Disrupted Control-Related Functional Brain Networks in Drug-Naive Children with Attention-Deficit/Hyperactivity Disorder

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Attention-deficit/hyperactivity disorder (ADHD) is a common neurodevelopmental disease featuring executive control deficits as a prominent neuropsychological trait. Executive functions are implicated in multiple sub-networks of the brain; however, few studies examine these sub-networks as a whole in ADHD. By combining resting-state functional MRI and graph-based approaches, we systematically investigated functional connectivity patterns among four control-related networks, including the frontoparietal network (FPN), cingulo-opercular network, cerebellar network, and default mode network (DMN), in 46 drug-naive children with ADHD and 31 age-, gender-, and intelligence quotient-matched healthy controls (HCs). Compared to the HCs, the ADHD children showed significantly decreased functional connectivity that primarily involved the DMN and FPN regions and cross-network long-range connections. Further graph-based network analysis revealed that the ADHD children had fewer connections, lower network efficiency, and more functional modules compared with the HCs. The ADHD-related alterations in functional connectivity but not topological organization were correlated with clinical symptoms of the ADHD children and differentiated the patients from the HCs with a good performance. Taken together, our findings suggest a less-integrated functional brain network in children with ADHD due to selective disruption of key long-range connections, with important implications for understanding the neural substrates of ADHD, particularly executive dysfunction.