symptoms by users of analogue and digital mobile phones - A Swedish- Norwegian epidemiological study". National Institute for Working Life, 1998:23, Umea, Sweden, 84pp.

Norway (1998)

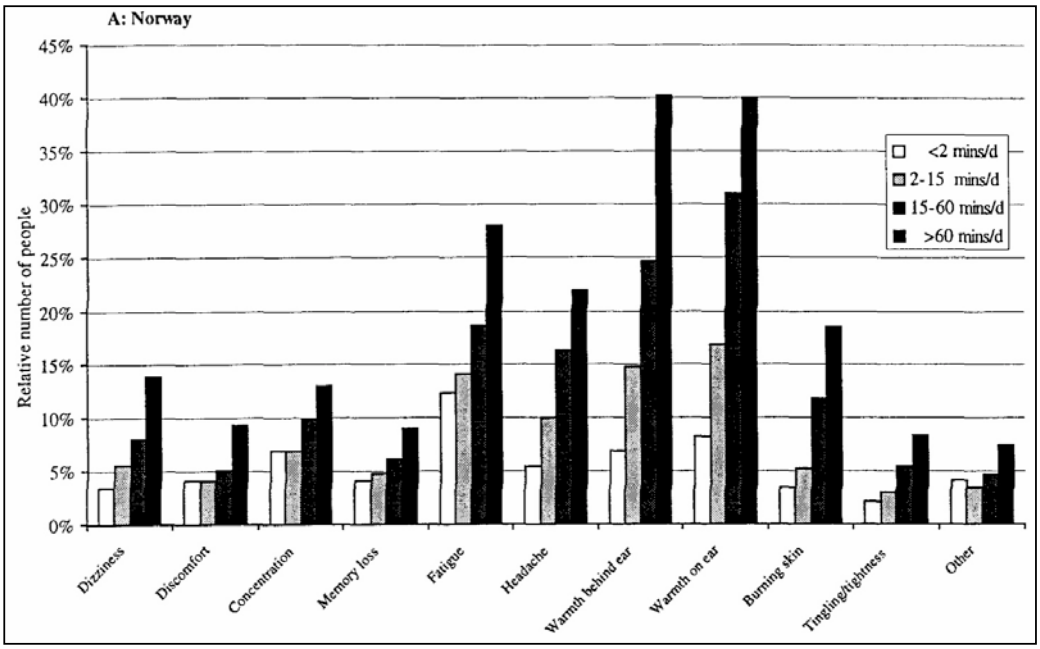
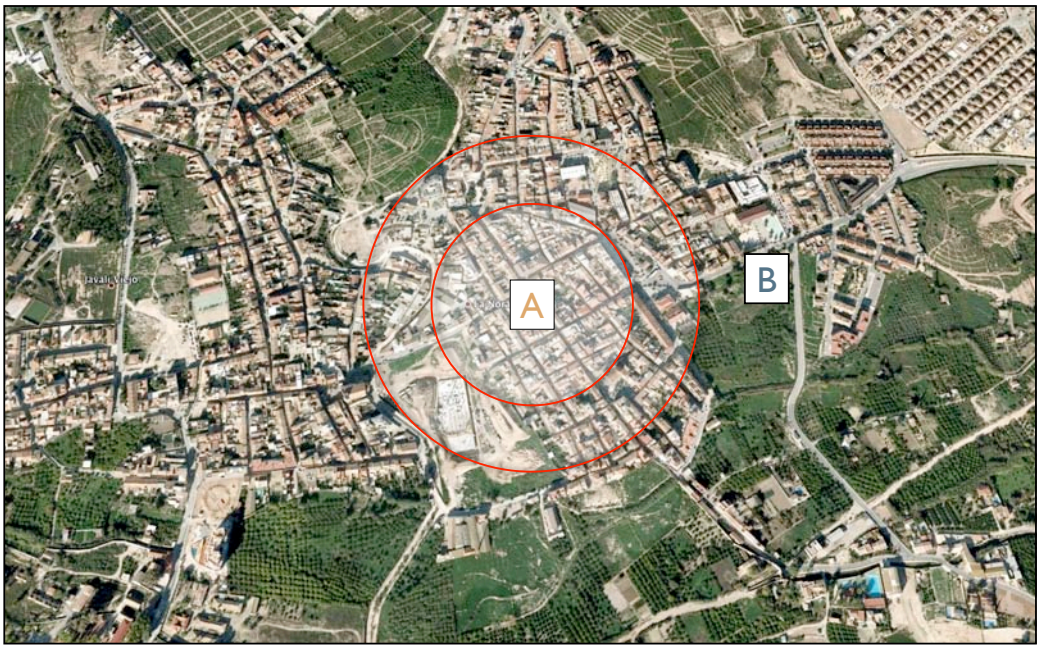


Figure 11: Prevalence of symptoms for Norwegian mobile phone users, mainly analogue, with various categories of length of calling time per day, from Mild et al. (1998).

In:
Cherry N. EMF/EMR Reduces Melatonin in Animals and People. (2002):1-14. *http://www.neilcherry.com/documents.php*
From:
Mild, K.H., Oftedal, G., Sandstrom, M., Wilen, J., Tynes, T., Haugsdal, B. and Hauger E., 1998: "Comparison of symptoms by users of analogue and digital mobile phones - A Swedish- Norwegian epidemiological study". National Institute for Working Life, 1998:23, Umea, Sweden, 84pp.

La Ñora, Spain (2001)



Town of 1900 inhabitants, with GSM cell phone tower.

Questionnaire distributed, 5% of inhabitants responded. The questionnaire was composed of 25 different items mainly concerning health information about the respondents.

The respondents scored and marked from 0 to 3 the presence of the suffered health dysfunction: 0 never, 1 sometimes, 2 often, 3 very often.

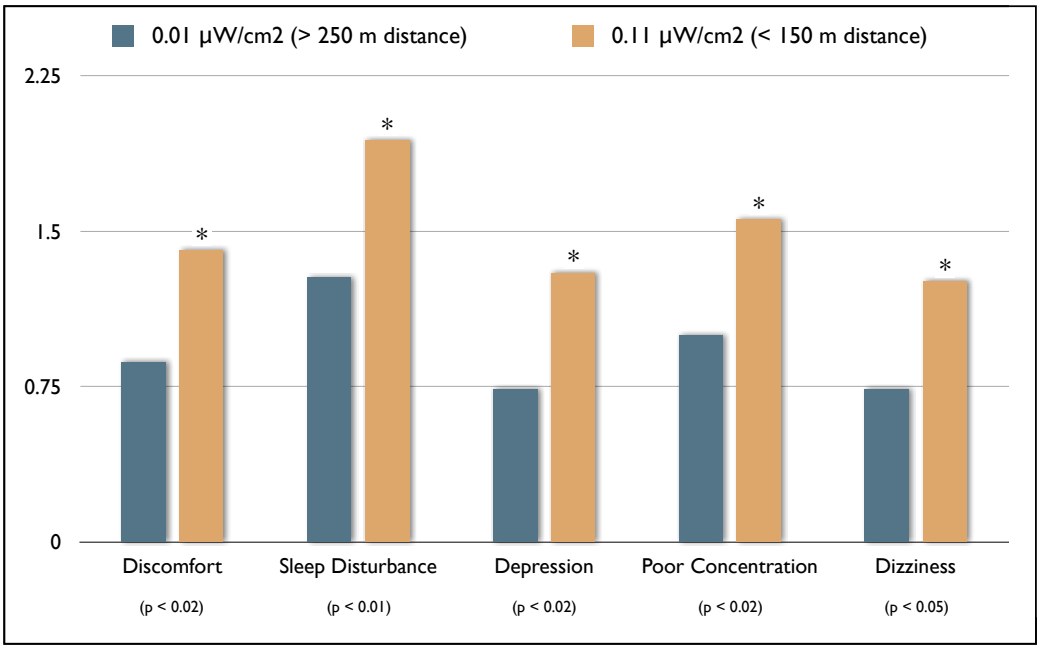
Power density of signal in bedrooms of respondents was measured.

Area A (< 150 meters from tower) = average power density 0.11 μW/cm^2.

Area B (> 250 meters from tower) = average power density 0.01 μW/cm^2.

Navarro E, Segura J, Portolés M, Gómez-Perretta C. The Microwave Syndrome: A Preliminary Study in Spain. Electromagn Biol Med (2003); 22(2-3):161-169.

La Ñora, Spain (2001)



Symptom score (0 – 3) vs Average Bedroom Exposure Levels to Microwave RF

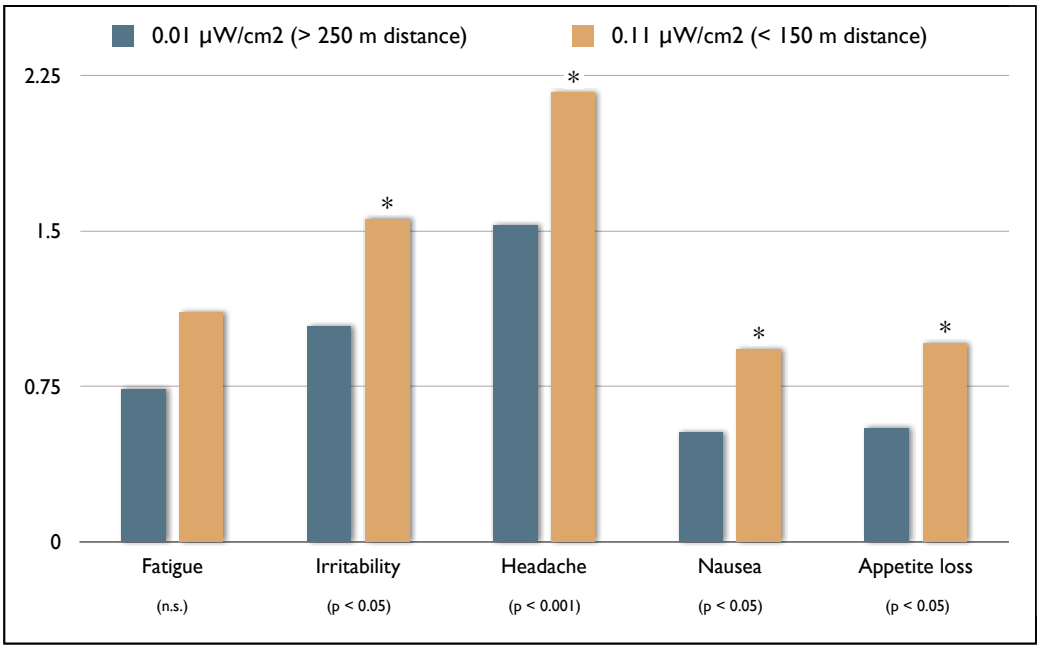
FCC Guidelines: **600 - 1000 μW/cm^2**

Navarro E, Segura J, Portolés M, Gómez-Perretta C. The Microwave Syndrome: A Preliminary Study in Spain. Electromagn Biol Med (2003); 22(2-3):161-169.

Abstract

A health survey was carried out in Murcia, Spain, in the vicinity of a Cellular Phone Base Station working in DCS-1800 MHz. This survey contained health items related to " microwave sickness " or "RF syndrome." The microwave power density was measured at the respondents' homes. Statistical analysis showed significant correlation between the declared severity of the symptoms and the measured power density. The separation of respondents into two different exposure groups also showed an increase of the declared severity in the group with the higher exposure.

La Ñora, Spain (2001)



Symptom score (0 – 3) vs Average Bedroom Exposure Levels to Microwave RF

Based on the data of this study the advice would be to strive for levels not higher than 0.02 V/m for the sum total, which is equal to a power density of 0.0001 µW/cm2 or 1 µW/m2, which is the indoor exposure value for GSM base stations proposed on empirical evidence by the Public Health Office of the Government of Salzburg in 2002.

Oberfeld G, Navarro E, Portoles M, Maestu C, Gomez-Perretta C. The Microwave Syndrome -- Further Aspects of a Spanish Study. (2004):1-8. *http://www.powerwatch.org.uk/pdfs/20040809_kos.pdf*

France (2002)

Questionnaire re multiple symptoms that have been described for “microwave syndrome”.

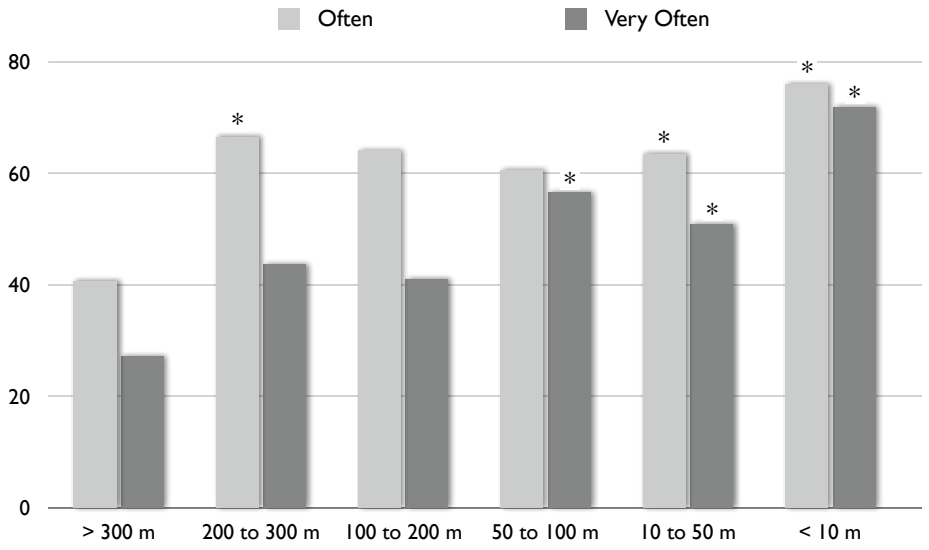
n = 530

Evaluated incidence of symptoms as a function of residential proximity in meters to a cell phone tower.

Santini R, Santini P, Danze JM, Le Ruz P, Seigne M. [Investigation on the health of people living near mobile telephone relay stations: I/Incidence according to distance and sex]. *Pathol Biol (Paris)* (2002); 50(6):369-373.

Santini R SP, Le Ruz P, Danze J, Seigne M. Survey Study of People Living in the Vicinity of Cellular Phone Base Stations. *Electromagnetic Biology and Medicine* (2003); 22(1):41-49.

Fatigue



* p < 0.05 in comparison to residence > 300 meters or not exposed.

X axis = responses grouped by residential proximity to cell phone tower (in meters).

Y axis = percentage in exposure category answering "Often" or "Very Often" to a symptom query, in reference to total number of respondents living at that distance who answered "Never" to that symptom query.

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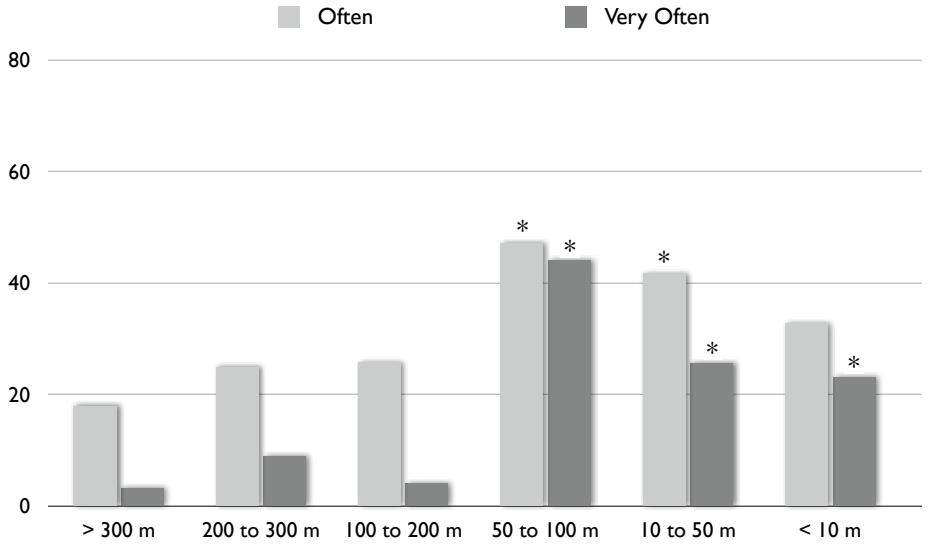
Irritability



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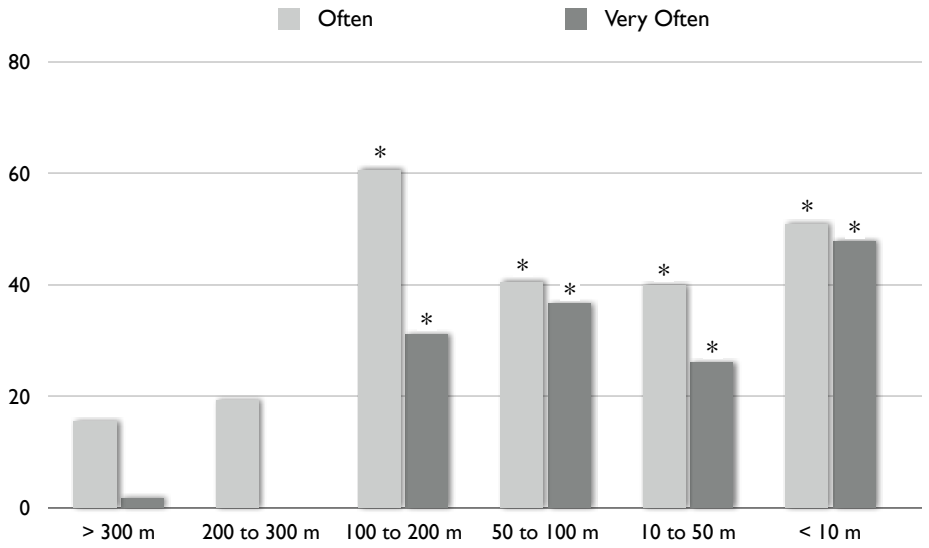
Headache



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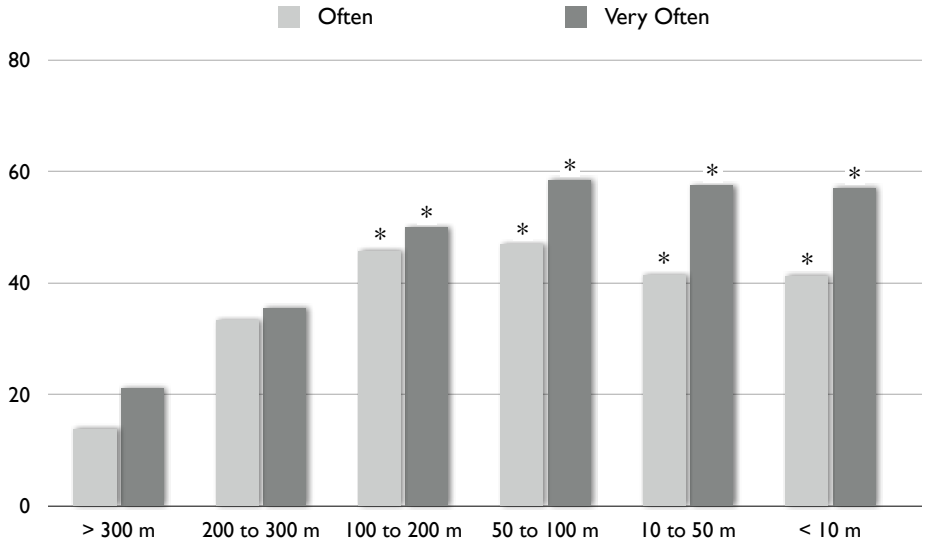
Sleep Disruption



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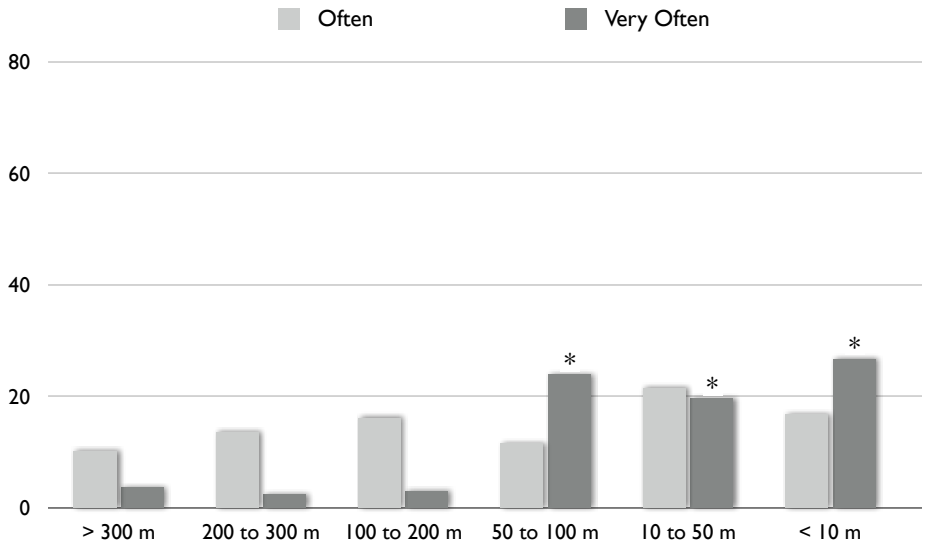
Depression



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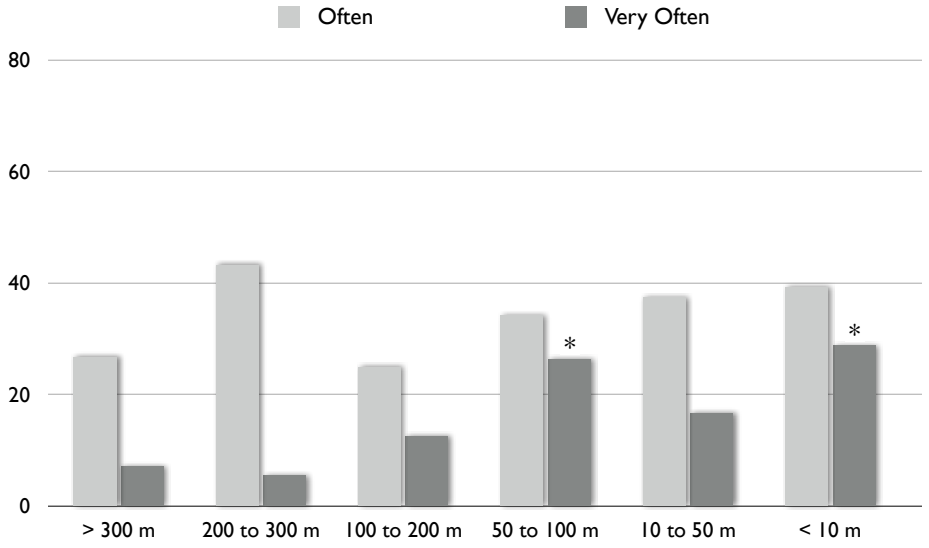
Difficulty in Concentration



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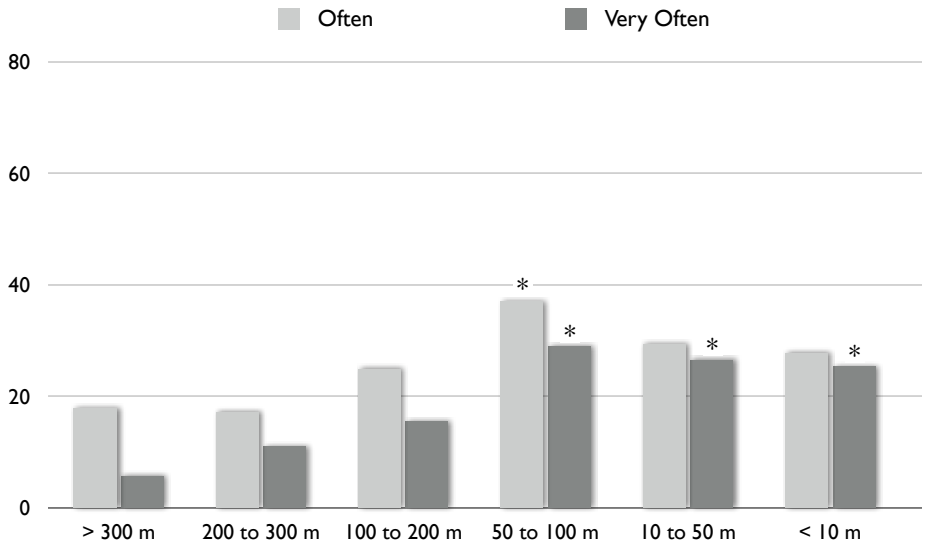
Memory Loss



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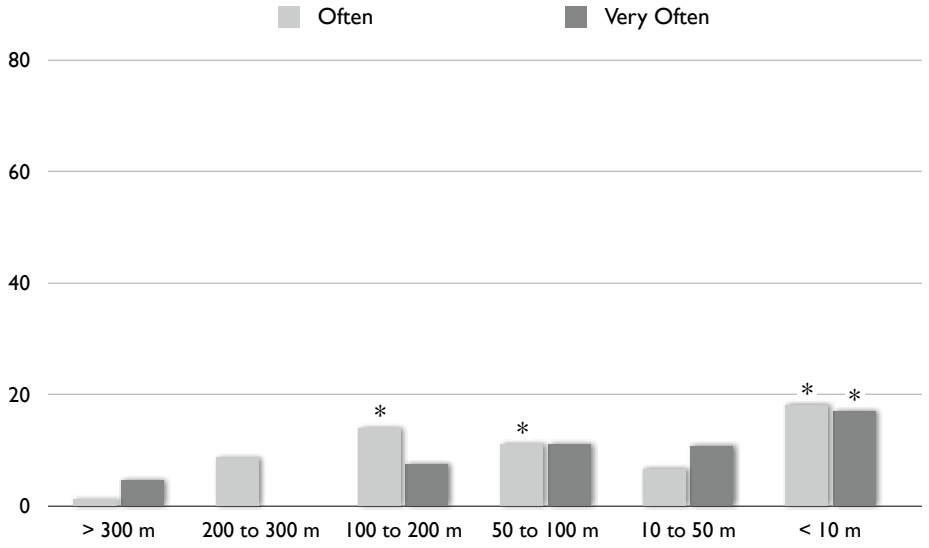
Skin Problems



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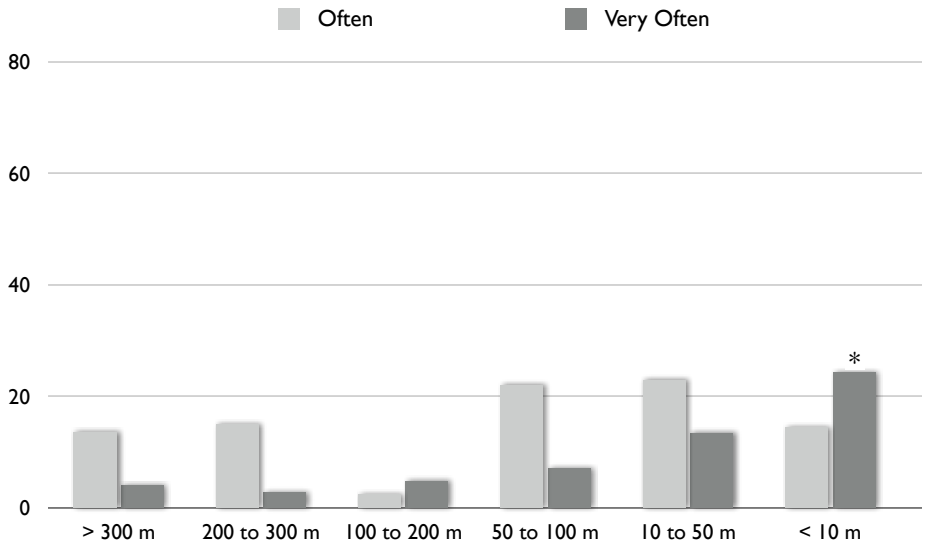
Visual Disruption



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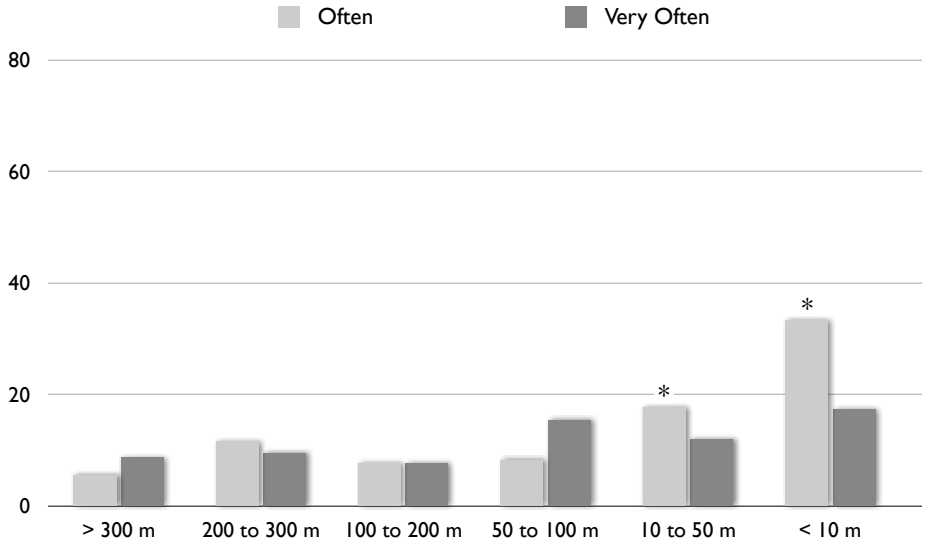
Hearing Disruption



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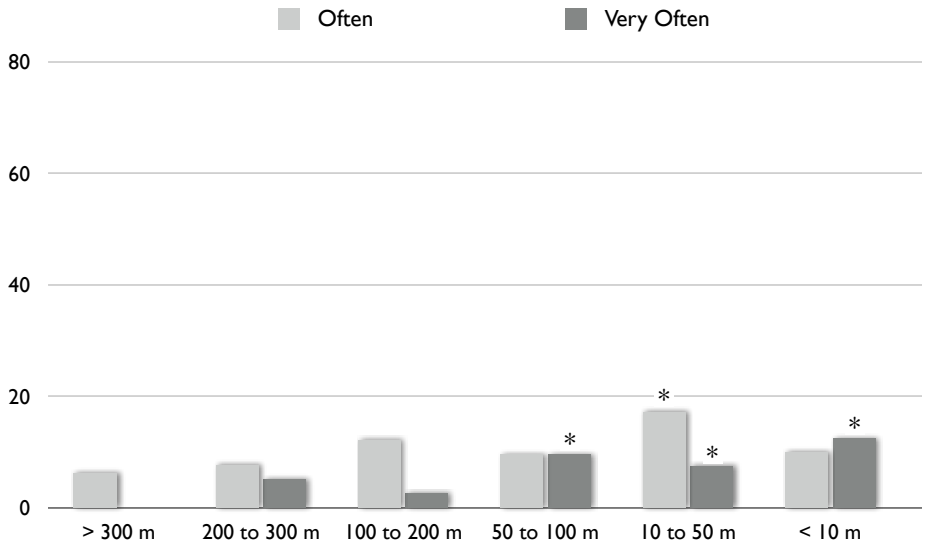
Dizziness



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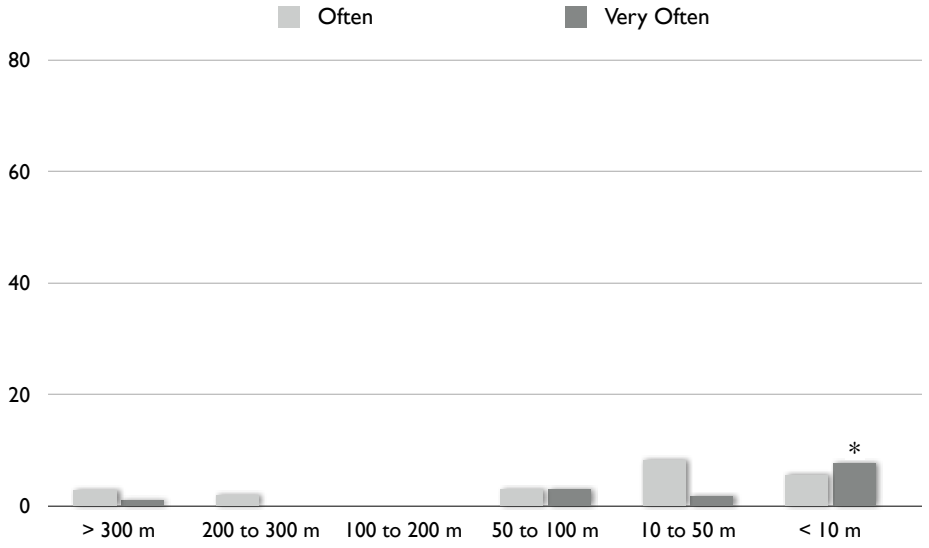
Movement Difficulties



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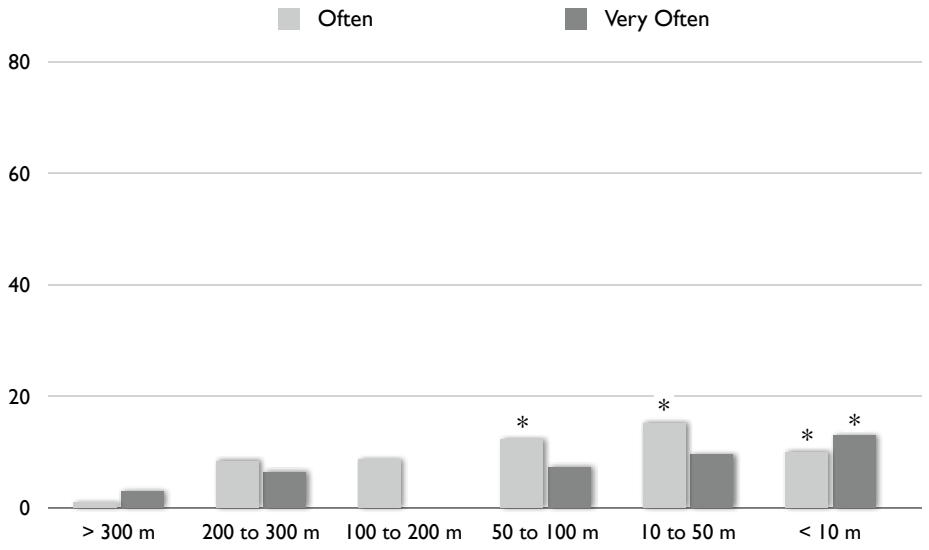
Cardiovascular Problems



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Elderly people are more vulnerable

Table 3. Influence of age on the percentages of complaints

	≤ 20 years		21–40 years		41–60 years		> 60 years	
	Distances of subjects from antennas (in meters)							
Symptoms	≤ 300	> 300	≤ 300	> 300	≤ 300	> 300	≤ 300	> 300
Fatigue	56.7	62.5	82.4*	25	81.4*	57.8	73.3*	40
Irritability	16.2	11.1	46.2	18.2	50.5	35.3	52.1*	21
Headaches	42.4	26.3	57.6*	18.2	52*	13.3	49.5*	10
Nausea	2	0	12.9	0	9.9	0	15.6	15.7
Loss of appetite	13.3	8.8	12.7	0	11.8	0	15.9	15
Sleep disturbances	26.1	14.8	53*	12.5	73.9	52.6	68.5*	44.4
Depressive tendencies	10.2	5.7	14	5.8	36	20	41.7	27.7
Feeling of discomfort	4.4	2.9	26.3	6	41.6	16.6	45*	19
Difficulties in concentration	30.3	40	42.1	18.7	45.8	36.8	53.3*	20
Memory loss	7.5	8	21.8	6.6	43	40	64	36.8
Skin problems	16.6	9.3	24.2	6.6	18.3	0	20.4	5.2
Visual disturbances	16.3	12.5	14.7	12.5	26.6	26.3	36.8	17.6
Hearing disturbances	9.4	5.1	15.4	0	29.8	21.7	43.8	31.5
Dizziness	6.2	5.2	3.2	6.6	15.4	4.5	39.3*	9.5
Movement difficulties	0	2.3	0	0	3.5	4	21.4	10.5
Cardiovascular problems	0	2.3	5.1	0	19.2*	0	36.4	15

for 16 Non Specific Health Symptoms experienced by 530 people (270 men + 260 women) in relation to their distances from cellular phone base stations (≤ 300 m vs. > 300 m [reference group]).
* = $P < 0.05$ for levels of complaints 2 + 3 pooled.

Influence of age on the percentage of complaints

Santini R, Santini P, Danze JM, Le Ruz P, Seigne M. [Investigation on the health of people living near mobile telephone relay stations: I/Incidence according to distance and sex]. *Pathol Biol (Paris)* (2002); 50(6):369-373.

Santini R SP, Le Ruz P, Danze J, Seigne M. Survey Study of People Living in the Vicinity of Cellular Phone Base Stations. *Electromagnetic Biology and Medicine* (2003); 22(1):41-49.

Shebeen El-Kom, Egypt (2003)

Study of 85 inhabitants living near the first cell phone tower in the city (tower operational since 1998).

Abdel-Rassoul G, El-Fateh OA, Salem MA et al. Neurobehavioral effects among inhabitants around mobile phone base stations. Neurotoxicology (2007); 28(2): 434-440.

BACKGROUND: There is a general concern on the possible hazardous health effects of exposure to radiofrequency electromagnetic radiations (RFR) emitted from mobile phone base station antennas on the human nervous system. AIM: To identify the possible neurobehavioral deficits among inhabitants living nearby mobile phone base stations. METHODS: A cross-sectional study was conducted on (85) inhabitants living nearby the first mobile phone station antenna in Menoufiya governorate, Egypt, 37 are living in a building under the station antenna while 48 opposite the station. A control group (80) participants were matched with the exposed for age, sex, occupation and educational level. All participants completed a structured questionnaire containing: personal, educational and medical histories; general and neurological examinations; neurobehavioral test battery (NBTB) [involving tests for visuomotor speed, problem solving, attention and memory]; in addition to Eysenck personality questionnaire (EPQ). RESULTS: The prevalence of neuropsychiatric complaints as headache (23.5%), memory changes (28.2%), dizziness (18.8%), tremors (9.4%), depressive symptoms (21.7%), and sleep disturbance (23.5%) were significantly higher among exposed inhabitants than controls: (10%), (5%), (5%), (0%), (8.8%) and (10%), respectively (P<0.05). The NBTB indicated that the exposed inhabitants exhibited a significantly lower performance than controls in one of the tests of attention and short-term auditory memory [Paced Auditory Serial Addition Test (PASAT)]. Also, the inhabitants opposite the station exhibited a lower performance in the problem solving test (block design) than those under the station. All inhabitants exhibited a better performance in the two tests of visuomotor speed (Digit symbol and Trailmaking B) and one test of attention (Trailmaking A) than controls. The last available measures of RFR emitted from the first mobile phone base station antennas in Menoufiya governorate were less than the allowable standard level. CONCLUSIONS AND RECOMMENDATIONS: Inhabitants living nearby mobile phone base stations are at risk for developing neuropsychiatric problems and some changes in the performance of neurobehavioral functions either by facilitation or inhibition. So, revision of standard guidelines for public exposure to RER from mobile phone base station antennas and using of NBTB for regular assessment and early detection of biological effects among inhabitants around the stations are recommended.

Shebeen El-Kom, Egypt (2003)

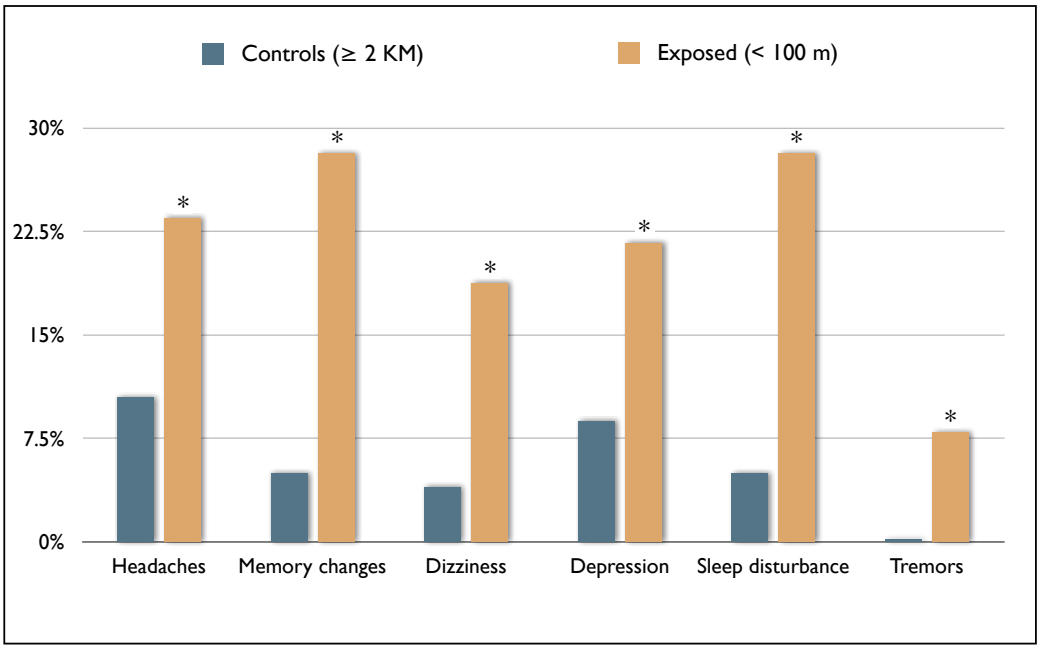
37 subjects lived in the building under the transmitters.

48 others worked in the building across the street.

A control group of 80 individuals worked in a building 2 kilometers away from the towers.

Controls were matched for age, sex, occupation, education level, and mobile phone use.

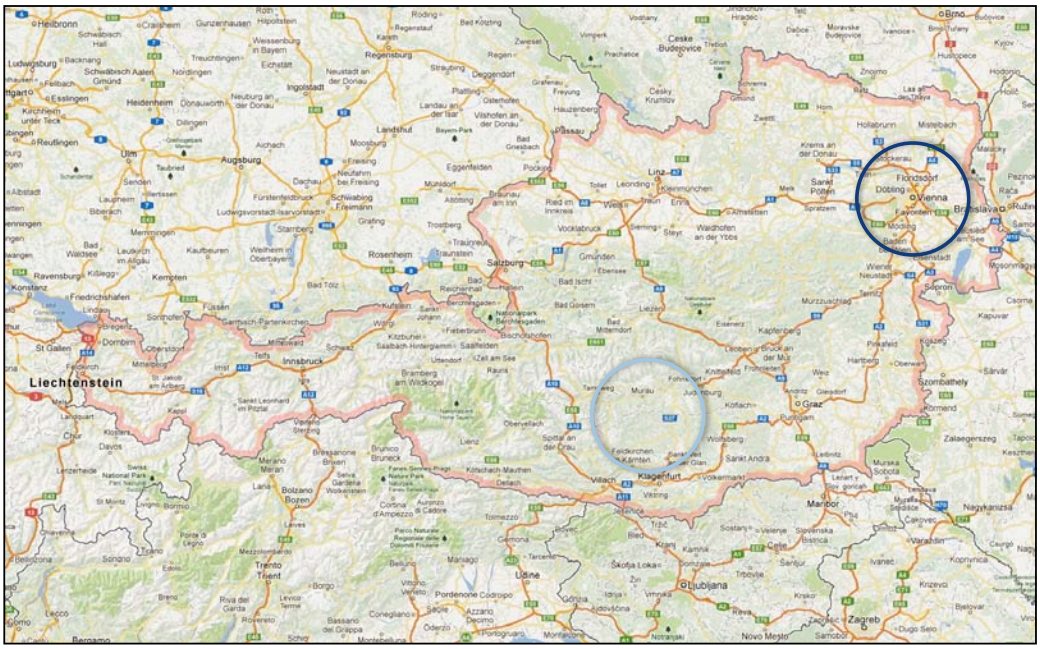
Shebeen El-Kom, Egypt (2003)



* = statistically significant at this sample size ($p < 0.05$ or better)

Abdel-Rassoul G, El-Fateh OA, Salem MA et al. Neurobehavioral effects among inhabitants around mobile phone base stations. Neurotoxicology (2007); 28(2): 434-440.

Vienna and Carinthia, Austria (2004)



Study of health effects around 10 cell phone towers ("base stations") in urban and rural Austria.

Criteria:

Towers operational for >2 years.

No local controversy.

No other towers nearby (when possible).

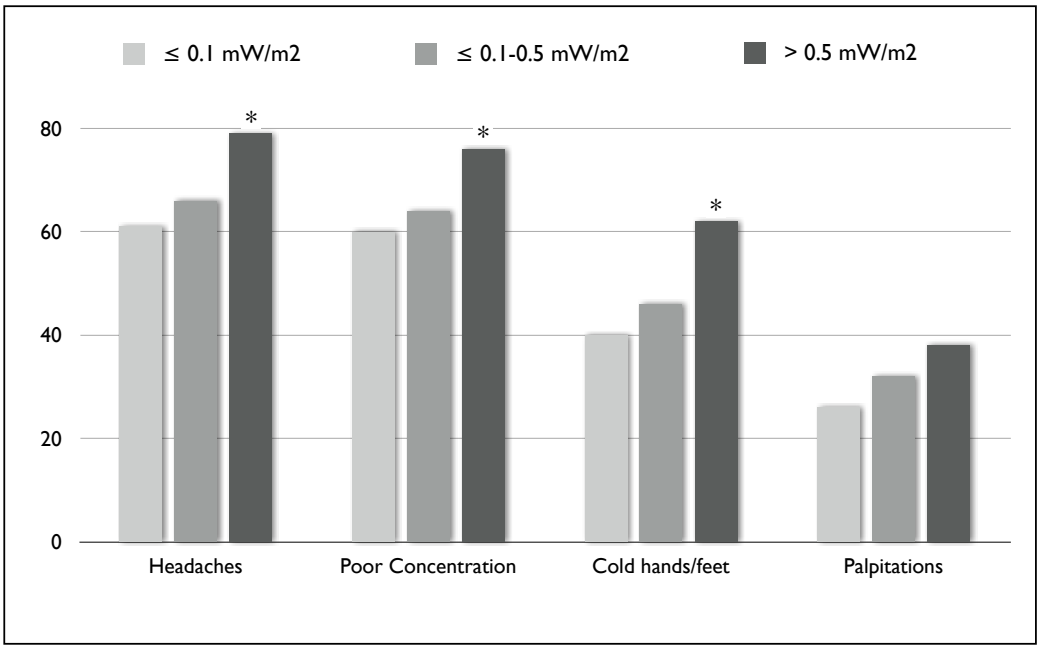
900 MHz transmission.

Random selection of households within the study areas.

Performance tests, symptom questionnaires, exposure measurements in the subject's bedroom.

Hutter HP, Moshammer H, Wallner P, Kundi M. Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations. *Occup Environ Med* (2006); 63(5):307-313.

Austria (2004)



Percentage of subjects reporting symptoms, stratified by RF exposure levels as measured in subject's bedroom.

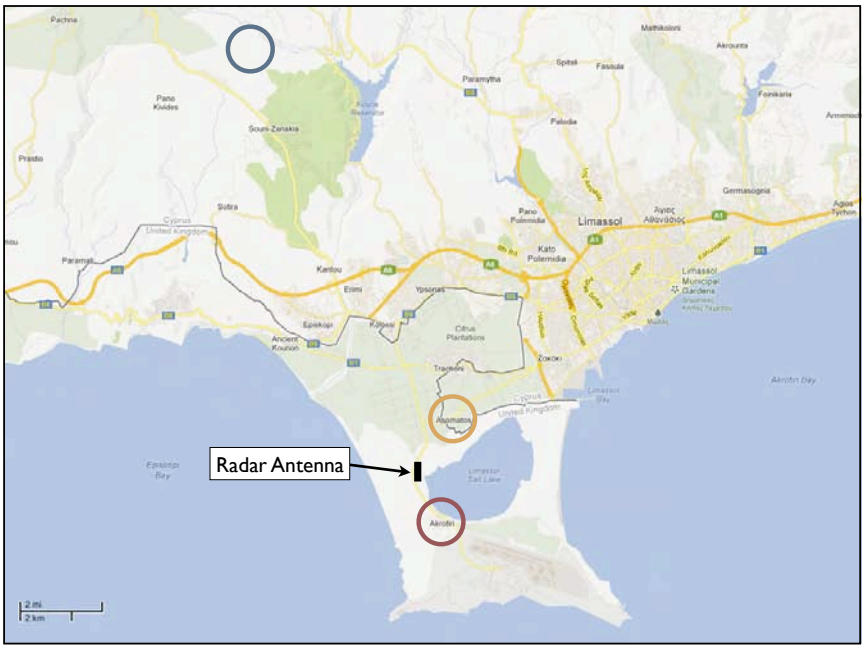
* = statistically significant for this sample size.

FCC Guidelines: 6000 mW/m^2

Hutter HP, Moshammer H, Wallner P, Kundi M. Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations. Occup Environ Med (2006); 63(5):307-313.

BACKGROUND: The erection of mobile telephone base stations in inhabited areas has raised concerns about possible health effects caused by emitted microwaves.
METHODS: In a cross-sectional study of randomly selected inhabitants living in urban and rural areas for more than one year near to 10 selected base stations, 365 subjects were investigated. Several cognitive tests were performed, and wellbeing and sleep quality were assessed. Field strength of high-frequency electromagnetic fields (HF-EMF) was measured in the bedrooms of 336 households.
RESULTS: Total HF-EMF and exposure related to mobile telecommunication were far below recommended levels (max. 4.1 mW/m2). Distance from antennae was 24-600 m in the rural area and 20-250 m in the urban area. Average power density was slightly higher in the rural area (0.05 mW/m2) than in the urban area (0.02 mW/m2). Despite the influence of confounding variables, including fear of adverse effects from exposure to HF-EMF from the base station, there was a significant relation of some symptoms to measured power density; this was highest for headaches. Perceptual speed increased, while accuracy decreased insignificantly with increasing exposure levels. There was no significant effect on sleep quality. CONCLUSION: Despite very low exposure to HF-EMF, effects on wellbeing and performance cannot be ruled out, as shown by recently obtained experimental results; however, mechanisms of action at these low levels are unknown.

Akrotiri, Cyprus (2005)

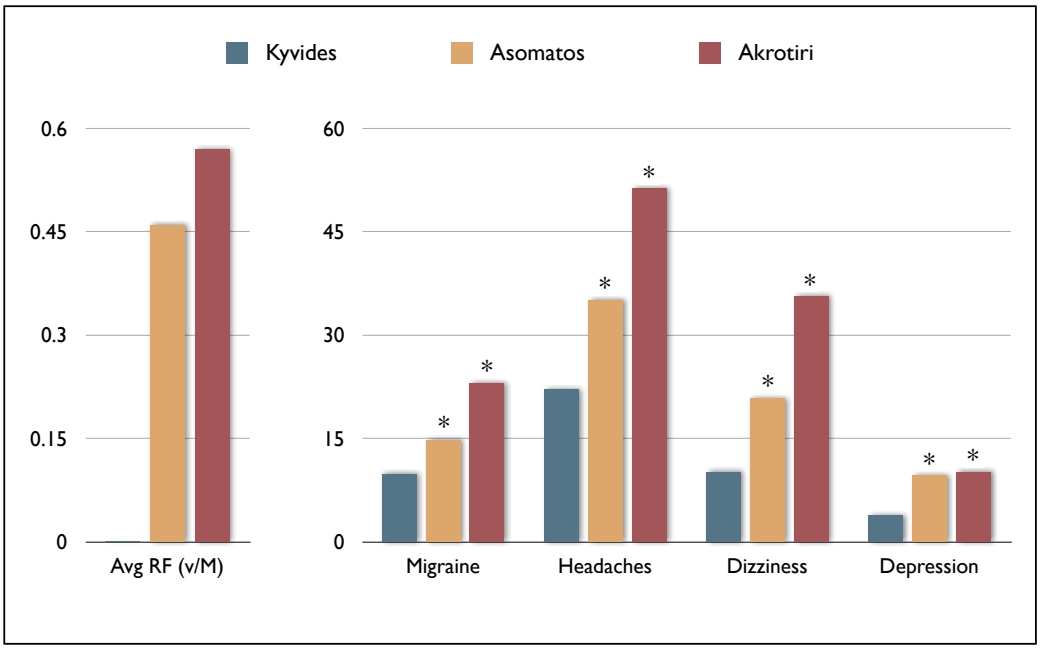


Evaluation of health concerns near a military radar antenna:

Measurement of average RF levels in two nearby communities:
Akrotiri [red circle]
Asomatos [yellow circle]
And as a control, in another village > 20 km distant [blue circle]
Akrotiri also had a cell phone tower.

Preece AW, Georgiou AG, Dunn EJ, Farrow SC. Health response of two communities to military antennae in Cyprus. Occup Environ Med (2007); 64(6):402-408.

Akrotiri, Cyprus (2005)



On left, average RF readings in the three communities (in v/M).

On the right, percentages of four reported symptoms were significantly higher in the towns with higher RF exposures.

Average power densities:
Akrotiri: 0.57 v/m = 0.863 μW/cm²
Asomatos: 0.46 v/m = 0.561 μW/cm²
Pano Kyvides: 0.001 v/m = 0.000001 μW/cm²

FCC Guidelines: 600-1000 μW/cm²

Preece AW, Georgiou AG, Dunn EJ, Farrow SC. Health response of two communities to military antennae in Cyprus. Occup Environ Med (2007); 64(6):402-408.

Selbitz, Bavaria (2009)

General health survey sent to 1080 residents of the village of Selbitz, Bavaria (population 4644), with 251 responses (23% return).

Two cell tower transmitters in the center of town.

Exposure areas determined by concentric circles of 100 to 400 meters radius.

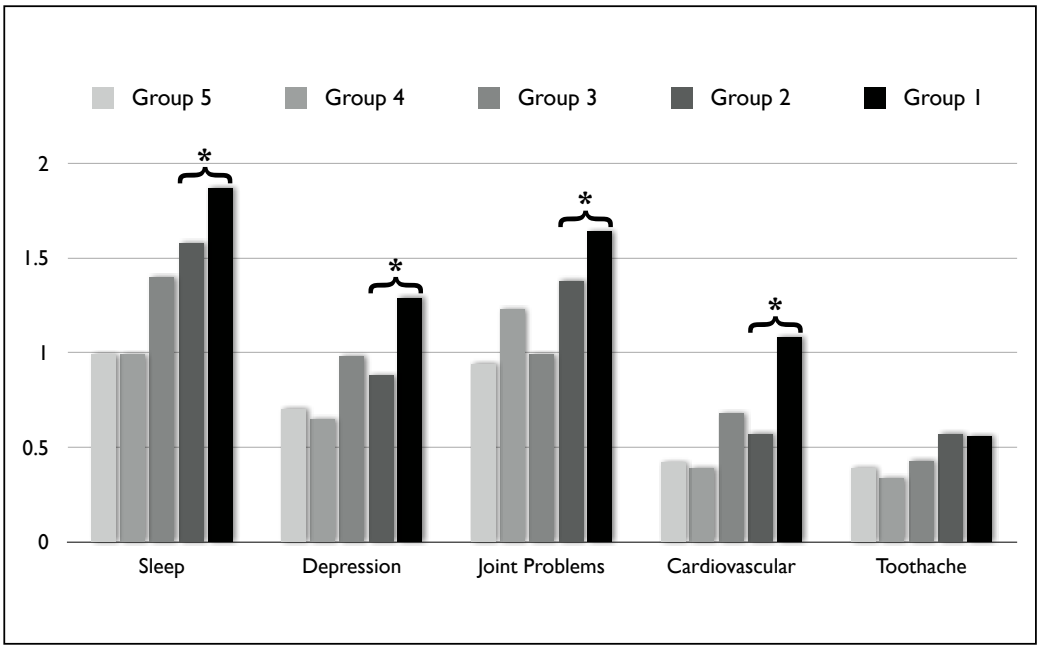
Field measurements stratified exposures into two regions:

Groups 1 and 2 (mean exposure 1.17 V/m)

Groups 3 and 4 (mean exposure 0.70 V/m)

Eger H, Jahn M. Specific Health Symptoms and Cell Phone Radiation in Selbitz (Bavaria, Germany) -- Evidence of a Dose-Response Relationship. *umwelt-medizin-gesellschaft* (2010); 23:1-20.

Selbitz, Bavaria (2009)



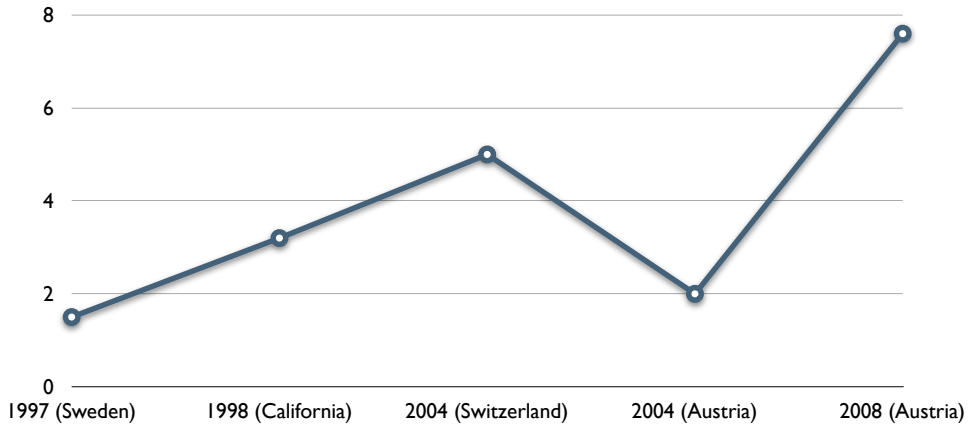
Some sample data from the study. Symptoms scored on 0 – 5 scale.

*** = statistically significant (Groups 1 + 2 compared to Groups 3 + 4).**

14 of 19 symptom categories showed statistically significant elevations in groups 1 and 2 as compared to groups 3 and 4.

Eger H, Jahn M. Specific Health Symptoms and Cell Phone Radiation in Selbitz (Bavaria, Germany) -- Evidence of a Dose-Response Relationship. *umwelt-medizin-gesellschaft* (2010); 23:1-20.

Incidence of self-identified electrohypersensitivity (%)



In the previous studies, we saw that some symptoms are more common with higher exposure to microwave RF transmissions.

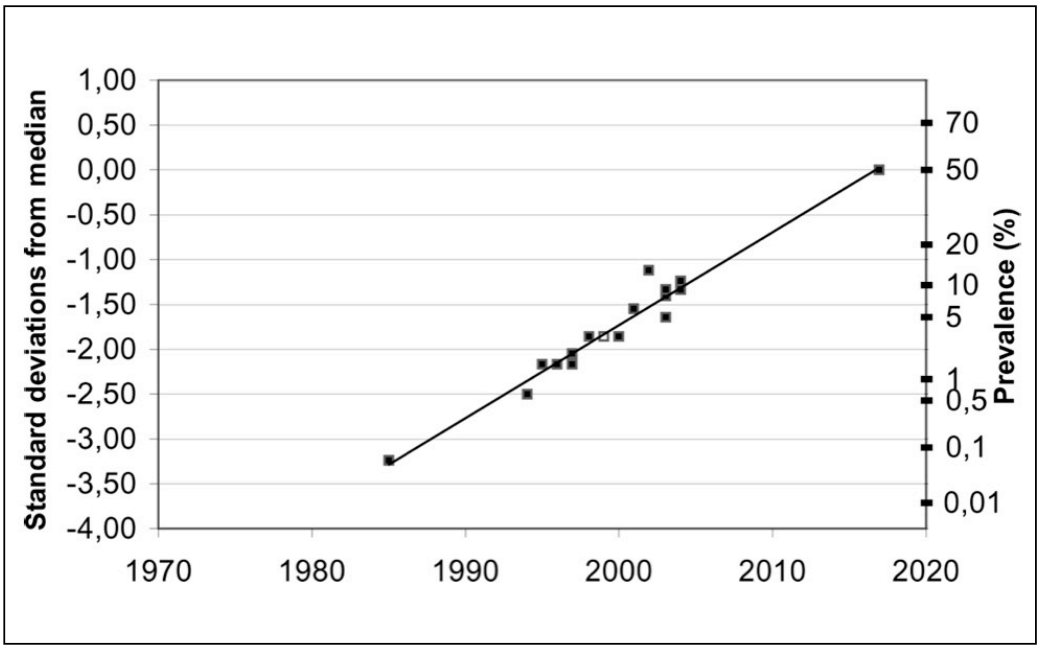
The people who had those symptoms may or may not have been aware that RF was a factor.

But some people with symptoms triggered by microwave RF exposures are aware that this is happening to them.

If these symptoms are sufficiently debilitating, the affected individual may consider themselves to be "electrohypersensitive".

The above graph shows the percentage of the population that self-identified as having "EHS" in surveys done in various countries over the last two decades.

The prevalence of self-reported EHS is increasing.



The prevalence (%) of people around the world who consider themselves to be electrosensitive, as reported in various research studies from 1997 to 2008, plotted over time in a normal distribution graph.

The endpoint at 50% is an extrapolated value.

Hallberg O, Oberfeld G. Letter to the editor: will we all become electrosensitive? Electromagn Biol Med (2006); 25(3): 189-191.

Stockholm County, Sweden, 1997: 1.5% of the population reported being hypersentive to electrical or magnetic fields. (Hillert et al., 2002)

California, 1998: 3.2% of the adult population reported being sensitive to sources of EMF. (Levallois et al., 2002)

Switzerland, 2004: 5% of the population had symptoms attributable to EHS. (Schreier et al., 2006)

Austria, 2004: 2% of the population was estimated to have electrohypersensitivity.

Austria, 2008: 29.3% with some adverse response, 2.1% reported intense disturbance, and 3.5% had experienced enough difficulty that they had consulted a physician about the problem. (Schrottner and Leitgeb, 2008)