Research Trainee Showcase

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Research Area: ADHD Symptomatology and Ventroneedral Prefrontal Structure


Dr. Albaugh’s research, which examined data from the international IMAGEN study, used a multi-informant approach to investigate whether or not dimensionless measures of ADHD symptoms and brain imaging data could shed new light on the root source of ADHD’s symptoms, including inattention, hyperactivity and impulsivity. This publication represented the largest structural imaging study to date on ADHD-symptoms in adolescents and earned him the Trainee Award for Outstanding Research Publication in the Postdoctoral Trainee Research Showcase at the Dean’s Award in Research Awards event in November 2017.

In the largest voxel-based morphometry (VBM) study to date on adolescent attention-deficit/hyperactivity disorder (ADHD) symptomatology, Albaugh et al. (2017) reported that parent and youth ratings of ADHD symptoms were each negatively associated with grey matter volume in an overlapping portion of the vmPFC (Figure 1 and 2). In the largest VBM study to date on adult ADHD, a significant negative correlation was revealed between vmPFC GMV and dimensional measures of inattention (Miller et al., 2015). It is possible that vmPFC structure during adolescence is not only linked to concurrent symptoms of hyperactivity/hyperarousal, but may also be linked to ADHD symptomatology later in adulthood.

We employed structural equation modeling (SEM) in order to examine the degree to which adolescent vmPFC volume predicts hyperactive/inattentive symptoms in early adulthood.

Neuropsychometric and behavioral data were obtained from the IMAGEN study conducted across eight European sites, which includes 2,233 adolescents recruited from schools at age 14 years (SD = 0.41 year; age range = 12.8-15.7 years).

In the present study, a total of 1,104 participants possessed ADHD symptom data at the 5-year follow-up, as well as quality controlled neuroimaging data and complete psychometric and demographic data at baseline. Of these 1,104 participants, 679 (64.4%) possessed quality controlled neuroimaging data at 5-year follow-up.

Psychopathology Assessment

At baseline and 5-year follow-up, the self-report version of the Strengths and Difficulties Questionnaire (SDQ) was used to assess symptoms of hyperactivity and inattention.

Structural MRI

High-resolution anatomic MRIs were acquired with a three-dimensional T1-weighted magnetization prepared gradient echo sequence (MPRAGE) based on the ADNI protocol.

Preprocessing of the structural T1-weighted data was performed with Statistical Parametric Mapping version 8, using a standard automated pipeline.

For VBM, grey matter images were smoothed with a Full Width at Half Maximum Gaussian kernel of 8 mm, expanded to standard MNI space and modulated by multiplying the linear and non-linear component of the deformation matrix generated during spatial normalization.

Results

• Using a brain region previously identified in Albaugh et al. (2017), we conducted a hypothesis-driven, ROIs-based analysis.
  • The model showed good fit (RMSEA = 0.048; Comparative fit index = 0.896; Tucker-Lewis Index = 0.824; AGFI = 0.915; BIC = 1230).
  • Our analysis revealed that there was a significant direct effect of baseline vmPFC volume on hyperactive/inattentive symptomatology at 5-year follow-up (β = -0.205, p = .001) where smaller volumes at baseline were associated with higher levels of hyperactive/inattentive symptoms at 5-year follow-up.

Conclusions

While accounting for baseline symptomatology, smaller ventromedial prefrontal volume during adolescence predicted greater hyperactive/inattentive symptomatology at 5-year follow-up.

Our findings suggest that vmPFC structure during adolescence may become the consequence for the subsequent expression of hyperactive/inattentive symptomatology.

The vmPFC represents a primary hub in the brain’s default mode network (DMN)—a network posited to play a central role in mental-wandering and loss-avoided thoughts. Although dysfunctional, it is possible that inattention reductions in the vmPFC during adolescence may be related to a reduced transition into this state, potentially improving the reduction of inattention-related symptomatology. Future research is needed to test this hypothesis.