Different Developmental Pattern of Brain Activities in ADHD: A Study of Resting-State fMRI

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Abstract

There are distinct symptoms for attention deficit hyperactivity disorder (ADHD) at different ages. To explore the developmental mechanism of ADHD from childhood to adolescence, patients from different age groups with ADHD drawn from a large dataset should be investigated. In this study, we hypothesized that there are significant differences in the developmental patterns of local and global brain activities between ADHD and typically developing (TD) individuals. Three voxel-based measurements and the functional connectivity (FC) of the brain networks were extracted from resting-state functional magnetic resonance imaging (fMRI) of both ADHD and TD participants 7-16 years of age. The topological properties of brain networks in both groups were also analyzed, including hubs, hemispheric symmetry, together with local and global efficiency. The results showed, from the local perspective, that the ADHD group had abnormal amplitude of low-frequency fluctuation, fractional amplitude of low-frequency fluctuation, and regional homogeneity in the medial orbital frontal cortex, anterior cingulate cortex, postcentral gyrus, thalamus, precuneus, and cerebellum compared with the TD group. From the global perspective, the aberrant FC between multiple networks, such as the default mode network (DMN), the attention network, and the executive control network, might directly contribute to symptom differences in childhood and adolescence in ADHD patients. Finally, from the developmental perspective, there was delayed maturation of brain networks in the ADHD group, especially in the DMN. Overall, we presented the differences in brain networks between the ADHD and TD group from multiple perspectives and demonstrated the developmental abnormality of brain networks in ADHD patients, contributing to the study of the etiology of ADHD.