Electromagnetic hypersensitivity - state of the art and the legal situation in Sweden

Martin Tondel, MD, PhD
CONSULTANT
specialist in occupational and environmental medicine

Occupational and Environmental Medicine
Sahlgrenska University Hospital, Gothenburg, Sweden

Public Health Management, Department of Knowledge Based Policy and Guidance, National Board of Health and Welfare, Stockholm, Sweden
• a government agency under the Ministry of Health and Social Affairs

• activities and duties within
  – social services
  – health and medical services
  – environmental health
  – communicable disease prevention
  – control and epidemiology

• the Government determines the policy guidelines for our work
Public Health Management

- Responsibility for health protection and environmental medicine
- Detect, prevent and eliminate health hazards in the environment
- Central authority in the environmental health
- Guidance for municipalities, counties and county councils
- Investigate and revise relevant regulations
- Evaluate the application and effect of law within the sphere of environmental health
Health protection network

Counties
n=21

Municipalities
n=290

National Board of Health and Welfare

OEM at the county councils
n=8
Magnetic fields (µT)

Distance (m)

400 kV: 1200 A
220 kV: 500 A
130 kV: 350 A
70 kV: 350 A
40 kV: 300 A
20 kV: 300 A

reference value 100 µT
Magnetic fields 1 m above ground in central Gothenburg
Green <0.2 µT, yellow >0.2 µT, red >1 µT

<table>
<thead>
<tr>
<th>ELF</th>
<th>0.1 m (µT)</th>
<th>0.5 m (µT)</th>
<th>1.0 m (µT)</th>
<th>Freq (Hz)</th>
<th>Ref value* (µT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum cleaner 1600 W</td>
<td>6</td>
<td>0.3</td>
<td>&lt;0.05</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Hairdryer</td>
<td>30</td>
<td>0.5</td>
<td>&lt;0.05</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Alarm clock</td>
<td>2.1</td>
<td>0.14</td>
<td>0.08</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Microwave oven 700 W</td>
<td>14</td>
<td>1.5</td>
<td>0.30</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Flat computer screen 19 inch</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>TV, not flat screen</td>
<td>0.8</td>
<td>0.1</td>
<td>&lt;0.05</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Electrical stove</td>
<td>0.8</td>
<td>0.1</td>
<td>&lt;0.05</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Induction oven†</td>
<td>1.2</td>
<td>0.07</td>
<td>&lt;0.05</td>
<td>25,000</td>
<td>0.25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Freq (Hz)</th>
<th>Typical exposure (µT)</th>
<th>Ref value** (µT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine driver train</td>
<td>16.7</td>
<td>10</td>
<td>1,500</td>
</tr>
<tr>
<td>Relay interlocking plant 400 kV</td>
<td>50</td>
<td>10-40</td>
<td>500</td>
</tr>
<tr>
<td>Welding</td>
<td>50</td>
<td>1-300</td>
<td>500</td>
</tr>
<tr>
<td>Officework</td>
<td>50</td>
<td>0.2</td>
<td>500</td>
</tr>
</tbody>
</table>

† Also magnetic fields 50 Hz similar values at electric oven
* public
**occupation

Magnetfält och hälsorisker 2009
More base stations = Lower output = Lower exposure!

talking in mobile phone 1,000 > than the mobile base station

2 m distance from person talking in mobile phone 200 > than the mobile phone base station
Mobile base station

Reference value UMTS (3G)

Reference value GSM 900

Power density (W/m²)

Distance (m)
# Average power density 48 places in Gothenburg area

<table>
<thead>
<tr>
<th>Source</th>
<th>Frequency (MHz)</th>
<th>Power density (mW/m²)</th>
<th>Reference values</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM radio</td>
<td>100</td>
<td>0.28</td>
<td>2 000</td>
</tr>
<tr>
<td>Analogue TV</td>
<td>600</td>
<td>0.06</td>
<td>3 000</td>
</tr>
<tr>
<td>Digital TV</td>
<td>700</td>
<td>0.02</td>
<td>3 500</td>
</tr>
<tr>
<td>NMT base stations</td>
<td>450</td>
<td>0.0005</td>
<td>2 250</td>
</tr>
<tr>
<td>GSM900 base stations</td>
<td>900</td>
<td>0.14</td>
<td>4 500</td>
</tr>
<tr>
<td>GSM1800 base stations</td>
<td>1800</td>
<td>0.04</td>
<td>9 500</td>
</tr>
<tr>
<td>3 G base stations</td>
<td>1 900</td>
<td>0.04</td>
<td>9 500</td>
</tr>
<tr>
<td>Others</td>
<td>--</td>
<td>0.002</td>
<td>--</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>--</strong></td>
<td><strong>0.57</strong></td>
<td><strong>0.02</strong></td>
</tr>
</tbody>
</table>

RF from the sun and sky 3 μW/m²

Terminology

Sensitivity to electricity

Electromagnetic hypersensitivity (EHS)

Allergy to electricity

Idiopathic Environmental Intolerance attributed to exposure to electromagnetic field
Electromagnetic hypersensitivity (EHS)

- symptoms near or when using electrical equipment
- giving varying degrees of discomfort or illness of the individual
- and the individual relates to the activation of the electrical equipment

(Ergqvist RALF 2000)

EHS is not a diagnosis in Swedish healthcare
EHS is characterized by a variety of non-specific symptoms, which afflicted individuals attribute to exposure to EMF.

dermatological symptoms
• redness, tingling, and burning sensations

neurasthenic and vegetative symptoms
• fatigue, tiredness, concentration difficulties, dizziness, nausea, heart palpitation, and digestive disturbances

not part of any recognized syndrome.
DISEASES
- hypertension
- cancer in situ genetic carrier e.g. Huntington

ILLNESSES
- fracture
- anaemia
- cancer

WELL & HEALTHY
- multiple chemical sensitivity
- electromagnetic hypersensitivity
- sick building syndrome
Sensitivity to electricity

- 1.5% Stockholm county  
  - Hillert L, 2002
- 1.9% Skåne county  
  - Carlsson F, 2005
- 8-10% Germany  
  - Infas 2002-2006
- 3.2% California  
  - Levallois, 2002
- 4% England  
  - Eltiti, 2007
- 5% Switzerland  
  - Schreier, 2006
hat impact on your health, do you believe electromagnetic fields from e.g. electrical appliances, power lines have?

egative impact:

HR 2001 3,1 % (200,000 adults in Sweden)
women 50-59 years 4,9%
Environmental Health Report 2009

Percentage of people ≥1 time/week

<table>
<thead>
<tr>
<th>Condition</th>
<th>EHS</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat/burning sensation in the skin</td>
<td>27 %</td>
<td>2.0 %</td>
</tr>
<tr>
<td>Itching, burning eyes</td>
<td>22</td>
<td>7.5</td>
</tr>
<tr>
<td>Fatigue</td>
<td>52</td>
<td>34</td>
</tr>
<tr>
<td>Headache</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>Nausea, dizziness</td>
<td>8.7</td>
<td>3.4</td>
</tr>
<tr>
<td>Difficulties to concentrate</td>
<td>25</td>
<td>5.9</td>
</tr>
</tbody>
</table>
EHS - provocation studies

Rubin GJ et al - review
(Pychosom Med 2005, Bioelectromagnetics 2010)

- 46 studies involve 1,175 volunteers
- little evidence suggest that individuals with EHS can detect EMF
- many studies have found evidence that a nocebo effect can explain acute symptoms
- research needs to clarify chronic exposures and test new varieties of electromagnetic emissions
- best evidence suggests that EHS should not be viewed as a bioelectromagnetic phenomenon
Hypothesis to EHS

Electrical or magnetic fields
  – via serotonin/melatonin effects, free radicals

Increased excitability of nervous system

Psychological mechanisms
  – Stress/conditioning
  – Attribution
  – Somatization
  – Nocebo

Light flickering

Chemical influences
  – e.g. phenols, flame retardants, mercury from amalgam

"Multi-factorial"
No support for the hypothesis that people with electrical hypersensitivity have an increased sensitivity to EMF and RF

No scientific support for the relationship between RF and acute symptoms or objective measurable physiological responses

FAS 2008
FAS 2009
SCENIHR 2009
SSM 2009:36
Future research

• provocation studies probably does not lead to any new findings

• nocebo-effect has been emphasized in several recent studies and reviews

• functional brain imaging promising to study placebo- and nocebo-mechanisms
General guidelines on the reception of patients with regard to their problems with amalgam and electricity SOSFS 1998:3

Medical professionals:

- listen, take the patient seriously and foster trust
- give time to the patients to describe his/her various symptoms
- understand that problems and symptoms are real and not imagined
- respect the patient's explanation
- right to an all-round medical examination
General guidelines on the reception of patients with regard to their problems with amalgam and electricity SOSFS 1998:3

Medical history
symptoms in details
previous and current diseases
medication
social situation incl occupation, work conditions, family situation, tobacco/alcohol consumption

Physical examination

Laboratory tests
blood status, ESR
serum iron
B12/folic acid
electrolytes including calcium
S-creatnine
liver tests
S-glucose
thyroid tests
urine status
Borrelia, viral serology

Differential diagnoses
skin diseases such as atopic eczema, rosacea and other exanthema
allergies, asthma, bronchial hyperactivity
anaemia
malabsorption
endocrine or metabolic illness
neurologic diseases
infection
collagenosis
malignancy
mental disturbance such as depression, anxiety etc.
somatoform syndrome
other environment-related symptom
Treatment and actions

adapted to the conditions in each case

experience with successful drug therapy is limited

cognitive behavioral therapy can be positive if the patient is motivated

none established effects by reducing EMF exposure

long-term sick leave should be avoided
Sensitivity to electricity

- primary care important

- knowledgeable and interested physicians early in the disease process

- professional and dignified treatment

- unbiased assessment important
Prognosis

Good, if appropriate action:
- early in the course of the disease
- in mild cases with only skin symptoms

Worse, for long-standing cases with multiple symptoms
No list of disability or impairments (no “authorized disabilities”)

Financial support to NGOs with disability issues on the programs e.g. the Swedish Association for the Electro Sensitive

Social and medical support based on the appraisal of that person’s ability or hindrance and not on specified diagnoses
• Building and operation of mobile base stations are not licensed under the Swedish Environmental Code

• People's concerns can not alone be the basis for actions against the establishment of mobile base stations with the support of the Environmental Code

• The precautionary principle is therefore not applicable to mobile base stations
Medical effects of EMF

• High exposures to low frequency fields induces currents in the body that can cause:
  – nerve stimulation 10-100 mV/m
  – painful sparks 0.6-1.5 kV/m
  – magnetophosphenes 5-15 mT (50 Hz)

• High exposures to RF fields induce heat in the body and can cause internal burns. Catarract appears at 100 W/kg.
International Agency for Research on Cancer (IARC)

Group 1: carcinogenic to humans (α-, β-, γ-radiation)

Group 2a: probably carcinogenic to humans (UV-light)
Group 2b: possibly carcinogenic to humans (ELF)

Group 3: not classifiable as to its carcinogenicity to humans (static electric fields)

Group 4: probably not carcinogenic to humans
WHO ELF (0-100 Hz)

- Childhood leukaemia - possibly carcinogen
- Other childhood cancer - evidence inadequate
- Breast cancer - weak association
- Reproductive/developmental disorders – inadequate
- Cardiovascular disease - not shown association
- Neurodegenerative disorders - PD, MS no evidence, ALS, AD inadequate
- Cognitive system - less clear
- Electromagnetic hypersensitivity - unrelated

EHC 2007:238
Occupational exposure to ELF

Alzheimer’s disease  Amyotrophic lateral sclerosis

Kheifets, OEM 2009
Alzheimer’s disease

Duration of living at the identical place of residence:

<table>
<thead>
<tr>
<th>Duration</th>
<th>380 kV</th>
<th>220 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any duration</td>
<td>50-80 m</td>
<td>40-55 m</td>
</tr>
<tr>
<td>&gt; 5 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 10 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 15 years</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Distance to nearest 220/380 kV power line

* adjusted for sex, educational level, occupational attainment, urban-rural area, civil status, language region, number of apartments per building, and living within 50 m of a major road.

Huss et al., AJE, 2009
RF (100 kHz - 300 GHz)

- Animal studies carcinogenicity - no consistent results
- In vitro, ROS, genotoxicity, apoptosis, gene expression, immunology, enzyme activity – no effects
- Great uncertainty about biomarkers (S100B, TTR)
- Epidemiological, animal and cell studies - unlikely RF causes cancer
- Brain tumours: more epidemiological studies with better methods and longer follow-up time for safer conclusions, mobile use < than latency
- BBB damage of cellphones – not confirmed
- Cognitive effects, EEG changes, few studies – unclear significance
- Functional imaging (PET, NIRS) – conflicting results
- HRV, HT in a few studies of mobile phones and/or base stations
- No scientific support for RF exposure and self-reported symptoms, repeated studies are required due to contradictory results
- No reproductive disturbance or abnormality in animals or humans
- The effect on sperm quality – no basis for assessment

NO REASON TO CHANGE GUIDE LINES
Brain tumour incidence in Sweden 1960-2007

<table>
<thead>
<tr>
<th>Introduced in market</th>
<th>Mobile telephone generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>NMT 450, NMT 900</td>
</tr>
<tr>
<td>1992</td>
<td>GSM 900, GSM 1800</td>
</tr>
<tr>
<td>2000</td>
<td>UMTS 3G</td>
</tr>
</tbody>
</table>
Health effects of RF not demonstrated at this point
But there are indications that there might be a risk

... if there is a risk, it is likely to be greater for exposures in childhood and adolescents ...

Why would the risk be larger?

• Children who start using phones will have many years of use
• Much greater quantity of use compare to previous generations
• SAR tend to be higher in children’s brain tissue
• Child brain tissue more sensitive?
Links to documents

FAS årsrapporter www.fas.se

SSM vetenskapliga råd årsrapporter www.ssm.se

WHO’s faktablad 322, 304, 296, 299 och 193 om elektromagnetiska fält och folkhälsa http://www.who.int/en/

EU-kommissionens vetenskapliga kommitté SCENIHR 2009

IARC vol 80 om ELF http://monographs.iarc.fr/ENG/Monographs/vol80/volume80.pdf

ICNIRP guidelines 1998 http://www.icnirp.de/


