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Research Paper

Balance training improves postural balance, gait, and functional strength in adolescents with intellectual disabilities: Single-blinded, randomized clinical trial

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Abstract

Background: Adolescents with intellectual disabilities often present with problems of balance and mobility. Balance training is an important component of physical activity interventions, with growing evidence that it can be beneficial for people with intellectual disabilities.

Objective: The aim of this study was to investigate the effect of balance training on postural balance, gait, and functional strength in adolescents with intellectual disabilities.

Methods: Thirty-two adolescents with intellectual disabilities aged 14–19 years were randomly assigned either to a balance training group ($n = 15$) or a control group ($n = 16$). Subjects in the balance training group underwent balance training for 40 min per day, two times a week, for 8 weeks. All subjects were assessed with posture sway and the one-leg stance test for postural balance; the timed up-and-go test and 10-m walk test for gait; and sit to stand test for functional strength.

Results: Postural balance and functional strength showed significant improvements in the balance training group ($p < 0.05$) as compared to baseline; however, postural balance and muscle strength showed no significant improvements in the control group. Further, postural balance and functional strength significantly improved in the balance training group compared with those in the control group.

Conclusions: Balance training for adolescents with intellectual disabilities might be beneficial for improving postural balance and functional strength.

Keywords: Adolescent; Intellectual disability; Postural balance; Gait; Strength

During motor development, equilibrium is crucial for controlling and acquiring motor skills.[1,2] For completion of independent walking, control of static balance must be achieved first; insufficient ability to control posture during the development process slows the acquisition of independent movement and locomotion.[3] Specifically, the ability to achieve equilibrium is a major factor in motor development, and development of postural control has a huge impact on the development of voluntary motor control.[4]

Delay in motor control and its development are closely related to intellectual disabilities.[5] Intellectual disabilities are defined as disorders with limitations in adaptive behavior, which occur due to insufficient or incomplete development of intellectual ability.[2] Young people with intellectual disabilities show functional defects in three domains of learning, cognitive, affective, and social, as well as in other areas.[6–8] In particular, they display significant delays in the area of motor development, which includes physical fitness and motor skills, within the psychomotor domain.[8]

Delays in acquiring physical fitness and in the motor development of adolescents with intellectual disabilities lead to a delay in functional development.[9] Typically, in young people with intellectual disabilities, basic movements become dull, and the abilities for exercise, manipulation, and coordination become increasingly poorer.[10] Children with intellectual disabilities have severe difficulties in maintaining correct posture and/or their equilibrium when standing up straight.[11] Further, while their physical development is completed to a certain extent, several of their motor functions remain deficient.[12,13]

Difficulties in controlling balance lead to problems with gait and locomotion and an increased risk of falling.[14,15] Many reports have demonstrated that the presence of intellectual

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disabilities increases the risk of falling, with the injuries caused by falls being relatively more common or severe.[14–17] Individuals with intellectual disabilities present an increased risk of falls, with possible fractures due to a reduction in bone mass; moreover, after such falls, the rate of complications in these individuals is more than twice that in people without developmental disabilities.[17] In recent years, however, some studies have concluded that both the frequency of falls and the incidence of injuries due to falls are higher in individuals with intellectual disabilities than in people without intellectual disabilities.[14,15,17]

A greater understanding of the nature of balance and gait problems, as well as the roles of balance and gait in causing falls in individuals with intellectual disabilities may help to develop intervention strategies aimed at preventing falls and injuries.[18] For adolescents with intellectual disabilities, physical activity is crucial for enjoying a good quality of life and for appropriate growth and development.[19] Appropriate physical activity in school-age children may improve not only their motor function but also cognitive, social, and emotional abilities.[20] At school-age, if both balance ability and locomotion can be improved through proper exercise, one can expect a harmonious development of the body and decrease of falls.[21,22] Previous studies have reported that the postural sway in the standing posture of adolescents with intellectual disabilities is higher than that in individuals with normal intelligence, leading to problems in static balance.[11,23]

Data published in the literature about the prevention of falls indicate that improvements in balance, strength, and walking ability would have a positive impact on the prevention of falls; further, various exercise programs have been developed and introduced.[10,24,25] However, most such studies have targeted individuals with normal intelligence and not subjects with physical disabilities or elderly individuals with intellectual disabilities. Few studies have evaluated exercise programs for preventing falls and/or improving balance in individuals with intellectual disabilities.[10,24,25]

Previous studies that have examined the effects of balance and gait training in individuals with intellectual disabilities have focused on elderly people with intellectual disabilities; further, a greater number of studies have focused on balance training than on gait training, with or without a treadmill.[26,27]

Therefore, this study aimed to develop a method of intervention for preventing falls via a balance exercise program, and to analyze its effects on balance, gait, and lower extremity functional strength in adolescents with intellectual disabilities.

Subjects and methods

Participants

The study group included 32 participants with mild intellectual disabilities, who were students of a special education school in Gyeonggi Province, South Korea. The group consisted of 14 women and 18 men, aged 14–19 years (16.68 ± 1.70 years). The intelligence quotients (IQs) of the participants were determined using the Wechsler Intelligence Scale test. All participants had an IQ within the range suggestive of mild mental retardation (50–70). Participants were excluded if they had any musculoskeletal, neurological, cardiovascular, or respiratory system impairments or other accompanying ailments. Individuals who participated in less than 80% of the exercise program and those who were unable to perform follow-up tests were also excluded from the final analyses.

All parents or legal guardians provided written informed consent prior to participation. Our study protocol was approved by the Institutional Review Board of Sahmyook University, South Korea, allowing the adolescents' involvement in the program and access to relevant information.

To minimize selection bias, the subjects were assigned randomly to either the balance training group (n = 16) or control group (n = 16) using Random Allocation Software (version 1.0).[28] However, one subject in the balance training group was excluded from the analysis because his participation in the program was less than 80%. Thus, the study included in total 31 subjects: 15 in the balance training group and 16 in the control group. No significant differences were observed between the two groups with regard to gender, age, height, causes of intellectual disability, or weight (Table 1).

Procedures

Study participants were tested prior to the start and after the end of the 8-week period of the intervention program.

Table 1
Description of subject's baseline characteristics (N = 31)

	Balance training group (n = 15)	Control group (n = 16)	$x^2/t(p)$
Gender (male/female)	15 (8/7)	16 (9/7)	0.027 (0.875)
Age (year)	16.27 ± 1.17[a]	17.06 ± 1.75	1.318 (0.198)
Height (cm)	156.66 ± 11.84	159.16 ± 10.72	0.616 (0.543)
Weight (kg)	54.14 ± 16.39	56.49 ± 10.26	0.483 (0.633)
Cause of intellectual disability			0.015 (0.901)
Down syndrome	10	11	
Unknown syndrome	5	5	

[a] Mean ± standard deviation.