

A coordinate-based meta-analysis comparing brain activation between attention deficit hyperactivity disorder and total sleep deprivation

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Abstract

Study Objectives

Sleep disruption is common in attention deficit hyperactivity disorder (ADHD). Likewise, deficits in attention are a hallmark of sleep deprivation in healthy individuals. Whether ADHD and sleep deprivation modulate common, or disparate, neural systems is unknown. No study has yet utilized functional magnetic resonance imaging (fMRI) to investigate sleep loss in ADHD. We address this gap by performing a novel meta-analysis to compare patterns of fMRI activation during sleep deprivation and ADHD.

Methods

We performed a coordinate-based activation likelihood estimate (ALE) meta-analysis using the GingerALE software. A systematic review of task-based fMRI studies of sleep deprivation vs. rested and also ADHD vs. healthy controls (HC) yielded 134 articles. fMRI coordinates were extracted for each contrast (i.e. “ADHD vs. HC,” “TSD vs. Rested”) and normalized to the Talairach-atlas. Separate ALE analyses were performed for ADHD and sleep deprivation. We directly compared these initial estimates to determine shared vs. distinct areas of fMRI neural activation in ADHD and sleep deprivation.

Results

Conjunction analyses revealed overlapping hypoactivations between ADHD and sleep loss in executive function regions, notably the dorsal anterior cingulate cortex. Sleep deprivation, however, was associated with significantly exaggerated hyperactivation in the thalamus.

Conclusions

Our study indicates that ADHD and sleep deprivation share a common neural signature: hypoactivation of executive function neuroanatomy. In contrast, sleep loss, but not ADHD, was associated with thalamic hyperactivations, intimating a potential compensatory response in sleep loss not present in ADHD. By elucidating shared and distinct patterns of functional neuroanatomy, these data provide novel targets for future experimental investigations of sleep loss in ADHD.

ADHD, sleep, sleep deprivation, meta-analysis, ALE, fMRI

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