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The 20-years evolution of exposure to electromagnetic field emitted by urban radiocommunication systems in Warszawa

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Extended Abstract
The common use of radiocommunication systems and their dynamic development affect the parameters of human exposure to the electromagnetic field (EMF). Due to the large number of users in the urban environment, there are the highest density of radiocommunication antennas and the EMF with the most complex spectrum and the highest level. The aim of this retrospective study is to recognise and evaluate of the urban exposure to EMF emitted by radiocommunication systems, based on the results of own research, characterizing nearly twenty years of the evolution of the parameters of this exposure in public buildings in Warszawa, the capital city in Poland.

The background characteristic of EMF exposure (over 2002-2006, summer and winter seasons) was investigated inside office buildings (broadband measurements, 5 Hz - 3 GHz frequency range, 60-minutes recordings with 4 seconds sampling rate, and spectrum analysis). That time, the dominant sources of exposure in the center of Warszawa were analogue FM radio (88-108 MHz) and analog VHF/UHF television (174-713 MHz) emitters. Weaker signals were recorded from the GSM 900 and DCS 1800 mobile phone systems (to an extent depending on distance to the broadcasting center located in the city center). Outside the center, the proportions of particular contributions to the frequency spectrum and the measured broadband EMF level were inversed - the dominant contribution was recorded from the emissions caused by the use of mobile phone base stations located in the proximity of the measurement sites, with weaker components from RTV systems, weakening in proportion to the distance from the city center (median values of electric field strength 0.74 V/m in the center and 0.47 V/m outside the center).

Starting from 2011, the research on EMF exposure covered the measurements by the selective exposimeters (pocket-size autonomous radiofrequency electric field sensitive data loggers; 8-24-hours recordings with 6 seconds sampling rate), simultaneously in predefined narrow frequency bands, harmonized with the frequencies of signals emitted by typical radiocommunication devices. Frequency-selective exposimetric studies confirmed earlier observations from broadband measurements - the higher level of exposure was found in the center of Warszawa and a dominant contribution to the EMF exposure was caused there by the emission from RTV broadcasting centers (the narrowband contribution from the RTV frequency bands caused: 96% in the center and 34% outside the center, respectively, of the median values of the total broadband electric field strength (broadband RMS value) measured there).

A long term analysis of the results of the EMF research in the center of Warszawa, over past 20 years of developing radiocommunication systems before the introduction of the newest generation ones (5G recognized), did not show significant changes in the level of total exposure (broadband RMS value) – in public buildings there, the EMF exposure were significantly lower than 10% of general public reference levels provided by international safety guidelines. Observed changes in the pattern of EMF exposure covered the relative contributions to the total exposure (broadband RMS value) from particular type of EMF sources – the increasing influence of EMF exposures caused by the use of new radiocommunication technologies (3G and 4G LTE systems) and decreasing influence from RTV broadcasting.

Discussed investigations did not cover the evaluation of EMF exposure in the proximity to emitting antennas, located usually at the building roofs or free-standing constructions, where exposure is locally significantly stronger, even exceeding reference levels set for the evaluation of workers exposure.

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