Personal EMF exposure of Children

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Introduction

Due to their development and growth, increasing exposure to electromagnetic fields (EMF) and their whole life exposure, children are one of the risk groups regarding the exposure to EMF. The children’s lifestyles and their use of different new technologies are different to the adults and therefore it is not necessary that their typical EMF exposure is similar to the exposure of adults.

Nevertheless there is a need for better understanding of the interaction between the children and the EMF, published studies in this field are rare compared to the adults. The pattern of the typical exposures of the children are not well known, consequently there are missing parameters when preparing studies to analyze potential health risk factors due to the EMF (childhood leukemia, different tumors...) and planning of the radiation protection of children and policy of children health protection.

Materials and Methods

Young participants and their parents were invited to take part in a survey study where they carried low and high frequency personal exposimeter.

For low frequency exposure, the Emdex II (Enertech, USA) was used, which measures low frequency magnetic flux density. The measurement range of the exposimeter is 0.01 – 300 μT. For high frequency exposure, the EME Spy 120 (Antennis, now Satimo, France) was used, which measures the high frequency electric field strength separately for different frequency ranges: FM (88 - 108 MHz), TV VHF (174 – 223 MHz), TETRA (380 – 400 MHz), TV UHF (470 - 830 MHz), GSM TX (880 – 915 MHz), GSM RX (925 - 960 MHz), DCS TX (1710 - 1785 MHz), DCS RX (1805 - 1880 MHz), DECT (1880 – 1900 MHz), UMTS TX (1920 – 1980 MHz), UMTS RX (2110 – 2170 MHz) and WiFi (2400 – 2500 MHz). The measurement range of the high frequency exposimeter is 0.05 V/m – 5 V/m. 

On both exposimeters is possible to select the measurement interval, in which the measurement results are stored. In the study, we normally used the interval of 30 s to obtain the desired autonomy of the dosimeter for about 2 to 3 days yet not to miss any important fluctuations in the measurement quantities.

Beside exposimeter most of the volunteers carried also the GPS logger. Custom server application is used to correlate the measured values with corresponding GPS coordinates based on the time of the measurements. The application also features data filtration before presenting the results on the map. The results are presented with color coded circles and if all the results are presented, the circles are overlapping when the position is still.

During the period when the volunteers carried the dosimeter they also filled a questionnaire in which they marked their activity during the measurements. The activities were divided in two categories regarding the location (urban or rural area) and regarding the activities (home, work, transport/outside, sleeping). Based on these results it is later possible to categorize the results. All the results of the study were collected and partially analyzed. Beside the maximum and average values we have calculated also the percentage of the time, when the value of the magnetic flux density was higher than 0.3 μT.

Results

From 21 participants 6 of them lived close to the sources of low frequency magnetic field, whereas none of them identified any important high frequency source in their vicinity. Most of the participant carried both exposimeters simultaneously, whereas 3 of them carried only low frequency and 4 high frequency exposimeters. All the participants were younger than 16 years at the time of the participation, with the average age of 12. The low frequency exposimeter was worn for 768 hours and the high frequency for 705 hours with the average carrying time of 42 hours.

The results for low frequency exposure show great variability of the exposure between the participants. The maximum value of the magnetic flux density varied from 1.25 to 139 μT. Moreover also the average value varied considerably: from 0.04 to 1.35 μT whereas the average value for all the measurements is 0.32 μT. In total, 6 out of 21 participants had an average exposure over 0.3 μT. The same 6 participants had also values of magnetic flux density greater than 0.3 μT for more than 10 % of the time. An important indicator for the exposure is the percentage of the time, when the magnetic flux density was higher than 0.3 μT. The value of this parameter varied from 0.15 up to 77 % which demonstrates that some of the participants were exposed to elevated magnetic field nearly all the time. High was also the average value of all the results in the study (0.32 μT) indicating that in the research more volunteers participated which lived close to frequency sources (6 out of 21) as they were more interested in participating in the research.

The average high frequency exposure is very low and in general below the measurement range of the exposimeter (0.05 V/m). Slightly higher average values were measured only for GSM and DECT phones, base stations and WiFi. Maximum values are above the measurement range of the exposimeter (5 V/m) for equipment worn close to the body (mobile and DECT phones), evidently higher for equipment located in the living environment (WiFi, 2.47 V/m) but low for radio and TV broadcasting (below 0.3 V/m).

Figure: on the panel A, exposure close to 400 kV power line is presented. Panel B adn C presents the exposure close to 110 kV power line, whereas panel D and present the results for typical exposure in an urban area (city centre). Color circles present measurement points, whereas the color of the circle corresponds to the measured value (in μT). It can be seen that for some situations the values close to high voltage power lines are much higher than for typical urban exposure.

Conclusion

Although the results of the study are based on a small sample (currently 21 participants), they clearly show that there is a great variability of the exposure of the young people to the EMF. The differences in the average whole day exposure could be in the range of a few orders of magnitude.

Close to the low voltage sources (transformer substation, power line) lived 6 participants. Half of them were exposed to the magnetic flux density higher than 0.32 μT for about one third of time or more meaning that most of the time these participants were at home, the magnetic field values were elevated. For high frequency sources the highest values were measured for body worn devices or devices used close to the body such as mobile and cordless phones or WiFi; other sources contributed little since most of the measured values were at the lower measurement range of the exposimeter.

The results show that it is important to conduct wider survey studies to further evaluate the exposure of the children to EMF.

Literature