A Computational Model for the Automatic Diagnosis of Attention Deficit Hyperactivity Disorder based on Functional Brain Volume

Lirong Tan, Sheng Ren, Jeff N. Epstein, Long J. Lu


In this paper, we investigated the problem of computer-aided diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) using machine learning techniques. With the ADHD-200 dataset, we built a Support Vector Machine (SVM) model to classify ADHD patients from typically developing controls (TDCs), using the regional brain volumes as predictors. Conventionally, volume of a brain region was considered to be an anatomical feature and quantified using structural magnetic resonance images. In the present study, however, we have initially proposed to measure the regional brain volumes using fMRI images. Brain volumes measured from fMRI images were denoted as functional volumes, which quantified the volumes of brain regions that were actually functioning during fMRI imaging. We compared the predictive power of functional volumes with that of regional brain volumes measured from anatomical images, which were denoted as anatomical volumes. The former demonstrated higher discriminative power than the latter for the classification of ADHD patients vs. TDCs. Combined with our two-step feature selection algorithm, our SVM classification model using functional volumes achieved a balanced accuracy of 67.7%, which was 16.1% higher than that of a relevant model published previously (Sato, Hoexter, Fujita, & Rohde, 2012). Furthermore, our classifier highlighted 10 brain regions that were most discriminative in distinguishing between ADHD patients and TDCs. These 10 regions were mainly located in occipital lobe, cerebellum posterior lobe, parietal lobe, frontal lobe, and temporal lobe. Our present study using functional images will likely provide new perspectives about the brain regions affected by ADHD.