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.

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.
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 harassed 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/cm^2 (FCC Guidelines: 600 μW/cm^2).

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

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 μW/cm^2, 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.


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


[link to full study]
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).


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 $0.11 \mu W/cm^2$.

Area B (> 250 meters from tower) = average power density $0.01 \mu W/cm^2$.


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

FCC Guidelines: $600 - 1000 \mu W/cm^2$


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.
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.


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.


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.
* = statistically significant for this sample size.


Irritability

* 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.
* = statistically significant for this sample size.

Headache

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.
* = statistically significant for this sample size.


Sleep Disruption

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.
* = statistically significant for this sample size.


Depression

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.
* = statistically significant for this sample size.


Difficulty in Concentration

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.
* = statistically significant for this sample size.


Comments on Notice of Inquiry, ET Docket No. 13-84
**Visual Disruption**

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.

* = statistically significant for this sample size.


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**Hearing Disruption**

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.

* = statistically significant for this sample size.


Dizziness

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.

* = statistically significant for this sample size.


Comments on Notice of Inquiry, ET Docket No. 13-84

Movement Difficulties

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.

* = statistically significant for this sample size.


Cardiovascular Problems

| 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. |

* = statistically significant for this sample size.


**Elderly people are more vulnerable**

<table>
<thead>
<tr>
<th>Table 3. Influence of age on the percentages of complaints</th>
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<td>Distances of subjects from antennas (in meters)</td>
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<td>Fatigue</td>
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<td>Inability to concentrate</td>
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<td>Nausea</td>
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<td>Depressive tendencies</td>
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<td>Dizziness</td>
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<td>Movement difficulties</td>
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<td>Cardiovascular problems</td>
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</tbody>
</table>

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


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 near mobile phone base stations. METHODS: A cross-sectional study was conducted on (85) inhabitants living nearby the first mobile phone station antenna in Shebeen El-Kom, Menoufiya governorate, Egypt. 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. 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 RFR from mobile phone base station antennas and using of NBTB for regular assessment and early detection of biological effects among inhabitants around the antennas 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)

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.


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/m²


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 antenna 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.
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.


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

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)


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.

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 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.


Stockholm County, Sweden, 1997: 1.5% of the population reported being hypersensitive 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., 2008)

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)