Research in Developmental Disabilities 34 (2013) 198–206

Contents lists available at SciVerse ScienceDirect

Research in Developmental Disabilities

Adolescents with intellectual disability have reduced postural balance and muscle performance in trunk and lower limbs compared to peers without intellectual disability

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ARTICLE INFO

Article history:
Received 30 May 2012
Received in revised form 9 July 2012
Accepted 9 July 2012
Available online 31 August 2012

Keywords:
Young adults
Postural control
Mental retardation

ABSTRACT

For adolescent people with ID, falls are more common compared to peers without ID. However, postural balance among this group is not thoroughly investigated. The aim of this study was to compare balance and muscle performance among adolescents aged between 16 and 20 years with a mild to moderate intellectual disability (ID) to age-matched adolescents without ID. A secondary purpose was to investigate the influence of vision, strength, height and Body Mass Index (BMI) on balance. A group of 100 adolescents with ID and a control group of 155 adolescents without ID were investigated with five balance tests and three strength tests: timed up and go test, one leg stance, dynamic one leg stance, modified functional reach test, force platform test, counter movement jump, sit-ups, and Biering-Sørensen trunk extensor endurance test. The results showed that adolescents with an ID in general had significantly lower scores in the balance and muscle performance tests. The group with ID did not have a more visually dominated postural control compared to the group without ID. Height, BMI or muscle performance had no strong correlations with balance performance. It appears as if measures to improve balance and strength are required already at a young age for people with an ID.

1. Introduction

Individuals with intellectual disability (ID) show: a high prevalence of obesity (Rimmer & Yamaki, 2006); low level of physical activity and performance (Frey & Chow, 2006; Lin et al., 2010); frequently more falls (Chiba et al., 2009; Sherrard, Tonge, & Ozanne-Smith, 2001); and increased health risks (Rimmer & Braddock, 2002) compared to the population in general. Physical activity has a positive effect on obesity, physical performance and health risks factors. It can also improve postural balance for people with ID with age between 18 and 45 (Guidetti, Franciosi, Gallotta, Emerenziani, & Baldari, 2010).

The postural balance system is complex and requires interaction between musculoskeletal and neural subsystems such as visual, vestibular, and somatosensory systems (Shumway-Cook & Woollacott, 2001, chapter 7). The somatosensory system seems to mature at 3–4 years of age, while the visual and vestibular systems reach adult level at 15–16 years of age (Steindl, Kunz, Schrott-Fischer, & Scholtz, 2006). To fully measure balance ability, several balance tests are required that involve the various subsystems (Horak, Wrisley, & Frank, 2009).

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0891-4222/$ – see front matter
http://dx.doi.org/10.1016/j.ridd.2012.07.008

Some studies have measured the balance in individuals with ID and shown a reduced ability compared to the general population (Dellavia, Pallavera, Orlando, & Sforza, 2009; Hale, Miller, Barach, Skinner, & Gray, 2009; Lahtinen, Rintala, & Malin, 2007; Suomi & Koceja, 1994). However, these studies only measured balance in one single way (one or two subsystem) and in small populations of elderly people. It would be valuable to investigate if the reduced ability is existent already at a young age. Recently, falls have been reported to be more common in adolescents with ID compared to their peers without ID (Sherrard et al., 2001), which could depend on reduced postural balance. To understand if postural balance is reduced in young individuals with ID, it is necessary to perform tests on a large sample.

During normal conditions, the visual subsystem appears to be the dominant subsystem for postural balance among healthy individuals (Shumway-Cook & Woollacott, 2001, chapter 7). Clinical observations from the Swedish Development Centre for Disability Sport, suggest that adolescents with ID have a more visually dominated postural balance than their peers. However, the literature reports contradictory results in adults. Dellavia et al. (2009) found that the ratio between eyes-open and eyes-closed sway was greater for adults without ID than for those with ID (Dellavia et al., 2009), but Suomi and Koceja (1994) found the opposite for a group of adults with ID. Various studies show that a high Body Mass Index (BMI) and height also can influence postural balance among children, adults and elderly people without ID (Deforche et al., 2009; Duncan, Weiner, Chandler, & Studenski, 1990; Handrigan et al., 2010). Another factor that seems to be important for postural balance is leg strength and some studies report a correlation between postural balance, strength and falls in older people (Wiacek et al., 2009; Yokoya, Demura, & Sato, 2008). However, Granacher and Gollhofer (2011) could find no correlation between strength and postural balance for young healthy people.

The main purpose of this study was to investigate postural balance among adolescent men and women aged 16–20 years with mild to moderate ID, and make comparisons with age-matched adolescents without ID. A secondary purpose was to investigate the influence of vision, strength, height and BMI. The hypotheses are that adolescents with ID have reduced postural balance, strength and a more visually dominated postural balance in comparison with non-ID adolescents.

2. Method

2.1. Recruitment

It was calculated that 80 persons in each group were required to detect a difference in the postural balance test dynamic one-leg stance (DOLS) between groups with an odds ratio of 2.0 (power = 0.80, significance level = 0.05, one-sided test). Two upper secondary schools in Sweden were contacted, one for adolescents with ID and one for non-ID adolescents. Permission was given by the principals of the two schools for a visit to all classes to provide information about the study. All students, both ID and non-ID, received verbal and written information about the study and was asked to participate. A letter was sent home to the guardians of the students with ID younger than 18 years old. The letter contained information about the study and a request to return a signed approval form allowing their son/daughter to participate. Only students whose guardians returned the approval form were allowed to take part (Fig. 1).

2.2. Participants

Adolescents in the age range 16–20 years were included. A group of 100 adolescents with ID, both men and women, volunteered to participate (ID-group). The control group included 155 adolescents, both men and women, without ID (Table 1). All adolescents who volunteered to do so were allowed to participate in the study. The ID-group had a significantly higher mean BMI and the height for women was significantly lower than for non-ID women.

All participants in the ID group had been administratively defined as having a mild to moderate ID (IQ 70–35) by means of an intellectual functioning test (IQ-test) and standardized tests to determine limitations in adaptive behaviour in three skills; conceptual, social and practical. Those tests were carried out by a registered psychologist.

Exclusion criteria for both groups were; sensory deficits in lower extremities (loss of sensibility, affected stretch reflexes or reduced strength in lower extremities), recent injury to lower extremities, impaired vision (visual acuity value >0.10), history of or ongoing vestibular neuritis, illness in the few days preceding the tests, a diagnosis of cerebral palsy and use of walking aids.

2.3. Test procedure

An interview was done with each participant concerning exclusion criteria followed by screening for any loss of sensory function. Age, height and weight of each student were measured. Vision test was carried out by using an eye chart. A battery of five postural balance tests (two static and three dynamic) and three muscle strength tests was used (Blomqvist, Wester, Sundelin, & Rehn, 2011). The postural balance tests were performed before the muscle performance tests and in an alternating order to avoid any systematic bias. The strength tests were however, performed in the same order each time. All tests were performed barefoot. There was no trial run and all participants were allowed three attempts, with a 30 s rest between each, at all tests. There were six different test leaders during the test period, two were experienced physiotherapists, and four physiotherapy students. All test leaders were trained and educated by one of the physiotherapists who was also a test leader. The training and education included practical performance of and discussion about the tests.