Sweden

Report on EMF Activities
13th International Advisory Committee on EMF
June 2008

Kjell Hansson Mild, Department of Radiation Physics, Umeå University, Umeå, Sweden
Janez Marinko, Swedish Work Environment Authority (SWEA), Solna, Sweden
Lars Mjönes, Swedish Radiation Protection Authority, (SSI), Stockholm, Sweden

Activities in Sweden

Within its environmental surveillance program the Swedish Radiation Protection Authority, SSI, has, performed measurements of radio frequency electromagnetic fields at 118 places in 17 municipalities between the years2001 and 2007. The study includes all sources within the frequency range of 60 MHz–2.6 GHz. Exposure was higher in densely than in sparsely populated areas. There is no indication that the overall exposure from all measured sources has increased in recent years, excluding exposure from handsets for mobile telephony. Mobile phone base stations, especially GSM900, caused the highest contribution to exposure. WLAN, TETRA and WIMAX contributed only sparsely.

During autumn 2008 SSI together with the National Board of Health and Welfare and a number of local clinics for environmental medicine has performed local one-day seminars on "EMF, new techniques like TETRA and WIMAX". Four seminars took place during 2008, two were held in 2007. SSI has also continued to regularly, twice a year, give the training course "Electromagnetic fields from a radiation protection point of view" primarily aimed at municipality employees.

The Swedish central authorities working with the EMF issue from different perspectives have a working group that meets two or three times a year to discuss common questions. The authorities also publish common information material on EMF.

For the fifth consecutive year the SSI:s independent Expert Group on Electromagnetic Fields has delivered its annual report "Recent Research on EMF and Health Risks (SSI Report 2008:12). The report covers among other research areas http://www.ssi.se/ssi_rapporter/ssirapport.html .

Swedish EMF research in 2007-2008

Prepared by Kjell Hansson Mild, Umeå University, Radiation Physics, Sweden

The number of researcher in Sweden dealing with EMF and health issues has been going down the last few years, and now only a handful of researchers are active. There are only two PhD students working on their theses on EMF and health related topics, and only some grants for research on EMF has been granted lately. In spite of this several publications has come out in the last year, and most are on the mobile phone issue. Many of the studies, however, have been done in an international collaboration.

Söderqvist et al (2007) performed a population-based study to assess ownership and use of mobile phones and cordless phones among children aged 7–14 years. A questionnaire comprising 24 questions was sent to 2000 persons selected from the Swedish population

registry using a stratified sampling scheme. The response rate was 71.2%. Overall, 79.1% of the respondents reported mobile phone access, and 26.7% of them talked for 2 minutes or more per day. Of those who reported mobile phone access, only 5.9% reported use of hands-free equipment. Use of cordless phones was reported by 83.8% of the respondents and 38.5% of them talked for 5 minutes or more per day. Girls generally reported more frequent use than boys. The study showed that most children had access to and used mobile and cordless phones early in life and that there was a rapid increase in use with age. It also showed very low use of hands-free equipment among children with mobile phone access, and finally that girls talked significantly more minutes per day using mobile and cordless phones than boys did.

Hillert et al (2008) studied the effect of radiofrequency field (RF) on self-reported symptoms and detection of fields after a 3 h GSM exposure time and with a well defined study group including subjects reporting symptoms attributed to mobile phone use. The study group was 71 subjects age 18–45, including 38 subjects reporting headache or vertigo in relation to mobile phone use (symptom group) and 33 non-symptomatic subjects. Headache was more commonly reported after RF exposure than sham, mainly due to an increase in the non-symptom group. Neither group could detect RF exposure better than by chance. The higher prevalence of headache in the non-symptom group towards the end of RF exposure justifies further investigation of possible physiological correlates.

As a part of the above study by Hillert et al the effect of the prolonged (3 hours) exposure on self-reported symptoms, cognitive function, and EEG recorded sleep was also studied (Arnetz et al (2007)). The study group consisted of 36 women and 35 men. Twenty-two women and sixteen men reported symptoms they related to mobile phone use (SG). The participants spent three different sessions in the laboratory. The habituation session was followed by two subsequent sessions were they either were exposed to sham exposure (sham) or 884MHz GSM signals for 3 h (average SAR 1.4 W/kg). During actual exposure, as compared to sham exposure, sleep initiated one hour after exposure was affected. There was a prolonged latency to reach the first cycle of deep sleep (stage 3). The amount of stage 4 sleep was also decreased in exposed subjects. NG subjects reported more headaches during exposures vs. sham exposure. Neither group (SG and NG) was able to detect the true exposure status more frequently than by chance alone. The study indicates that during laboratory exposure to 884MHz signals, components of sleep are adversely affected. Moreover, participants that otherwise have no self-reported symptoms related to mobile phone use, appear to have more headaches during actual radiofrequency exposure as compared to sham exposure.

Schröttner et al (2007) studied individual electrosensitivity by provocation of the lower arms to directly coupled 50 Hz electric currents. Self declared EHS persons were selected from members of a self aid group, from responders to a newspaper call, and from persons actively asking for investigations in their search for help. The quantitative electro-sensitivity was quite different among the three groups. The members of the EHS self aid group exhibit a considerable overlap with general population sample. Pooled together it could be shown that hypersensitive persons as a group differ significantly from the general population sample, however with a pronounced overlap with the normal range. It can be concluded that EHS groups are very inhomogeneous and contain numerous persons with no increased ability to perceive low frequency electric or magnetic fields. This investigation shows the importance of the study design, in particular of the recruitment strategies of EHS persons for the final outcome.

Johansson A et al (2008) studied the effects of exposure to a mobile phone-like radiofrequency (RF) electromagnetic field on serum concentrations of substance P (SP), tumor necrosis factor receptor 1 (TNF R1), and brain derived neurotrophic factor (BDNF) in people with atopic dermatitis (AD) was examined. Fifteen subjects with Atopic Dermatitis (AD) and 15 controls were exposed for 30 min to an RF field at 1 W/kg via an indoor base station antenna attached to a 900 MHz GSM mobile phone and concentration of SP, TNF R1 and BDNF were measured before and after exposure. No effects related to RF exposure condition were encountered for any of the measured substances.

Hardell et al (2006) presented a case–control study on testicular cancer and use of cellular and cordless telephones. The results were based on answers from 542 (92%) cases with seminoma, 346 (89%) with non-seminoma, and 870 (89%) control. There was no dose–response effect and OR did not increase with latency time. No association was found with place of keeping the mobile phone during standby, such as trousers pocket.

An evaluation of long-term use of mobile phones and the risk for brain tumours in case-control studies has been performed Hardell et al (2008) (see also Hardell et al, 2007, for a review of long term users). Ten studies were identified on glioma and meta-analysis yielded OR = 0.9, 95% CI = 0.8-1.1. Latency period of ≥10-years gave OR = 1.2, 95% CI = 0.8-1.9 based on six studies, for ipsilateral use (same side as tumour) OR = 2.0, 95% CI = 1.2-3.4 (four studies), but contralateral use did not increase the risk significantly, OR = 1.1, 95% CI = 0.6-2.0. Meta-analysis of nine studies on acoustic neuroma gave OR = 0.9, 95% CI = 0.7-1.1 increasing to OR = 1.3, 95% CI = 0.6-2.8 using ≥10-years latency period (four studies). Ipsilateral use gave OR = 2.4, 95% CI = 1.1-5.3 and contralateral OR = 1.2, 95% CI = 0.7-2.2 in the ≥10-years latency period group (three studies). Seven studies gave results for meningioma yielding overall OR = 0.8, 95% CI = 0.7-0.99. Using ≥10-years latency period OR = 1.3, 95% CI = 0.9-1.8, was calculated (four studies) increasing to OR = 1.7, 95% CI = 0.99-3.1 for ipsilateral use and OR = 1.0, 95% CI = 0.3-3.1 for contralateral use (two studies). This meta-analysis gave a consistent pattern of an association between mobile phone use and ipsilateral glioma and acoustic neuroma using ≥10-years latency period.

Cardis et al (2007) has published a paper on the design and the epidemiological methods used in the Interphone study, a multinational case-control study set-up to investigate whether mobile phone use increases the risk of cancer and, more specifically, whether the RF fields emitted by mobile phones are carcinogenic. The study focused on tumours arising in the tissues most exposed to RF fields from mobile phones: glioma, meningioma, acoustic neurinoma and parotid gland tumours. In addition to a detailed history of mobile phone use, information was collected on a number of known and potential risk factors for these tumours. The study was conducted in 13 countries. Australia, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, New Zealand, Norway, Sweden, and the UK using a common core protocol. This paper describes the study design and methods and the main characteristics of the study population. INTERPHONE is the largest case-control study to date investigating risks related to mobile phone use and to other potential risk factors for the tumours of interest and includes 2,765 glioma, 2,425 meningioma, 1,121 acoustic neurinoma, 109 malignant parotid gland tumour cases and 7,658 controls. Particular attention was paid to estimating the amount and direction of potential recall and participation biases and their impact on the study results.

Schuz et al (2007) tested the hypotheses that nighttime bedroom measurements of extremely low frequency electromagnetic fields (ELF EMF) may represent a more accurate reflection of

exposure and have greater biologic relevance than previously used 24-/48-hour measurements. Accordingly, the authors extended a pooled analysis of case-control studies on ELF EMF exposure and risk of childhood leukemia to examine night time's residential exposures. Data from four countries (Canada, Germany, the United Kingdom, and the United States) were included in the analysis, comprising 1,842 children diagnosed with leukemia and 3,099 controls (diagnosis dates ranged from 1988 to 1996). The odds ratios for night time ELF EMF exposure for categories of 0.1-<0.2 microT, 0.2-<0.4 microT, and >or=0.4 microT as compared with <0.1 microT were 1.11 (95% confidence interval (CI): 0.91, 1.36), 1.37 (95% CI: 0.99, 1.90), and 1.93 (95% CI: 1.11, 3.35), respectively. The fact that these estimates were similar to those derived using 24-/48-hour geometric mean values (odds ratios of 1.09, 1.20, and 1.98, respectively) indicates that the night time component cannot, on its own, account for the pattern observed. These results do not support the hypotheses that night time measures are more appropriate; hence, the observed association between ELF EMF and childhood leukaemia still lacks a plausible explanation.

Mannerling et al 2007) studied 4-day old chicken embryos from different flocks pre-treated with 50Hz magnetic fields (MF) prior to a 60-min UV-C exposure (1.7mW/cm2) to investigate the possible protective effect of MF exposure on UV-induced embryo death. Different flux densities (0.010, 0.025, 0.050, 0.10, and 0.20 mT), field directions (vertical and horizontal), as well as MF exposure times (10, 20, and 60min) were employed. No significant effects were found by MF exposure, irrespective of exposure time, flux density, or field direction on the survival of embryos.
Johansson LE et al (2008) presents two methods of determining the total field, including phase information, when only field amplitudes have been measured on a set of planes in the near field of a complex electromagnetic source. The methods are intended for use in dosimetry studies and other applications where the field distribution from electromagnetic sources are needed.

Published papers 2007-2008

Arnetz B, Åkerstedt T, Hillert L et al. The Effects of 884 MHz GSM Wireless Communication Signals on Self-reported Symptoms and Sleep. An Experimental Provocation Study. PIERS ONLINE, VOL. 3, NO. 7, 2007 1148-50.

Cardis E, Richardson L, Deltour I, Armstrong B, Feychting M, Johansen C, Kilkenny M, McKinney P, Modan B, Sadetzki S, Schuz J, Swerdlow A, Vrijheid M, Auvinen A, Berg G, Blettner M, Bowman J, Brown J, Chetrit A, Christensen HC, Cook A, Hepworth S, Giles G, Hours M, Iavarone I, Jarus-Hakak A, Klaeboe L, Krewski D, Lagorio S, Lonn S, Mann S, McBride M, Muir K, Nadon L, Parent ME, Pearce N, Salminen T, Schoemaker M, Schlehofer B, Siemiatycki J, Taki M, Takebayashi T, Tynes T, van Tongeren M, Vecchia P, Wiart J, Woodward A, Yamaguchi N. The INTERPHONE study: design, epidemiological methods, and description of the study population. Eur J Epidemiol 2007;22(9):647-64.

Fhager A and M Persson: Using a priori data to improve the reconstruction of small objects in microwave tomography, IEEE Trans. Microwave Theory Techniques, Vol. 55, Issue 11, Page 2454-2462, November, 2007.

Hansson Mild K, Hardell L, Carlberg M. Pooled analysis of two Swedish case-control studies on the use of mobile and cordless telephones and the risk of brain tumours diagnosed during 1997-2003. Int J Occup Saf Ergon. 2007;13(1):63-71.

Hardell L, Carlberg M, Söderqvist F, Hansson Mild K, Morgan LL. Long-term use of cellular phones and brain tumours: increased risk associated with use for > or =10 years. Occup Environ Med. 2007 Sep;64(9):626-32. Epub 2007 Apr 4. Review.

Hardell L, Carlberg M, Ohlson CG, Westberg H, Eriksson M, Hansson Mild K. Use of cellular and cordless telephones and risk of testicular cancer. Int J Androl. 2007 Apr;30(2):115-22. Epub 2006 Dec 20.

Hillert L, Åkerstedt T, Lowden A et al. The Effects of 884 MHz GSM Wireless Communication Signals on Headache and Other Symptoms: An Experimental Provocation Study. Bioelectromagnetics 29:185-196, 2008.

Johansson A., Forsgren S., 2, Stenberg B., Wilén J., Kalezic N., Sandström M. No effect of mobile phone-like RF exposure on patients with atopic dermatitis. Bioelectromagnetics, EarlyView online Jan 31, 2008.

Johansson, L. E. Nord, R. Kopecký, A. Fhager and M. Persson, ``Computational methods for modeling of complex sources", COMPEL: The International Journal for Computation and Mathematics in Electrical and Electronic Engineering, vol. 27, no. 1, pp. 133-143, 2008.

Lu M, Persson M, Analysis of Dielectric Loaded Double Trapezoidal-Ridge Waveguide by Edge Element Method, Microwave and Optical Technology Letters, Vol.49, No.1, 2007. PP.1-4.

Mannerling AC, Hansson Mild K, Mattsson MO. Extremely low-frequency magnetic field exposure and protection against UV-induced death in chicken embryos. Electromagn Biol Med. 2007;26(2):73-81

Nordebo S, A. Fhager, M. Gustafsson and M Persson: A Systematic Approach to Robust Preconditioning for Gradient Based Inverse Scattering Algorithms, Inverse Problems, Vol. 24, Issue 2, Art. No. 025027, April, 2008.

Schröttner J, Leitgeb N, Hillert L. Investigation of Electric Current Perception Thresholds of Different EHS Groups. Bioelectromagnetics 28:208–213, 2007.

Schuz J, Svendsen AL, Linet MS, McBride ML, Roman E, Feychting M, Kheifets L, Lightfoot T, Mezei G, Simpson J, Ahlbom A. Night time exposure to electromagnetic fields and childhood leukaemia: an extended pooled analysis. Am J Epidemiol 2007;166(3):263-9.

Söderqvist F, Hardell L, Carlberg M, Hansson Mild K. Ownership and use of wireless telephones: a population-based study of Swedish children aged 7-14 years. BMC Public Health. 2007 Jun 11;7(147):105.