Refinement by integration: aggregated effects of multimodal imaging markers on adult ADHD.

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Abstract

BACKGROUND:
Attention-deficit/hyperactivity disorder (ADHD) is biologically heterogeneous, with different biological predispositions - mediated through developmental processes - converging upon a common clinical phenotype. Brain imaging studies have variably shown altered brain structure, activity and connectivity in children and adults with ADHD. Recent methodological developments allow for the integration of information across imaging modalities, potentially yielding a more coherent view regarding the biology underlying the disorder.

METHODS:
We analyzed a sample of adults with persistent ADHD and healthy controls using an advanced multimodal linked independent component analysis approach. Diffusion and structural MRI data were fused to form imaging markers reflecting independent components that explain variation across modalities. We included these markers as predictors into logistic regression models on adult ADHD and put those into context with predictions of estimated intelligence, age and sex.

RESULTS:
We included 87 adults with ADHD and 93 controls in our analysis. Participants' courses associated with all imaging markers explained 27.86% of the variance in adult ADHD. No single imaging modality dominated this result. Instead, it was explained by aggregation of relatively small effects across several modalities and markers. One of the top markers for adult ADHD was multimodal and linked to morphological and microstructural effects within anterior temporal brain regions; another was linked to cortical thickness. Several markers were also influenced by estimated intelligence, age and/or sex.

LIMITATIONS:
Although complex analytical approaches, such as the one applied here, provide insight into otherwise hidden mechanisms, they also increase the complexity of interpretations.

CONCLUSION:
No dominant imaging modality or marker characterizes structural brain phenotypes in adults with ADHD, but we can refine our characterization of the disorder by the integration of small effects across modalities.