Dynamic balance in children with attention-deficit hyperactivity disorder and its relationship with cognitive functions and cerebellum

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Abstract

BACKGROUND:
Attention-deficit hyperactivity disorder (ADHD) is linked to the presence of motor deficiencies, including balance deficits. The cerebellum serves as an integrative structure for balance control and is also involved in cognition, including timing and anticipatory regulation. Cerebellar development may be delayed in children and adolescents with ADHD, and the inconsistent reaction time is commonly seen in ADHD. We hypothesized that dynamic balance deficits would be present in children with ADHD and they would correlate with attention and cerebellar functions.

METHODS:
Sixty-two children with ADHD and no other neurological conditions and 62 typically developing (TD) children were examined with five trials of the Phyaction Balance Board, an electronic balancing platform. Cerebellar clinical symptoms were evaluated using an international ataxia rating scale. Conners’ Continuous Performance Test was used to evaluate patterns of reaction.

RESULTS:
Children with ADHD had poorer performance on balancing tasks, compared to TD children (P<0.001). They exhibited significantly greater sway amplitudes than TD children (P<0.001) in all of the five balancing trials. The effect size of the difference between the groups increased continuously from the first to the last trial. Balance score in both groups was related to the variation in the reaction time, including reaction time standard error (r =0.25; P=0.0409, respectively, r =0.31; P=0.0131) and Variability of Standard Error (r =0.28; P=0.0252, respectively, r =0.41; P<0.001). The burden of cerebellar symptoms was strongly related to balance performance in both groups (r =0.50, P<0.001; r =0.49, P=0.001).

CONCLUSION:
This study showed that ADHD may be associated with poor dynamic balance control. Furthermore, we showed that maintaining balance correlates with neuropsychological measures of consistency of reaction time. Balance deficits and impaired cognitive functioning could reflect a common cerebellar dysfunction in ADHD children.