Predicting clinical symptoms of attention deficit hyperactivity disorder based on temporal patterns between and within intrinsic connectivity networks.

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Abstract

Attention deficit hyperactivity disorder (ADHD) is a common brain disorder with high prevalence in school-age children. Previously developed machine learning-based methods have discriminated patients with ADHD from normal controls by providing label information of the disease for individuals. Inattention and impulsivity are the two most significant clinical symptoms of ADHD. However, predicting clinical symptoms (i.e., inattention and impulsivity) is a challenging task based on neuroimaging data. The goal of this study is two-fold: to build predictive models for clinical symptoms of ADHD based on resting-state fMRI and to mine brain networks for predictive patterns of inattention and impulsivity. To achieve this goal, a cohort of 74 boys with ADHD and a cohort of 69 age-matched normal controls were recruited from the ADHD-200 Consortium. Both structural and resting-state fMRI images were obtained for each participant. Temporal patterns between and within intrinsic connectivity networks (ICNs) were applied as raw features in the predictive models. Specifically, sample entropy was taken as an intra-ICN feature, and phase synchronization (PS) was used as an inter-ICN feature. The predictive models were based on the least absolute shrinkage and selectionator operator (LASSO) algorithm. The performance of the predictive model for inattention is $r = 0.79$ ($p < 10^{-8}$), and the performance of the predictive model for impulsivity is $r = 0.48$ ($p < 10^{-8}$). The ICN-related predictive patterns may provide valuable information for investigating the brain network mechanisms of ADHD. In summary, the predictive models for clinical symptoms could be beneficial for personalizing ADHD medications.