Diagnosis of Subtypes of Adhd Using Functional Connectome and Machine Learning Techniques

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Attention-deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by inattention, disorganization, and/or hyperactivity-impulsivity that often persists into adulthood. ADHD is generally classified into three main subtypes: predominantly inattentive, predominantly hyperactive-impulsive, and combined types. Despite being one of the most common neurodevelopmental disorders, there is lack of high-accuracy objective diagnostic tools for ADHD. The aim of this study was to investigate the possibility of using functional connectome in machine learning techniques as an objective diagnostic tool for ADHD. We used the dataset created by the ADHD-200 consortium, which consists of 776 resting-state fMRI and anatomical datasets aggregated across 8 independent imaging sites, of which 285 are children and adolescents with ADHD, and 491 are typically developing healthy controls. These datasets have been used in the ADHD-200 global competition (2011) and various subsequent studies to make 3-way diagnostic classifiers that separate ADHD-Combined type, ADHD-Inattentive type, and typically developing controls using various analysis methods. Their 3-class prediction accuracies approximately ranged from 40% to 70%. In this study, we used connectivity matrices constructed from rs-fMRI images as features in fully connected feedforward neural networks. Combining the adjacency matrices with nodal features such as degrees, centrality measures (betweenness, eigenvectors, and subgraphs), clustering coefficient, and eccentricity, we achieved an average accuracy of 82% for the 3-class classification, which is much higher than those of previous studies. We suggest that machine learning techniques applied to structural and functional connectome can potentially provide us with a useful diagnostic tool for ADHD with high accuracy.

Keywords: ADHD, functional connectome, machine learning, neural network, graph features

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