UNDERESTIMATION OF EMF EXPOSURE FOR CHILDREN FOR MOBILE TELEPHONES AND FOR EAS SYSTEMS

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Back in 1996 we published results showing that for a given mobile telephone, the EMF absorption measured in terms of specific absorption rates (SARs) would be progressively higher for smaller and smaller children(Gandhi et al., *IEEE Trans. MTT,* 46, 1884-97, 1996). Continuing this work, we used anatomically identical head models that were of average dimensions and larger or smaller in all dimensions by 11.1% or -9.1%, respectively. To obtain generalization, two different shapes of the head model i.e. the Utah Model and the "Visible Man" Model (obtained from the cadaver of a fairly husky individual of weight 105 kg) with larger and smaller versions of each, three different handset dimensions and two different types of antennas for each of these handsets were used to obtain peak 1-g and 10-g SARs for the body tissues as well as for the brain (Gandhi & Kang, *Phys. Med. Biol.*, 47, 1501-18, 2002). It was argued that the smaller head sizes may be representative of the heads of children. The peak 1-g body tissue SAR for the smaller head sizes calculated using the widely accepted finite-difference time-domain (FDTD) computational EMF method was shown to be up to 56% higher at 1900 MHz and up to 20% higher at 835 MHz compared to the larger models. The proportionality was even higher for the brain tissues where the peak 1-g SAR for the smaller model was up to 220% at 1900 MHz and up to 144% at 835 MHz of the SARs of the larger models. Similar to the results reported in the earlier 1996 paper for head models of adult and children, these latter results also confirm that there is a deeper penetration of absorbed energy for the smaller head models e.g. the children compared to that for the larger head models representative of the adults.

It is unfortunate that the industry has chosen a SAM ("standard anthropomorphic mannequin") head model with a 5-10 mm thick plastic spacer in the shape of "pinna" for determination of SAR of mobile phones for compliance testing against IEEE and ICNIRP Safety Guidelines. In two different published studies, we have shown (Gandhi & Kang, *IEEE Trans. MTT*, 52, 2004-12, 2004; Kang and Gandhi, *Phys. Med. Biol.,* 47, 4301-13, 2002) that use of plastic spacers results in an underestimation of the SAR by up to 15% for every additional millimeter of thickness of such spacers. Thus, we have shown that the SAR obtained for SAM is up to two or more times smaller than for the anatomic models of the adult head. This underestimation is even higher for exposure to the smaller heads of the children.

In Europe, compliance of the induced current densities for the CNS tissues (i.e. the brain and the spinal cord) with ICNIRP Guidelines is required for all electronic article surveillance (EAS) devices. For almost all of the EAS systems, the region of the highest magnetic fields is at a height above the floor, corresponding to the heads of the children. Thus, higher current densities for the brain are induced for the children as compared to those for adults for which the heads are in weaker magnetic fields (Gandhi & Kang, *Phys. Med. Biol.,* 46, 2759-71, 2001).