Cerebellum Structural Covariance Networks in PTSD and Depression

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BACKGROUND

The cerebellum is commonly known for its role in sensorimotor function, but it is also critical for cognition and emotion [1-3]. Recent neuroimaging studies have reported altered cerebellum activation, functional connectivity, and volume in posttraumatic stress disorder (PTSD) and major depressive disorder (MDD) [4-8]. The aim of this exploratory study was to identify the structural covariance networks of the cerebellum in PTSD and depression using coordinate-based neuroimaging meta-analysis.

METHODS

Using Sleuth, the BrainMap structural / voxel-based morphometry (VBM) database was searched for studies reporting volume abnormalities (patients < controls or patients > controls) in gray and white matter with at least one coordinate in the cerebellum (Talairach Daemon label). Anatomic likelihood estimation (ALE) meta-analyses were conducted separately for **PTSD (257 subjects, 7 experiments, 57 coordinates)** and **depression or MDD (1058 subjects, 19 experiments, 254 coordinates)** using GingerALE (voxel-level uncorrected $p < 0.01$, cluster-level FWE $p < 0.05$). Spherical (12 mm radius) regions of interest were defined around the significant nodes, and the Mango software and BrainMap functional database were used to identify the functional paradigms and behavioral domains most associated with activation in the cerebellum structural covariance networks (z-score > 3).

RESULTS

ALE (PTSD) 0.002 0.004 0.006 0.008 0.010
ALE (MDD) 0.003 0.006 0.009 0.012 0.015
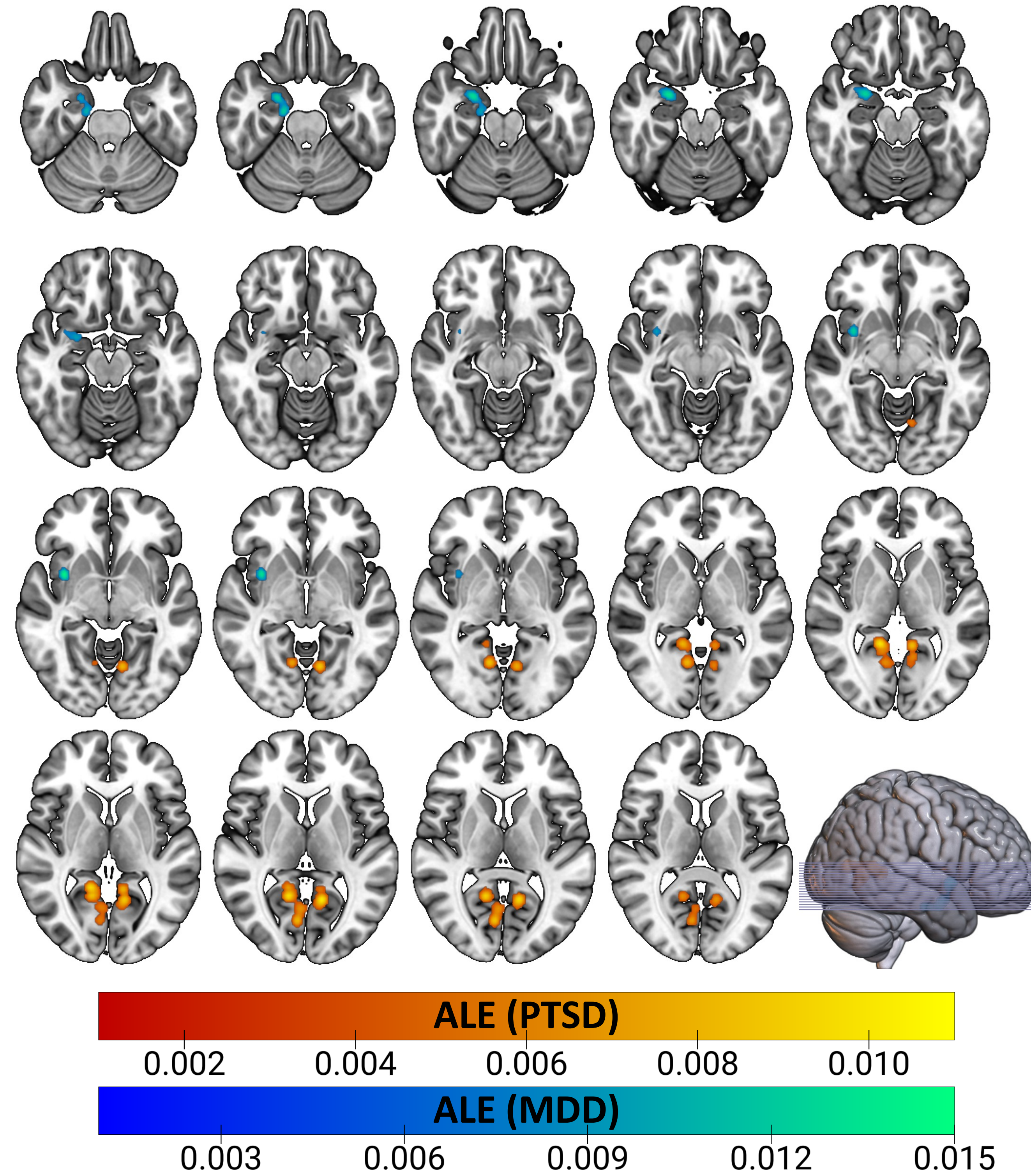
Paradigm Analysis	z-score
PTSD	
n.s.	---
Depression	
Face monitoring / discrimination	5.755
Affective pictures	5.519
Olfactory monitoring / discrimination	5.140
Emotion induction	4.703
Taste	3.455
Passive viewing	3.377

Behavioral Analysis	z-score
PTSD	
n.s.	---
Depression	
Olfaction	6.029
Fear	5.427
Sexuality	5.002
Gustation	4.025
Negative emotion	3.826
Memory	3.140

The **PTSD network** included nodes in the bilateral anterior lobes of the cerebellum, bilateral lingual gyri, and bilateral posterior cingulate/precuneus. No functional paradigms or behavioral domains were significantly associated with the PTSD network. The **depression network** included nodes in the right putamen and right parahippocampus/amygdala. The functional paradigms significantly associated with the depression network were face monitoring/discrimination, affective pictures, olfactory monitoring/discrimination, emotion induction, taste, and passive viewing. The behavioral domains significantly associated with the depression network were olfaction, fear, sexuality, gustation, negative emotion, and memory.

CONCLUSIONS

The cerebellum structural covariance networks were distinct with no overlapping nodes between PTSD and depression. These findings reveal unique alterations in structural networks in PTSD and depression and demonstrate the need for further studies of cerebellum's role in the pathophysiology of these disorders.

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