

Neuroimaging / Multi-modal comparisons

Sleep-dependent association between atrophy and functional connectivity in mild cognitive impairment

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Abstract

Background: Sleep quality might influence the risk of developing Alzheimer's disease (AD) in mild cognitive impairment (MCI) patients, driving alterations in brain morphology and functional connectivity. However, the relationship between sleep, gray matter atrophy, and functional connectivity is poorly understood. The present study aims to compare levels of these brain alterations associated with sleep habits in MCI patients.

Method: Structural magnetic resonance imaging (MRI) and resting-state functional MRI (rs-fMRI) data from 38 MCI and 38 age-matched controls were analyzed to investigate atrophy and connectivity, respectively. MCI were stratified into "good" (n=20) and "poor" (n=18) sleepers, stratified at the 50th percentile of the Sleep Continuity in Alzheimer's Disease Scale, a self-report questionnaire assessing sleeping quality. Independent component analysis was used to identify the default mode (DMN) and frontoparietal (FPN) networks. For each patient and modality (i.e., structural and rs-fMRI), z-score maps were computed based on the control sample. Moreover, for each subject and network, a composite z-score map across modalities was computed with the following formula: z-score atrophy - z-score connectivity. Voxelwise between-modality comparisons were performed with nonparametric inference using FSL randomise (n=5000 permutations). Multiple comparisons were corrected at a threshold-free-cluster enhancement level of $p < 0.025$ FWE-corrected.

Result: Connectivity DMN values within the precuneus significantly exceed atrophy in both MCI groups. By contrast, only MCI good sleepers showed connectivity FPN values exceeding atrophy, widespread in frontal, temporal, and parietal regions. Finally, comparing MCI groups using composite z-score maps, we reported significant FPN connectivity values exceeding atrophy within the right inferior frontal gyrus in MCI good sleeper.

Conclusion: These findings suggest that, among MCI patients, sleep quality may influence the relationship between brain morphology and functional connectivity, resulting in FPN connectivity exceeding atrophy. Our findings might suggest different sleep-induced slopes in brain atrophy and connectivity within the FPN network. These results might offer novel targets and surrogate outcomes for interventions aimed at restoring sleep disorders in MCI.