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RELATIONSHIP BETWEEN BALANCE AND CO-ORDINATION AND FOOTBALL PARTICIPATION IN ADOLESCENTS WITH INTELLECTUAL DISABILITY

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ABSTRACT

Balance and motor coordination problems are often seen in persons with intellectual disability (ID). This study aimed to examine the relationship between balance and coordination and football participation in adolescents with ID. The study involved 197 male participants with ID aged between 14 and 19 years (16.22±2.00), of which 110 (65 mild ID, 45 moderate ID) played soccer in a school team, and 87 (48 mild ID, 39 moderate ID) did not participate in any sport. Balance and coordination skills were evaluated using the Bruininks-Oseretsky Test of Motor Proficiency, second edition short form (BOT-2 SF). A significant positive relationship was found between all the balance and co-ordination sub-tests and the duration of playing football in the adolescents with ID ($p<0.05$). Balance and co-ordination scores were significantly higher in both the mild and moderate ID participants, who played football compared with the individuals with ID who did no sport ($p<0.05$). In adolescents with moderate ID, the difference in the 7th item of the balance sub-test was not significant. The results indicate that football participation and balance and coordination are related in adolescents with mild and moderate ID.

Keywords: Intellectual disability; Balance; Coordination; Bruininks-Oseretsky Test; Motor skills; Football participation.

INTRODUCTION

Intellectual disability (ID) is defined by the American Association on Intellectual and Developmental Disabilities as an intellectual disability characterised by significant limitations both in intellectual functioning and in adaptive behaviour as expressed in conceptual, social, and practical adaptive skills. This disability originates before age 18 (Schalock *et al*., 2010). According to the Diagnostic and Statistical Manual of Mental Disorders based on intelligence quotients (IQ), ID is classified as mild at an IQ level of 50-55 to approximately 70, and as moderate at IQ level 35-40 to 50-55 (APA, 2000).

Intellectual disability is a brain development deficiency, which affects cognitive functions and motor skills in an individual with ID (Hartman *et al*., 2010; Vuijk *et al*., 2010; Westendorp *et al*., 2011). Several previous studies have shown that children and adolescents with ID have lower level motor skills compared to peers without ID (Frey & Chow, 2006; Hartman *et al*., 2010; Vuijk *et al*., 2010; Westendorp *et al.*, 2011; Wang *et al*., 2012; Rintala & Loovis, 2013; Pitetti *et al*., 2017). Adequate motor skills are essential for children to be able to participate in age-related physical activities, and gross motor skills may play an important role in maintaining

a sufficient level of physical activity throughout life (Laukkanen *et al*., 2014). Young people with better motor and cognitive functions participated more and also reported greater enjoyment in both formal (such as music or art lessons, organised sports, or youth groups) and informal activities (such as reading, talking on the phone, or doing a puzzle) (Wuang & Su, 2012). Adequate levels of motor skills may contribute to lifelong enjoyment of physical activity, participation in sports and healthy lifestyles (Vuijk *et al.*, 2010).

Problems with balance and co-ordination commonly occur in individuals with ID (Jankowicz-Szymanska *et al*., 2012; Zur *et al*., 2013). Insufficient balance negatively affects a child's motor skills, as balance underlies almost all forms of movement. Functional abilities, such as sitting, standing and walking and successful performance of sports, dancing and exercise hinge on a well-integrated skill to ensure postural control (DePeepe & Ciccoglione, 1993; McGuine *et al*., 2000; Simeonsson *et al*., 2003). Blomqvist *et al.* (2013) have shown that adolescents with mild to moderate ID have worse postural balance than their peers without ID.

In typically developing children, participation in physical activity or sports has positive effects on motor skills (Luban *et al*., 2010). Westendorp *et al*. (2011) reported that the gross motor skills of children with ID between the ages of 7 and 12 years who participated in organised sports, were higher than those of children with ID who did not participate in sports, and lower than those of peer children without ID.

PURPOSE OF STUDY

From a review of the literature, it seems that no previous studies have evaluated the effect of football participation on balance and coordination performance in adolescents with ID. Therefore, this study was planned to investigate the relationship between football participation and balance and coordination performance in adolescents with ID to those persons with an ID that does not participate in sport. Our study hypothesis was 'balance and coordination performance are related to football participation in adolescents with ID.

METHODOLOGY

Research design

This study was a cross-sectional study. Balance and coordination skills were measured once in adolescents with ID who engaged in football and persons with ID who did not participate in sports.

Participants

The study sample consisted of a total of 197 adolescents with ID, comprising 110 (65 mild ID, 45 moderate ID) who regularly participated in football, and 87 (48 mild ID, 39 moderate ID) who did not do any sports. A total of 19 adolescents were excluded from the study; 11 who were not able to co-operate, five with other disabilities and three with severe ID**.** The participants with ID were students of Special Education Schools for the intellectually disabled and diagnosed with ID at the Ministry of Health hospitals. The ID levels of the participants were obtained from the Special Education Schools. All the adolescents with ID lived at home with their families. The football group of 110 adolescents with mild and moderate ID had been playing in their school football teams at least two days per week, for at least one year.

The exclusion criteria for both groups were visual disorders, auditory disorders, problems of the vestibular system and extremity injuries affecting motor performance.

Ethical clearance

The study was approved by the Local Research Ethics Committee (Study number: 60116787/020/20026), and all procedures were in accordance with the ethical standards of the Declaration of Helsinki. The participants and their parents were informed about the study, and informed consent was obtained from the parents or legal guardian of each participant.

Measurements

Anthropometric measures

The age, height, weight, and body mass index (BMI) of the participants were recorded. Height and weight were measured with a Seca unit without shoes. The demographic data of the participants are shown in Table 1.

Table 1. **DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS**

Physical variables	**Mild ID** (N=113) Sport (n=65) Mean±SD	Non-sport (n=48) Mean±SD	p*	**Moderate ID** (N=84) Sport (n=45) Mean±SD	Non-sport (n=39) Mean±SD	p*
Age (yr)	16.21±1.71	15.72±1.55	0.715	16.93±1.72	16.05±2.90	**0.000**
Height (cm)	167.54±10.59	163.31±10.96	0.766	169.60±0.07	160.90±1.47	**0.000**
Weight (kg)	59.93±14.06	58.29±14.00	0.724	63.17±16.33	57.20±17.16	0.587
BMI(kg/m^2)	21.24±4.27	21.77±4.68	0.386	21.81±4.89	21.75±5.04	0.574

* Mann-Whitney U Test **Bold** p-value significant ID=Intellectual disability SD=Standard Deviation

Bruininks-Oseretsky Motor Proficiency Test Short Form (BOT-2, SF)

The Bruininks-Oseretsky Test of Motor Proficiency is a widely-used scale to evaluate motor problems in children and adolescents with disorders such as cerebral palsy, intellectual disability, developmental co-ordination disorder, attention deficit, hyperactivity syndrome and autism. This evaluation method was re-assessed in 2005 and the second version, the BOT-2, was issued. BOT-2 is a method which evaluates motor functions of children and adolescents between the ages of 4 and 21 years (Bruininks & Bruininks, 2005). The revised BOT-2 is a reliable (range 0.90-0.97) and valid substitute for the original BOT-2 in evaluating motor proficiency in children and adolescents with ID aged from 4 to 18 years (Wuang *et al.,* 2009).

In this study, the short form of the BOT-2 was used. The short form of BOT-2 contains 14 different items from 8 sub-tests. The BOT-2 assesses proficiency in four motor-area composites. Body composite is grouped into bilateral co-ordination and balance sub-tests that tap the balance and motor skills required for successful participation in sports and recreational games. Bilateral co-ordination and balance sub-tests were used in the study. In all the sub-tests, the movement required was demonstrated once before the performance and evaluation. The participants attempted the movement once, and were then tested and the score obtained was recorded.

BOT-2 Bilateral Co-ordination Sub-tests

Bilateral co-ordination was assessed using the 3rd and 6th items of the bilateral co-ordination sub-tests of BOT-2.

Jumping in place- same sides synchronised, 3rd Item: This evaluates the ability to jump 5 times while standing with synchronised movement of lower and upper extremities of the same side. Complete movements during 5 jumps were scored. The highest score of this item is 3.

Tapping feet and fingers- same sides synchronised, 6th Item: The participant is asked to touch the floor with the same side index finger and foot while sitting and to turn his head away while the hand and foot of the other side are on the floor. This movement is repeated for the other side. These synchronised movements are repeated 10 times and evaluated. Accurately executed movements during these 10 repetitions are scored. The highest score of this item is 4.

BOT-2 Balance Sub-tests

Balance was assessed using the 2nd and 7th items of the balance sub-tests of BOT-2.

Walking forward on a line, 2nd Item: The individual is evaluated walking along a line with his hands placed on his lower back. When six steps are completed, the test is stopped. Steps which do not extend beyond the line are accepted as accurate. The highest score of this item is 4.

Standing on one leg on a balance beam, 7th Item: The time the subject can stay on a balance board with his dominant foot and with his eyes open is recorded. The dominant lower extremity was determined by kicking a ball on the floor to ascertain with which leg they preferred to hit the ball and that was designated as the dominant side. The longest duration to remain on the balance board is 10 seconds. The highest score of this item is 4.

Statistical analysis

The data were analysed using the SPSS (20.0 version) statistics package software. Descriptive data were stated as average, standard deviation and percentage. The test of homogeneity variance was used to test the homogeneity of variables. The relationship between the duration of playing football and the bilateral co-ordination and balance scores was analysed with the Spearman's Rank Correlation Test. The relationship was calculated for the total sample. The Mann-Whitney U test was used to compare the scores from the bilateral co-ordination, balance sub-tests and total scores obtained by individuals with mild and moderate-level ID. A value of $p<0.05$ was accepted as statistically significant.

RESULTS

Participant demographics

The mean age of the overall participants was 16.22±2.00 years (range=14–19 yrs). No significant difference were found between the adolescents with mild ID who played football compared to those who did not, in respect of age, height, weight, and BMI ($p>0.05$). In the adolescents with moderate ID, a significant difference was found between those who participated and did not participate in sports in respect of age and height ($p=0.000$). No difference was determined between the groups in respect of body weight and BMI ($p>0.05$). The mean duration of playing soccer was 3.36±1.71 years.

Main analysis

A positive significant correlation at a low level was determined between all the sub-tests and the duration of playing football and balance (2nd item $r=0.358$, $p<0.001$; 7th item $r=0.229$,

p=0.001) and coordination (3rd item r=0.308, p<0.001; 6th item r=0.375, p<0.001) of the adolescents with ID (p<0.05) (Table 2).

***Table 2*. RELATIONSHIP BETWEEN DURATION OF PLAYING FOOTBALL AND BILATERAL CO-ORDINATION AND BALANCE SUB-TEST SCORES**

Variables	**Sub-tests**	**Duration of playing football** (N=197) r*	p
Bilateral Co-ordination	3rd Item	0.308	**<0.001**
	6th Item	0.375	**<0.001**
Balance	2nd Item	0.358	**<0.001**
	7th Item	0.229	**0.001**

* Spearman's Rank Correlation

***Table 3*. COMPARISON OF BILATERAL CO-ORDINATION AND BALANCE SUB-TEST SCORES**

Variables	**Mild ID** (N=113) Sports (n=65) Mean±SD	Non-sport (n=48) Mean±SD	p*	**Moderate ID** (N=84) Sports (n=45) Mean±SD	Non-sport (n=39) Mean±SD	p*
Bilateral coordination						
3rd Item	2.61±0.80	1.93±1.29	**0.000**	1.62±1.30	0.48±1.09	**0.007**
6th Item	3.10±1.31	2.29±1.84	**0.000**	2.57±1.52	0.48±1.14	**0.011**
Balance						
2nd Item	3.92±0.36	3.64±0.69	**0.000**	3.55±1.07	2.46±1.72	**0.000**
7th Item	3.58±0.72	3.08±1.26	**0.002**	2.93±1.17	2.23±1.34	0.195

* Mann-Whitney U Test p-value SD: Standard Deviation **Bold** indicates significant differences

In the adolescents with mild ID, co-ordination (3rd item p<0.001, 6th item p<0.001) and the balance (2nd item p<0.001, 7th item p=0.002) sub-test results were found to be statistically significantly better in the group who participated in football. In adolescents with moderate ID, except the 7th sub-test of balance (p=0.195), the balance (2nd item p=0.000) and coordination (3rd item p=0.007, 6th item p=0.011) sub-test results were statistically significantly better in the group who participated in football (Table 3).

DISCUSSION

In this study, the relationship between football participation and balance and co-ordination was examined in adolescents with mild and moderate ID and in non sport participation. The results

indicate that football participation and balance and co-ordination are related in adolescents with mild and moderate ID. The results we obtained in our study supported our hypothesis.

According to several previous studies, different exercise interventions have a positive effect on balance in adolescents with ID (Giagazoglou *et al.*, 2012; Villarroya *et al.*, 2013; Lee *et al.*, 2016; Wu *et al.*, 2017; Ambroży *et al.*, 2017). However, a recent systematic review and meta-analysis synthesised the results from reviewed studies investigating whether exercise training improves skill-related fitness including balance and co-ordination in adolescents with ID and the results did not support positive effects of exercise training on balance (Jeng *et al.*, 2017).

On the other hand, we found that football participation and balance and coordination are related in adolescent with ID. The reason for the different findings of our study and a study by Jeng *et al*. (2017) might be due to differences in the study designs. The sample of our study were adolescents with ID who played football for at least one year. However, in the study of Jeng *et al*. (2017), it was examined that the effect of different exercise interventions (hippotherapy, water aerobic exercise, balance and postural training on swisball exercise, road running training, traditional Greek dance, sensory-motor training) balance and coordination. Also, the duration of the interventions were shorter (8 to 16 weeks) than our study.

Although few studies have investigated the effect of exercise interventions on balance (Giagazoglou *et al.*, 2012; Villarroya *et al.*, 2013; Lee *et al.*, 2016; Wu *et al.*, 2017; Ambroży *et al.*, 2017), there is a lack of information about the relationship between balance performance and football participation in adolescents with ID. To the best of our knowledge, there has only been one study on balance in the paediatric ID population. Westendorp *et al*. (2011) examined the relationship between specific gross motor skills, including balance, and organised sports participation in children with ID between the ages of 7 and 12 years. Those who participated in organised sports were reported to have better balance than children with ID who did not participate in sports, but it was at a lower level than that of children with typical development.

Lee and Jeoung (2016), investigated the effects of motor skill development on behavioral problems in students with ID. Of the sub-domains of problematic behaviors, social problems were found to be associated with the motor skill developmental sub-domains of bilateral co-ordination, balance, speed and agility, upper limb co-ordination, and strength. These results demonstrate that increased co-ordination and gross motor development help to improve social problems. In the current study, there was seen to be a development of co-ordination and balance skills in individuals with both mild and moderate ID via sports participation. The development of these skills can also be considered to indirectly prevent behavioral problems.

Balance and co-ordination in individuals with ID are also important in terms of the risk of falling. In a study by Sherrard *et al*. (2001) it was reported that of children, adolescents and young adults with ID with injuries, most of the injuries (60.2%) were caused by a fall, and the rate of falls was higher in ID patients than in the general population.

The adolescents with ID in the current study were playing football regularly. Four tests were used for balance and co-ordination assessment in this study. It was thought that playing football over a considerable time would have a positive effect on balance and co-ordination skills. Golubovic *et al*. (2012) revealed that participating in an exercise program improved outcomes in all physical fitness tests including the balance test in mild ID. The reason for improvement in physical abilities was explained in the study as the development of abilities enabling the successful performance of motor tasks, primarily strength, co-ordination of upper and lower limbs, movement control, equalisation and regulation of muscle tone and spatial orientation.

LIMITATIONS

The main limitation of this study was that balance and co-ordination performance were evaluated as motor skills but these have been reported to be the most incomplete motor skill areas for individuals with ID (Tsimaras *et al*., 2000). The results of this study do not provide information about other motor skill areas. Future studies should examine the whole range of motor skill areas in subjects with mild and moderate ID.

PRACTICAL APPLICATION

There is relationship between playing football and balance and co-ordination in mild and moderate ID adolescents. Therefore, adolescents with both mild and moderate ID should be encouraged to participate in football for better balance and co-ordination skills. Sports participation also improves motor skills and reduces the risks of falls. With better balance and co-ordination skills, individuals with ID could participate more in daily living activities, in addition to physical and sporting activities.

CONCLUSION

The results of this study showed that playing football was related to balance and co-ordination performance in adolescents with mild and moderate ID. Further studies are required to be able to investigate the effect of different sports (team sports, field sports, etc.) on balance and co-ordination performance in adolescents with ID. It can also be suggested that future experimental studies are made with sports interventions to examine the effect of sport on balance and co-ordination.

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