Effects of 50 and 60 Hz magnetic field exposure up to 7.6 mT on humans assessed using simultaneous EEG/fMRI

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The effects of power-line magnetic fields (MF, 50 Hz in Europe; 60 Hz in North America) on human neurophysiology are not completely understood. In this work, we used integrated electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) in humans exposed to three different MF flux densities at 50 and 60 Hz using the MRI scanner. MF exposure conditions were 3 mT (10 seconds, 12 repetitions, BOLD acquisition interleaved), 5 mT (10 minutes, with ASL – Arterial Spin Labeling- before/after exposure to quantify brain resting blood flow) and 7.6 mT (2 seconds, 100 repetitions). EEG was recorded at all times, including during exposure. N=30 subjects completed the study (25 at 60 Hz, 13 sham, 12 exposed; 5 at 50 Hz, 2 sham, 3 exposed), approved by Western University HSREB (#17816). EEG alpha power (8-12 Hz) was analyzed in occipital electrodes (O2, O1, OZ), while ASL and BOLD data were fused with anatomical images before an ANOVA was conducted. No MF exposure condition tested revealed any significant difference in EEG alpha power between "sham" and "exposed" groups. We obtained a similar result regarding brain functional activation and in brain resting blood flow. Our results suggests that acute MF exposure (up to 10 minutes) up to 7.6 mT does not induce detectable changes in occipital cortex electrical activity, brain functional activation and resting brain blood flow. Further research is warranted at higher MF flux density levels to identify thresholds at which objective effects of MF exposure can be detected in humans.