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The association between white matter and sleep spindles differs in young and older individuals

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Abstract

Study Objectives

Sleep is a reliable indicator of cognitive health in older individuals. Sleep spindles (SS) are non-rapid eye movement (NREM) sleep oscillations implicated in sleep-dependent learning. Their generation imply a complex activation of the thalamo-cortico-thalamic loop. Since SS require neuronal synchrony, the integrity of the white matter (WM) underlying these connections is of major importance. During aging, both SS and WM undergo important changes. The goal of this study was to investigate whether WM integrity could predict the age-related reductions in SS characteristics.

Methods

Thirty young and 31 older participants underwent a night of polysomnographic recording and a 3T magnetic resonance imaging acquisition including a diffusion sequence. SS were detected in NREM sleep and EEG spectral analysis was performed for the sigma frequency band. WM diffusion metrics were computed in a voxelwise design of analysis.

Results

Compared to young participants, older individuals showed lower SS density, amplitude, and sigma power. Diffusion metrics were correlated with SS amplitude and sigma power in tracts connecting the thalamus to the frontal cortex for the young but not for the older group, suggesting a moderation effect. Moderation analyses showed that diffusion metrics explained between 14% and 39% of SS amplitude and sigma power variance in the young participants only.

Conclusion

Our results indicate that WM underlying the thalamo-cortico-thalamic loop predicts SS characteristics in young individuals, but does not explain age-related changes in SS. Other neurophysiological factors could better explain the effect of age on SS characteristics.

aging, diffusion tensor imaging, EEG, magnetic resonance imaging, moderation analysis, sleep spindles, white matter integrity

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