Regional brain network organization distinguishes the combined and inattentive subtypes of Attention Deficit Hyperactivity Disorder

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DOI: https://doi.org/10.1016/j.nicl.2017.05.016

Abstract

Attention Deficit Hyperactivity Disorder (ADHD) is characterized clinically by hyperactive/impulsive and/or inattentive symptoms which determine diagnostic subtypes as Predominantly Hyperactive-Impulsive (ADHD-HI), Predominantly Inattentive (ADHD-I), and Combined (ADHD-C). Neuroanatomically though we do not yet know if these clinical subtypes reflect distinct aberrations in underlying brain organization.

We imaged 34 ADHD participants defined using DSM-IV criteria as ADHD-I (n = 16) or as ADHD-C (n = 18) and 28 matched typically developing controls, aged 8–17 years, using high-resolution T1 MRI. To quantify neuroanatomical organization, we used graph theoretical analysis to assess properties of structural covariance between ADHD subtypes and controls (global network measures: path length, clustering coefficient, and regional network measures: nodal degree). As a context for interpreting network organization differences, we also quantified gray matter volume using voxel-based morphometry.

Each ADHD subtype was distinguished by a different organizational profile of the degree to which specific regions were anatomically connected with other regions (i.e., in “nodal degree”). For ADHD-I (compared to both ADHD-C and controls) the nodal degree was higher in the hippocampus. ADHD-I also had a higher nodal degree in the supramarginal gyrus, calcarine sulcus, and superior occipital cortex compared to ADHD-C and in the amygdala compared to controls. By contrast, the nodal degree was higher in the cerebellum for ADHD-C compared to ADHD-I and in the anterior cingulate, middle frontal gyrus and putamen compared to controls. ADHD-C also had reduced nodal degree in the rolandic operculum and middle temporal pole compared to controls. These regional profiles were observed in the context of no differences in gray matter volume or global network organization.

Our results suggest that the clinical distinction between the Inattentive and Combined subtypes of ADHD may also be reflected in distinct aberrations in underlying brain organization.