

**WHO workshop on Electrical Hypersensitivity  
Prague, Czech Republic  
October 25-27, 2004**

**RAPPORTEUR'S REPORT**

**Rapporteur:** Kjell Hansson Mild, National Institute for Working Life, Umeå, Sweden

The WHO workshop on "Electrical hypersensitivity" in Prague, Oct 25-26, 2004, was well-attended with over 150 participants from 25 countries. There were a total of 18 invited talks, and for the free communications over 40 abstracts were submitted, of which 14 were presented in short oral presentations and 15 as posters. This report briefly summarizes the talks given by the invited speakers and the key points of discussion. Speakers slide presentations can be found on the meeting website.

After the opening of the meeting with an address from the Ministry of Health in the Czech Republic, read by Professor Ludek Pekárek, the WHO EMF Project's coordinator **Mike Repacholi** welcomed the participants to the meeting. He stressed that the objectives of this meeting were to identify what is known about electrical hypersensitivity, to review the scientific data on EHS and its possible connection to EMF, to discuss what further studies are needed to fill gaps in knowledge, and to determine what can be done to assist EHS sufferers.

The first presentation at the meeting was a tutorial by Dr **Berndt Stenberg** of the Northern University Hospital in Umeå, Sweden. Dr Stenberg is an occupational dermatologist who has been working since 1985 with patients seeking medical care for skin symptoms associated with visual display terminals (VDT) work. He has seen over 350 patients and gave an overview of the historical development of EHS and his experience on prognosis for different patient groups.

Dr Stenberg quoted a definition of EHS which originated in an EU-sponsored report (Bergqvist et al., 1997) as: "a phenomenon where individuals experience adverse health effects while using or being in the vicinity of devices emanating electric, magnetic or electromagnetic fields (EMFs)". This definition was subsequently mentioned by many of the speakers during the meeting.

Dr Stenberg stressed the importance of making a distinction between two groups of patients: those who experience facial skin symptoms in connection with work near a VDT, and those who, besides skin symptoms, also had general nervous system response when exposed to EMF from different electrical appliances, here called EHS. The first group has typically sensory sensation as stinging, itching, burning erythema, eczema, rosacea, while most of the EHS group has these symptoms, as well as fatigue, headaches, sleeplessness, dizziness, cardiac and cognitive symptoms.

The prognosis for the first group is generally good, they improve over time and most can still work. The EHS group with more general symptom have much in common with other environmental illnesses such as dental filling problems and Multiple Chemical Sensitivity (MCS). This group consists of slightly older individuals, with lower income, mainly women, many with different ethnic backgrounds. There are also factors in this group, such as atopic illness, different self-image, different coping strategies, proneness to anxiety, having been

through more traumatic life events than most people. The prognosis for this group is not as favourable as the other, and they do not generally recover as well as the first group. Dr Stenberg underlined the need for early and consistent management of both groups because of the nature and extent of the problem.

Dr **Herman Staudenmayer**, Denver, USA, presented a tutorial on Idiopathic Environmental Intolerance (IEI), and reflected on how toxicogenic and psychogenic theories could be applied to the EHS issue. At a WHO meeting in 1996 in Berlin IEI was defined as:

- An acquired disorder with multiple recurrent symptoms.
- Associated with diverse environmental factors tolerated by the majority of people.
- Not explained by any known psychiatric or psychological disorder.

He applied the Bradford Hill criteria of causality to EHS and added “reversibility” to the criteria. In none of these criteria did he find a connection to the toxicology theory, but rather to the psychogenic theory.

During discussion Dr Staudenmayer argued that the name EHS should be changed to IEI. This was supported by a number of people, making the point that the term EHS is misleading both in implying a causal relationship to EMF and because the term “hyper” has no medical support. Dr Staudenmayer suggested the use of IEI but with an addition of “EMF attributed” in analogy with the MCS issue.

Dr **Patrick Levallois**, Quebec, Canada, gave an overview of studies investigating the prevalence of EHS in the general population. The prevalence was found to vary between countries and was dependent on what definition of EHS was used and how the questions were phrased; underscoring differences in cultural background. He estimated that 1-3 % of the general population report a wide range of complaints that they attribute to EMF. The prevalence reported was higher for some subgroups (low income, ethnic minorities, and sometimes women). He stated that the link with the so-called «multiple chemical sensitivity» needs to be clarified.

Dr **Kjell Hansson Mild**, National Institute for Working Life, Umeå, Sweden, gave an overview of the different EMF sources that are encountered in everyday life. He argued that EMF cover a wide range of frequencies, encompassing fields from static up to hundreds of GHz. Thus it is more informative to quote the frequency range of the field exposure. He also made it clear that no study had shown that EHS people lived in an unusual EMF environment.

Professor **Jan Bures**, Prague, presented a quantitative characterization of the neural network of the human brain. He indicated that “at any moment about 1 % of the neurons were active and generated each one second period  $10^9$  action potentials which exposed the brain to a deluge of randomly distributed pico- and microampere currents. This inherent electrical noise with amplitude in the range of 10-100 microvolts and field intensities of about 1 V/m but does not interfere with the highest cognitive and executive functions of our brain.”

Dr **Eugene Lyskov**, Umeå, Sweden, reported on a set of neurophysiological studies on EHS patients. The group with skin rashes all complained about problems with VDT, fluorescent lights and TV. All these sources had flickering light, which was thus used to test the patients. It was found these patients had a higher critical flicker frequency (CFF) than normal, their visual evoked potential (VEP) was significantly higher than in controls, but their electroretinogram was normal. In follow-up studies with EHS patients, similar findings were

recorded: patients had increased CFF, increased VEP, increased heart rate, decreased heart rate variability (HRV) and increased electrodermal (EDA) reaction to sound stimuli. When a provocation with 60 Hz, 10  $\mu$ T magnetic field was conducted, no effect was seen in any of the physiological parameters, and they were the same for both the EHS group and controls. In a study with a 24 h ECG recording in a group of 20 EHS patients, a night time decrease in the ratio of the low frequency/high frequency components of the heart rate variability indicated an autonomic imbalance and lack of normal circadian rhythms in these patients.

In the subsequent discussion it was noted that the increased EDA could be a psychogenic response. It was also mentioned that these findings of a hyper reactivity in the central nervous system and in an imbalance in the autonomic nervous system were known as *vasoregulatory asthenia* or *neurocirculatory asthenia*. In the 50's and 60's many patients complained of the same symptoms as we now have in the EHS groups, but today no one is coming to the clinical physiology departments with these symptoms. Is EHS just another name for *neurocirculatory asthenia*?

Dr **Olle Johansson**, Karolinska Institute, Stockholm, Sweden, provided information on Swedish patients seeking medical care for skin symptoms and VDT work. He noted that the Swedish Association for the ElectroSensitive has been officially recognized as a handicap organization since 1993 and receives financial support from the government for its activities.

Dr Johansson has been studying skin biopsies from persons with the impairment electrohypersensitivity and reported that, in their skin, certain nerve fibres are scarce and short, and this might, in some way, lead to each nerve terminal having to work more and thus become supersensitive. He also found an increased number of mast cells in facial skin samples from persons with electrohypersensitivity. In addition to this, he also summarized a large number of other observations, both in persons with electrohypersensitivity as well as in normal healthy volunteers subjected to for instance VDTs and mobile phones.

Besides the invited speakers, other scientists were given the opportunity to present their work through short presentations. A particularly interesting presentation came from Dr **Ulrich Frick**, Germany, who reported on his study of EHS patients using transcranial magnetic stimulation. A survey was performed in the general population to characterize complaints in connection with EMF. From this survey two groups were selected according to the severity of their complaints. These groups were invited together with a group of EHS patients to participate in a laboratory study involving responses to single and double pulses of transcranial magnetic stimulation. No significant differences were found between the three groups in their threshold for detecting the real magnetic stimulus or in their motor response. The three did differ in their ability to distinguish between real and sham exposure, with the EHS group having the lowest ability to differentiate.

Another difference was noted when the response to a double pulse was measured as a voltage in the hand. The EHS group had a significantly lower cortical excitability to the second pulse when the interval between the pulses was 15 ms, whereas no differences between the three groups were seen at 2 or 6 ms intervals. These results are clearly of interest, showing a different neurophysiological response in the EHS group, and confirmation of this study is warranted.

Dr **Jörg Schröttner**, Graz, Austria, presented an investigation of electric current perception threshold in a large number of people, drawn from the general population and from a group

reporting electrical hypersensitivity. A total of 708 males and females with a wide age distribution (16-60 years) were studied. Data showed that EHS people differ significantly from the general population with a lower perception threshold value. This study adds to those showing hyper reactivity in the CNS of EHS individuals.

Professor **Anders Ahlbom**, Karolinska Institute, Stockholm, Sweden, gave an overview of the epidemiological studies on symptoms and EMF exposures. He noted very few such studies had been published; 2 on base stations and 3 on handheld phones. These were of poor quality and inconclusive as to any connection between symptoms and RF exposure. Of the experimental studies he noted the so-called TNO study as a good example, but which needed to be confirmed. Also it was noted that, in the TNO study, the exposure consisted of four sessions without ample washout time in between. Dr Ahlbom concluded that more provocation studies on EHS patients should be considered instead of epidemiological studies since there is a lack of clear inclusion and exclusion criteria or knowledge of what characteristic of exposure was appropriate.

Dr **Christopher Mueller**, Zurich, Switzerland, presented results of the NEMESIS project. This study consists of two parts, one field study and one laboratory study. In the field study, EHS people were exposed to 80-160 V/m and 2-6  $\mu$ T, 50 Hz fields for 4 h during sleep in their homes. In the field study subjective sleep parameters such as sleep quality and emotional states as well as objective parameters such as movements, heart rate and breathing frequency were measured. The study comprised 54 subjects with mean age 47 years, span 17-76 year, 21 males, 33 females.

It was found that the exposure affected the subjective parameters (soundness of sleep, well being in the morning)  $P=0.04$ , but sleep quality was not affected. An effect was also seen on shifting their position on the bed to the non-exposed site.

In the laboratory study, the EMF perception of an EHS and a control group was tested to 100 V/m, 4  $\mu$ T, on-off fields. In the laboratory study 49 EHS subjects and 14 controls took part. Seven of these 63 subjects reached statistical significant results in detection of fields on and off situations. No differences between EHS and controls were seen here. The conclusions from the whole project were:

- Electrosensitivity (ES) can be measured (persons with increased sensitivity to electric currents, not to be confused with EHS)
- ES is not individually stable over time.
- ES is not a prerequisite for perception of EMF.

Professor **Eduard David**, University Witten-Herdecke, Germany, conducted provocation studies starting with a questionnaire study performed during 1988-2004 and selected a group of EHS patients for testing with 50 Hz, 10  $\mu$ T, 2 min on-off. More than 50 EHS people participated and were compared to healthy controls. No specific medical symptoms were found or any psychological abnormalities. There was no difference between the control and EHS group regarding correct determination whether the ELF field was on or off.

Professor **Lawrie Challis**, UK, is the chairman of the UK's mobile telephony and health research programme (MTHR). This programme has funded 29 research projects out of 150 proposals. Among those funded are 10 provocations studies of which four are with people experiencing symptoms from mobile phone use and one is on symptoms in connection with

base stations. The latter will also include a partial replication of the so-called "TNO study". The exposure in the mobile phone studies will be with a standard phone modified to provide use either pulsed or CW RF fields, or sham; all with the same phone heating.

Professor **Norbert Leitgeb**, Graz, Austria, present chairman of the COST281, gave an overview of European planned and ongoing research on EHS. He noted that the EHS issue has a high public awareness, and that there are regional differences as to the attribution of EHS to EMF; in Northern Europe mostly indoor sources are of concern whereas in the southern European countries the focus is on outdoor sources.

Leitgeb reported results from a survey he conducted among physicians. About 96 % of participating physicians believed that EMF can cause illness. He also reported on his own studies on electric current perception and sleep problems. Measured perception threshold among a large group of subjects was found to be generally lower than previously found. The level where 0.5 % of the population could perceive the current was almost ten times lower than previously found. Overall there is a large spread in the values of perception threshold, some 2 orders of magnitude.

He also found that exposure to ELF magnetic fields before testing the perception threshold led to a temporary lowering of the threshold. This is a new finding that needs to be followed up in other laboratories.

Dr **Bruce Hocking**, Australia, a specialist in occupational medicine, has been working with patients claiming EHS for many years. He described his experience by giving examples to illustrate the diversity of cases. He also discussed the great difficulties in doing provocation studies since there are so many unknowns such as of the characteristics of EMF to use, exposure time, washout time, and blinding conditions. There is no "gold standard" for EMF sensitivity testing. He urged that peripheral nerve mechanisms as well as CNS mechanisms should be considered when studying EMF sensitivity.

Dr **Robin Cox**, UK, an occupational physician, presented an overview on human EMF studies in the UK. However, only two of the studies were directly related to the topic EHS and these two involved physiological investigations of people perceiving sensitivity to EMF. The researchers have in general found it difficult to recruit cases because of the patients' reluctance to subject themselves to EMF exposures that might produce unpleasant symptoms.

One of the studies was from King's College, London (Professor Wessely) and was a double blind provocation study with handheld mobile phone. The outcome studied was self-reported symptoms and levels of neuroendocrine hormones. The plan was to test 60 cases and 60 controls, and so far only 33 people have been tested, and therefore no results could be presented.

The other study conducted at the University College London hospital (Professor L. Luxon) was on the effect of mobile phone stimulation on labyrinthine function. So far the study included 51 subjects (25 cases and 26 controls) 18-55 years of age, however, 11 had declined to participate. The cases were not considering themselves generally EHS but experienced symptom with the use of a mobile phone. The majority described the headache they got in connection with the use of the phone as different from anything else they had experienced. The analysis of the study is still ongoing.

Dr **Lena Hillert** from the Karolinska Institutet, Stockholm, Sweden, discussed her experience with cognitive behavioural therapy (CBT) for EHS patients. Her EHS group is very heterogeneous in both complaints and reported triggering factors. The patients diagnosed themselves as EHS patients.

Since provocation studies have failed to provide support for a causal relationship between exposure to EMF and complaints, psychophysiological reactions (possibly in combination with environmental stresses) have been proposed as an alternative explanation. Therefore psychological methods, such as CBT were introduced. CBT is based on the way people structure their experiences (based on core beliefs and basic assumptions), which influence the way in which they think, feel, and behave. This method *"teaches patients to identify, evaluate, and respond to dysfunctional thoughts and beliefs"*.

This may be one way to control or reduce complaints. CBT has been shown to improve the well being of patients with asthma and cancer pain. This therapy is tailored to each participant and requires teamwork between the patient and the therapist.

So far three studies have been completed in Sweden with CBT. The average age of the patients was 42 years. The results varied, but the conclusion was that CBT may be of benefit for some patients reporting EHS but not for all.

Dr **Emilie van Deventer**, WHO, Geneva, discussed the various responses to the EHS issue being undertaken by governments. In a survey sent to over 50 Departments of Health in different countries only 13 answered, and most reported no activity for EHS. The WHO has EHS as one priority area in the research agenda and has encouraged its member states to fund research to identify if there is a relationship between EMF and EHS.

Dr **Jill Meara** Deputy Director of the NRPB, UK, was invited to discuss possible policy options for dealing with EHS individuals. One of the overarching issues was that EHS lacks a clear definition. Also there is a lack of understanding of what is included in the use of the word EMF, low or high frequency, electric or magnetic fields, chronic or intermittent exposure, etc. Looking at the overall evidence it is clear that there is no support or need for an intense electrical sanitation of the home and workplaces of EHS patients. A lowering of exposure levels of EMF in general could be proposed as a precautionary approach, especially for afflicted persons, but this was not seen as a remedy for a person's symptoms. As for treatment, since EHS has symptoms similar to other environmental illnesses, clinicians would normally adopt largely psychologically based managements strategies.

## **POSTERS**

Some of the poster presenters were given an opportunity to give a short oral summary of their posters.

Dr **Yoshikaza Ygawa** from the Graduate School of Medicine, The University of Tokyo, presented a research plan for a study on susceptibility to non-thermal levels of RF from base stations and handheld phones among subjects with and without complaints. Exposure to CW and intermittent RF exposure as well as noise exposure will be used. The parameters include a neuropsychiatric interview, Big Five Personality Test, and physiological functions such as peripheral circulation and skin temperature. In 2004 a pilot study will be completed, the base station study is scheduled for 2005 and the hand held phone study for 2006.

Dr **Martin Rösli**, Switzerland, presented results from a Swiss survey on concerns and health complaints attributed to EMF. It was found that half of the Swiss population was concerned about health effects from EMF exposure. The proportion of EHS individuals was estimated to be 5 %, but they do not attribute symptoms primarily to base station exposure but to power lines and handhold phones, TV and computers mainly.

Dr **Elaine Fox**, University of Essex, UK, is one of the contractors in the UK MTHR programme. She is leading a two-phase study on EHS. The first phase is the development of an EHS questionnaire, and the second is a provocation study with 132 cases and controls, and exposing to GSM 900, and 1800, and 3G signals. The questionnaire has been sent out to 20 000 people randomly selected in East Anglia, and 3 600 responded (18 %). Of these, 399 (11%) reported some sensitivity to EMF. Analysis of the result is ongoing and phase 2 is about to begin.

Professor **Osmo Hänninen**, Kuopio, Finland, has tried to develop a method for studying physiological responses in EHS patients. By using recordings of circulatory parameters controlled by the autonomic nervous system the results so far suggest that it may be possible to use this in the evaluation of subjects reporting EHS. He has been testing subjects with a handhold phone near the head and measured heart rate and blood pressure. Included in the provocation study was also a physical task in the form of 20 successive stand ups. The EHS patients' reactions deviated from the controls to the mobile phone signal and further studies on this are needed.