Use of portable exposimeters to monitor radiofrequency electromagnetic field exposure in the everyday environment

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Spatial and temporal distribution of radiofrequency electromagnetic field (RF-EMF) levels in the environment is highly heterogeneous. It is thus not entirely clear how to monitor RF-EMF exposure levels in the environment in a representative and efficient manner. In a microenvironmental survey a trained person uses portable measurement devices to conduct numerous RF-EMF measurements within a short time at different locations within various microenvironments such as residential areas, city centers and public transports. The aim of this study was to evaluate the appropriateness of such a microenvironmental survey for the purpose of a RF-EMF monitoring. Thus, the aim of the study was to evaluate the reproducibility and spatial representativity of such measurements.

Using the EXPOM3 devices we have conducted RF-EMF microenvironmental measurements in 51 different microenvironments from 20 different cities and villages in Switzerland. Measurements were conducted in 5 different city centers, 5 central urban residential areas, 5 non-central urban residential areas, 15 rural residential areas, 15 rural village centers and 6 industrial areas. In order to evaluate spatial representativity, we defined two crossing paths of about 1 km length in each microenvironment. These paths were successively measured, which needed about 15 min per path. Sampling rate was 4 s. To evaluate reproducibility, measurements in each microenvironment were repeated after two to four months on the same paths.

Mean RF-EMF exposure (sum of 15 main frequency bands between 87.5 and 5,875 MHz) was 0.53 V/m in industrial zones, 0.47 V/m in city centers, 0.32 V/m in central urban residential areas, 0.25 V/m non-central urban residential areas and 0.23 V/m in rural village centers and rural residential areas. Major exposure contribution was from mobile phone base station (>90% in all areas with respect to the power density scale). Pearson correlation between arithmetic mean values of the first path compared to arithmetic mean of the second path within the same microenvironment was 0.65 for total RF-EMF, 0.66 for all five mobile phone downlink bands combined, 0.73 for all five uplink bands combined and 0.82 for broadcasting (FM and TVB-T). Temporal correlation between first and second measurement of each path was high: 0.87 for total RF-EMF, 0.87 for all five mobile phone downlink bands combined, 0.77 for all five uplink bands combined and 0.79 for broadcasting.

This study demonstrates that microenvironmental surveys yield highly reproducible measurements which allow monitoring time trends in RF-EMF exposure over an extended time period of several years. Collecting data on a measurement path of about 1 km length with a sampling rate of 4 s provides data which are representative for the corresponding microenvironment. In the framework of a monitoring this allows comparing exposure values between different types of microenvironments.