Daily Caffeine Intake Induces Concentration-Dependent Medial Temporal Plasticity in Humans: A Multimodal Double-Blind Randomized Controlled Trial

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Caffeine is commonly used to combat high sleep pressure on a daily basis. However, interference with sleep-wake regulation could disturb neural homeostasis and insufficient sleep could lead to alterations in human gray matter. Hence, in this double-blind, randomized, cross-over study, we examined the impact of 10-day caffeine (3 Œ 150 mg/day) on human gray matter volumes (GMVs) and cerebral blood flow (CBF) by fMRI MP-RAGE and arterial spin-labeling sequences in 20 habitual caffeine consumers, compared with 10-day placebo (3 Œ 150 mg/day). Sleep pressure was quantified by electroencephalographic slow-wave activity (SWA) in the previous nighttime sleep. Nonparametric voxel-based analyses revealed a significant reduction in GMV in the medial temporal lobe (mTL) after 10 days of caffeine intake compared with 10 days of placebo, voxel-wisely adjusted for CBF considering the decreased perfusion after caffeine intake compared with placebo. Larger GMV reductions were associated with higher individual concentrations of caffeine and paraxanthine. Sleep SWA was, however, neither different between conditions nor associated with caffeine-induced GMV reductions. Therefore, the data do not suggest a link between sleep depth during daily caffeine intake and changes in brain morphology. In conclusion, daily caffeine intake might induce neural plasticity in the mTL depending on individual metabolic processes.

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