

Rapporteurs Report on the Dosimetry Issue

A Workshop was held from 27th to 29th of November 2006 in Stuttgart, Germany on “Do Children represent a special sensitive group for EMF exposure ” It was organized by FGF, EMF-Net and the State Ministry of Environment, Baden Württemberg.

The question whether children and pregnant women are especially vulnerable to the exposure of radiofrequency electromagnetic fields is an open question. Since 2000 a number of attempts were launched to answer this question. In June 2004 WHO held a workshop on this topic in Istanbul, the last COST281 in Graz (April 2006) dealt partly with this topic and EMF Net promotes studies on potential health risk from long term use of mobile by children in their highest priority needs 2006.

Since 2004, worldwide several projects have been initiated and this workshop summarized recently finished and ongoing studies.

The workshop was divided in four main parts (dosimetry, epidemiology, animal and in vitro studies, volunteers study). This report is dedicated to dosimetry.

The first day (27th of November) was dedicated mainly to biology, nevertheless the last talk given by Dr. Jafar Keshvari dealt with dosimetry and especially with the computational evaluation of SAR difference between children’s and adult’s head and eye tissues using anatomically correct head models and higher dielectric values. The speaker reported results obtained through simulations with different head models and a dipole operating at 900, 1800 and 2450 MHz. 5 models have been investigated two adults head models (female and male), two children head models (3-years and 7-years) and a flat phantom with different increases of conductivity and permittivity. In his talk the importance of the models has been pointed out. He explained also that the thickness and composition of different tissues play a more significant role in SAR variation compared to the variation of the tissue dielectric parameters.

The second day (28th of November) was dedicated mainly to dosimetry.

The first speaker was Dr. Joe Wiart, in his talk he pointed out the importance of the child head model and stressed the age dependence of the morphology, he presented results obtained with different MRI based child head models (5, 6, 7, 8, 9, 10, 12 year old) and discussed the large variability. He showed that the maximum SAR over 10 grams is comparable between adults and children, he explained also that the energy absorbed by the peripheral area of the brain is weak but seems to be higher in children than in adult. The thinner thickness of the skin, skull and pinna could explain this. At the end of his talk Joe Wiart explained that the main challenge in dosimetry is nowadays the numerical uncertainty estimation and the representativeness of the human head and body models used.

The second speaker was Prof. Om Gandhi. He started with pertinent references. He showed the difference between the results obtained with Visible Human model and those obtained using the UTAH model. During his talk he explained that the maximum SAR over 1 gram increases by reducing the size of the head. Prof. Gandhi also discussed the influence of the pinna and explained that the smaller the pinna the higher is the SAR. The representativeness of SAM (Specific Anthropomorphic Mannequin) has also been discussed, according to Prof. Gandhi the separation distance decided in international standards leads to an underestimation of the induced SAR. After that Prof. Om Gandhi moved to Electronic Article Surveillance (EAS); he showed that if the head of children is located in the main area of the deactivator the induced current should be higher than the safety value recommended by ICNIRP.

The third talk was given by Maria Christopoulou. She presented numerical calculations performed with different methods (FDTD and MoM) and different models of head (spherical and MRI based). She discussed the influence of the distance from the antenna to the head model and the influence of the variation of dielectric properties. She concluded that she observed the same level of exposure in her adult and child head models.

The fourth talk was given by Dr. Andreas Christ. In his talk he analysed the difference of RF exposure in adults and children induced by mobile handsets and the parameters that can influence the exposure. He presented comparison performed with 2 MRI based children heads, 5 adult models and scaled adult models. Dr. Christ explained that simulations have shown that the peak spatial SAR depends mainly on the head shape, the observed differences are within 30%. He discussed also the influence of the decrease of tissues permittivity and conductivity with age, the SAR variation due to the age dependence of tissues are within 30%. In both cases SAM is

conservative, there is no correlation between high SAR and adult versus child heads even if preliminary studies seems to show that subregions of the child head are higher exposed than adult ones.

The fifth talk was given by Prof. James C. Lin. He discussed the exposure and SAR simulations carried out with scaled human models for mobile communication. Prof. Lin presented results obtained with FDTD at different frequencies (GSM900, GSM1800, PCS1900, UMTS and WiFi) with an adult model (VH – Visual Human) and 2 uniformed down scaled adult (VH) models representing children 13 and 7 years old. The simulations show that the whole-body averaged SAR is higher for the smaller models and highest for the smallest, they show also that the local SARs are higher in the larger model. Since the model used are based on Visible Human Prof. Lin discussed in his talk the validity of these results and the representativeness of models used worldwide.

The sixth talk was given by Prof. Norbert Leitgeb. His talk dealt with the risk assessment of mobile phone use by children. He discussed the parameters that can influence the children exposure: anatomy (flexible ear, thinner skull), tissue parameters (age dependence of the conductivity), different use patterns and different penetration depths. He concluded that risk, if existent, should be low. He explained that long-term exposure health risks is not ruled out and according to him health risks, if existent, are higher for children. Based on this he said that if advice is given to adults to minimise exposure then it is even more justified for children.

The last talk was given by Prof. Luc Martens on the dosimetric evaluation for walkie-talkies used by children. A model has been developed for the walkie-talkie and the SAR induced by such systems has been evaluated with 2 children heads based on MRI (3 years old and 7 years old), the SAM phantom and with the standard flat phantom. The SAM phantom is of interest since shape and equivalent liquid have been optimized for handsets. Prof. Martens presented results that show large differences in 1g SAR between 3y and 7y old child head model but not in the 10g case. The simulation performed shows also changes in 1g SAR for varying dielectric properties up to 25%. Prof Martens explained also that according to the simulation carried out the homogeneous flat and SAM phantom should underestimate the spatial peak SAR in the heterogeneous child head phantoms for several configurations.

Discussion

The representativeness of the phantoms used has been intensively discussed. The variability of human morphology has been discussed and it became apparent that different external shapes and internal morphology can lead to large variation of induced SAR. The discussion stressed the difficulties to support results obtained with uniformed down scaled model and several speakers asked to develop new models and share the models that exist.

This part of the discussion has shown that uncertainty estimation (link to the variability of the models used) is one of the key points for numerical simulation.

The comparison between children and adult exposure induced by mobile phone has also been discussed. Dealing with maximum SAR over 10g the discussion revealed that there is no correlation between high SAR in adult versus child heads. On the other hand the discussion has shown that further investigation should be requested for subregions of the brain since the SAR in peripheral brain tissues is weak but higher in children than in adult (this should be linked to the thinner thickness of the skin, skull and pinna). Several speakers discussed the importance of such investigations for future epidemiological studies planned with children.

Dealing with walkie-talkies several speakers support the necessity to improve the methods that are used to check the compliance of such systems.

The discussion on risk assessment of mobile phone used by children gave the opportunity to discuss this topic in a larger context. The discussion showed that risk assessment can not be limited to dosimetry and must incorporate other parameters (such as usage and biology).

Joe Wiert