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Static balance in children with developmental coordination disorder

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Abstract

The purpose of this study was to compare the postural sway profiles of 9/10-year-old children with developmental coordination disorder and balance problems (DCD-BP, $n = 64$) with those of non-DCD children ($n = 71$). We measured center of pressure excursions in conditions with and without vision for 30 s while standing still on the dominant leg, the non-dominant leg, or both legs. Sway area, total path length, and Romberg's quotient were analyzed. Most measures differed significantly between groups, except sway area when the children stood with vision on either the dominant leg or both legs. When standing on the dominant leg or both legs, DCD-BP children demonstrated greater total path length in all conditions and a greater sway area in without-vision conditions. DCD-BP children showed more difficulty standing on the non-dominant leg with eyes both open and closed. While boys showed results similar to the total group, the girls with DCD-BP only exhibited significant differences in three conditions with eyes closed, but not with eyes open. Analysis of Romberg's coefficient also indicated that children with DCD-BP did not over-rely on visual information.

PsycINFO classification: 3250; 3297

Keywords: Developmental coordination disorder; Static balance; Visual information

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1. Introduction

The study of motor control entails the study of action, perception, and cognition and their neurophysiological underpinnings (Payne & Isaacs, 2002; Shumway-Cook & Woollacott, 2001). Studying the motor output from the nervous system to the body's muscles or effector system has been suggested as one way to comprehend the mechanisms of motor control (Shumway-Cook & Woollacott, 2001). Bernstein (1967, p. 127), defined coordination as "the process of mastering the redundant degrees of freedom of the moving organism". In children with developmental coordination disorder (DCD), the strategies for regulating muscle activity are much less uniform and consistent than in children without DCD. Thus, the bilateral motor coordination deficits in children with DCD may, in part, be incapable of organizing and employing proper motor control strategies and result in a less advanced motor control system (Williams, 2002).

Balance is the ability to maintain a weight-bearing posture, or to move through a sequence of postures, without falling, and constitutes an integral and inevitable component of most movement activities (Burton & Davis, 1992). Static balance is the ability of the body to maintain a desired posture in a stationary position, while dynamic balance implies changes in posture. Measures of assessing static balance include standing on a balance board, performing a stick balance with balancing on one foot like a stork representing the most common measurement method (Gallahue & Ozmun, 2002). Children without static balance lack the stabilizing framework that is necessary to develop normal functional activities. Additionally, static balance requires the least attention (Chen et al., 1996). Since some children with DCD also have ADHD (Kadesjo & Gillberg, 1998), static balance appears to be a good way to assess the primary ability of motor control.

Motor development undergoes continuous changes during an individual's life. From ages 6 to 10, coordination improves dramatically due to a better integration of sensory and motor systems (Gallahue & Ozmun, 2002). The control of static posture in typically developing children improves largely linearly from ages 2 to 12 (DeOreo, 1971), or 18 (Geuze, 2003; Hytonen, Pyykko, Aalto, & Starck, 1993; Wolff et al., 1998). Taguchi and Tada (1988) found that the amplitude of sway during static balance decreased between ages 2 and 14, and that the spontaneous sway mode in children reached adult levels by 9–12 of age for eye-open postures and by 12–15 for eye-closed postures. Several studies have also reported that the ability to hold a single-limb stance increases steadily between ages 6 and 8 (Figura, Cama, Capranica, Guidetti, & Pulejo, 1991; Riach & Hayes, 1987), reaching near-adult levels by 7–10 years of age (Berger, Quintern, & Dietz, 1985; Wolff et al., 1998). In terms of physiological development regarding balance, the proprioceptive system achieves near-adult levels at 4–6 years of age (Rine, Rubish, & Feeney, 1998) and matures earlier than the visual and vestibular system, which are matured by 14–15 years of age (Hirabayashi & Iwasaki, 1995).

In terms of gender, the stages of fundamental motor development and the abilities of motor coordination are different between boys and girls. Girls tend to be more proficient in static balance tasks than boys until about age 7 or 8, after which both genders level off around age 8 (DeOreo, 1971). Notwithstanding the fact that boys tend to exhibit better coordination than girls (Frederick, 1977), the boy–girl ratios of DCD prevalence ranged from 3:1 (Taylor, 1990), 5:1 (Missiuna, 1994), to 7:1 (Kadesjo & Gillberg, 1999).

Wann, Mon-Williams, and Rushton (1998) found that when children with DCD stood upright on a static floor with eyes closed, they displayed significantly greater standing sway