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An Evaluation of Fine and Gross Motor Skills in Adolescents with Down Syndromes

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Abstract

Down syndrome (DS) is the most common genetic cause of intellectual disability. Motor development of children with DS is delayed. The aim of the present study was to evaluate of fine and gross motor skills of adolescents with DS. The study sample of a total of 34 participants aged between 14 to 20 years comprised 16 adolescents with DS and a normally developing group of 18 adolescents without DS. Fine and gross motor skills of the participants were assessed by Bruininks-Oseretsky Test of Motor Proficiency, second edition short form (BOT-2 SF). The highest score of the test is 88 and higher score shows higher performance. The average age of adolescents with DS and without DS who participated in the study were 17.06±2.79 and 16.56±1.09, respectively. All partcipants were male. It was found a significant differences for all BOT-2 SF subtests and total scores when compared between adolescents with DS and adolescents without DS ($p<0.05$). Adolescents without DS has higher scores than adolescents with DS. In conclusion, both fine and gross motor skill performance of adolescents with DS is lower than normally developing adolescents. This study stresses the importance of interventions facilitating motor skills.

Keywords: Down syndrome, fine, gross, motor skill, adolescents

Introduction

Motor skills are the basis for any bodily movement which is an intentional movement involving a motor or muscular component. Motor skills must be learned and voluntarily produced to capable perform a goal-oriented task (Connolly, & Montgomery, 2005). Development of motor skills occurs over relatively extended time periods that refers to the processes of change in motor behavior (Haywood, & Getchell, 2009). Gross and fine motor skills are two distinct types of motor skills. Gross motor skills are movements which involve the use of the large muscules such as crawling, stand up, up stairs, walking and running. In the early years of life, gross motor skills are developed as they are required for the stability and control of the body in addition to exploration of the environment (Cools et al. 2009; Gallahue, & Ozmun, 2006; Haywood, & Getchell, 2009; Rigal, 2003). Fine motor skills are the use of small muscles involved in movements that require the functioning of the extremities to manipulate objects (Gallahue, & Ozmun, 2006). Fine motor skills play a role in many activities of daily life such as dressing and feeding ones self, in addition to being essential in writing, drawing, picking up objects and cutting, (Cools et al. 2009; Summers et al. 2008a).

An organised series of related movements used to perform basic movement tasks are described by Gallahue and Ozmun as Fundamental Movement Skills (FMS) (Gallahue, & Ozmun, 2006). FMS divide movement into three categories; locomotor movement tasks such as walking or running, manipulative movement tasks such as kicking and striking and stabilising movement tasks such as balance. FMS form the basis for many of the specific motor skills that we use in sport, leisure activities and everyday life (Okely, & Booth, 2004). FMS form the basis for many of the specific motor skills that we use in sport, leisure activities and everyday life (Okely, & Booth, 2004) and insufficient FMS impede the child's participation or performance at home, in schools, and in the community (Dolva, Coster & Lilja, 2004, Whittingham, Fahey, Rawicki, & Boyd, 2010).

Down syndrome (DS) is the most common genetic cause of intellectual disability. DS or trisomy is displaying a number of specific difficulties, such as delays in motor skill development and physical fitness, abnormal sensorimotor integration, obesity, health impairments, neurological impairments, delays in speech and language skill development, practical and social functioning, cognitive limitations (scott, & holfelder, 2015). Several previous studies have shown that children with DS have lower level motor skills compared to peers without DS. However, there is insufficient information about motor skills of adolescents with DS. The aim of the present study was to evaluate of fine and gross motor skills of adolescents with DS and compared with normally developing adolescents.

Material and Methods

This study was a cross sectional study. The study sample of a total of 34 participants were 16 adolescents with DS aged between 14 to 20 years and 18 age matched adolescents without DS as normally developing group. All partcipants were male. The inclusion criterias for adolescents with DS were having genetic diagnosis of Down syndrome by a pediatric neurologist, able to independent standing and walking, functional hearing and vision. The exclusion criterias were having a history of congenital heart defects and orthopaedic surgery. The study excluded normally developing adolescents with any diseases and injury which affect the development such as diseases such as metabolic, cardio-respiratory system,

musculo-skeletal system and metabolic diseases. Written consent was obtained from all the study participants and their parents.

Test of Bruininks-Oseretsky Test of Motor Proficiency

Fine and gross motor skills of the participants were assessed by Bruininks-Oseretsky Test of Motor Proficiency, second edition short form (BOT-2). BOT-2 SF is a is a widely used scale to evaluate motor problems in children and adolescents with nerodevelopmental disorders such as DS, cerebral palsy, mental retardation, developmental coordination disorder. BOT-2 is a valid and reliable method in both normally development and disabled children and adolescents which evaluates fundamental motor functions of children and adolescents between the ages of 4 and 21 years (Bruininks, & Bruininks, 2005). In this study the short form of the BOT-2 was used. The short form of BOT-2 (BOT-2 SF) contains 14 different items from 8 subtests and 14 items. The highest score of the test is 88 and higher score shows higher performance. The BOT-2 assesses proficiency in four motor-area composites including fine manual control, manual coordination, body coordination and trength and agility (Bruininks, & Bruininks, 2005).Table 1 showes motor-area composites, subtests and items of the BOT-2 SF.

Table 1. Motor-area composites, subtests and items of the BOT-2 SF.

Composite	Subtest and items
Fine manual control	**Fine motor precision**
	Drawing lines
	Folding paper
	Fine motor integration
	Copying a square
	Copying a star
Manual coordination	**Manual dexterity**
	Transferring pennies
	Upper-limb coordination
	Dropping and catching a ball
	Dribbling a ball
Body coordination	**Bilateral coordination**
	Jumping in place
	Tapping feet and fingers
	Balance
	Walking forward on a line
	Standing on balance beam
Strength and agility	**Running speed and agility**
	One legged stationary hop
	Strength
	Knee push-ups Sit-ups

Analyses of the data

The data were analyzed using the SPSS (16.0 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. Mann Whithney U test used to compare the BOT_2 sub-tests and total scores obtained by adolescents with normally developed and DS. A value of $p \leq 0.05$ was accepted as statistically significant.

Table 2. Demographic characteristics of the participants

	Down syndrome group (n=16)	Normally developing group (n=18)	Z value	P*
	Mean±SS	Mean±SS		
Age	17.06±2.79	16.56±1.09	-0,177	0,860
Weigth	62.19±14.19	62.89±7.90	-0.63	0.52
Heigth	156.25±10.54	174.50±8.90	-4.04	**0.000**

Table 3. BOT-2 SF subtests and total scores of the groups

	Down syndrome group (n=16)	Normally developing group (n=18)	Z value	P*
	Mean±SS	Mean±SS		
Fine motor precision	4.44±1.86	11.11±2.54	-4,738	**0.000**
Fine motor integration	2.12±1.54	7.00±1.81	-4,824	**0.000**
Manual dexterity	4.62±1.74	6.44±2.47	-3,413	**0.001**
Upper-limb coordination	6.94±3.66	11.61±0.77	-4,434	**0.000**
Bilateral coordination	2.75±2.17	6.11±1.53	-4,124	**0.000**
Balance	5.75±2.14	7.67±7.67	-3,554	**0.000**
Running speed and agility	4.00±2.22	7.67±0.97	-4,479	**0.000**
Strength	5.00±3.22	11.28±1.60	-4,703	**0.000**
Total BOT-2	35.81±12.09	69.00±5.92	-4,973	**0.000**

*Mann Whithney U Test- analysis

Findings and Results

The average age of normally developing and DS groups of the study were 16.56±1.09 and 17.06±2.79 years, respectively. There is no differences between groups in terms of age, weigth and heigth ($p<0.05$). Physical characteristics of participants are given at Table 1.

The average total scores of BOT-2 SF of normally developing and DS groups were 69.00±5.92 and 35.81±12.09, respectively. It was found a significant differences for all BOT-2 SF subtests and total scores when compared between adolescents with DS and normally developing adolescents without DS ($p<0.05$). Adolescents without DS has higher scores than adolescents with DS (Table 2).

Discussions and Conclusion

Fine and gross motor skills of adolescents with DS were evaluated and compared with normally developing adolescents by using BOT-2 SF for investigate the effect of DS on the fundamental motor skills. We found that both fine and gross motor skill performance of adolescents with DS is lower than those of normally developing adolescents.

Several previous studies have shown that children with DS have lower level motor skills compared to peers without DS. Our finding is similar with results of previous studies. Connolly and Michael was to examine the gross motor and fine motor abilities of children with mental retardation using the Bruininks Oseretsky Test of Motor Proficiency. They compared the motor skills of 24 mentally retarded children, 12 with DS and 12 without DS with age 7.6 years to 11 years. The results of the study showed that the children with DS had lower scores than the children without DS in the areas of running speed, balance, strength, and visual motor control and also the gross motor and fine motor skill composite scores were lower for the children with DS than for the children without DS (Connolly, & Michael, 1986).

Malak et al. (2015) reported that the reduced size of the cerebrum, brain maturation disorders, and pathophysiological processes lead to motor development delay in the DS. In their study, to examine the gross motor function and estimate what motor abilities are significantly delayed in children with DS if they attend physical therapy sessions and also to assess the functional balance. The study group consisted of 79 children with DS (42 boys, 37 girls), average age 6 years and 3 months ±4 years and 6 months. Children were assessed using the Gross Motor Function Measure-88 (GMFM-88) and Pediatric Balance Scale (PBS). They concluded that motor development, especially standing position and walking ability, is delayed in children with Down syndrome. Balance and motor functions are correlated with each other, so both aspects of development should be consider together in physical therapy of children with Down syndrome (Malak et al., 2015).

Best of our knowledge, there is no previous study which about both fine and gross motor skills in adolescents with DS. Only in a study by Wang et al. (2012) was to evaluate gross motor skills of adolescents with DS. They were to investigate the relationships between task-oriented postural control and motor ability in children and adolescents with DS. The participants were 23 children and adolescents with DS and 18 age- and gender-matched peers. A force plate was used to collect postural data represented by center of pressure (COP) parameters and assessments of motor ability were only applied to the DS group by the original version of Gross Motor Function Measure and 4 subtests of the Bruininks Oseretsky

Test of Motor Proficiency, second edition. The results showed that the participants with DS exhibited poor voluntary control of postural sway and insufficient motor ability (Wang et al., 2012). Children with DS delays in motor developments as results of associated impairments including muscle hypertonia, joint hyperextensibility, delayed acqisition of postural control, poor balance, and some children congenital heart disease and obesity (Russel, 1988). Although physical activity has same importance for health in each age group, it is observed in studies on physical performances of children and youth having DS that the exercises performed are significantly insufficient (Aksay, 2014). In this study we determined Fundamental motor skills of the adolescents by using BOT-2 SF. Proficiency in FMS are prerequisites for functioning in activities of daily living as well as for later participation in sport specific activities (Cools et al. 2009). Insufficient FMS are more likely to experience frustration and difficulty in the learning of more advanced skills (Stodden et al. 2008). Children with poor FMS have been found to have lower levels of health related fitness and participate less in organised sports and PA compared with children who have proficient motor skills (Stodden et al. 2008; Okely & Booth, 2004). Previous studies in DS showed that the low cognitive and motor skills of individuals (Oates et al., 2011) limit participation in physical activities (Barr and Shields, 2011; Menear, 2007). Because in general these individuals move slowly, the movement safety and movement quality may vary. The physical activity skills are higher in youth period, which degrade as age increases in DS like as in non-disabled individuals, (Menear, 2007).

In conclusion, both fine and gross motor skill performance of adolescents with DS is lower than normally developing adolescents. This study stresses the importance of interventions facilitating motor skills. The knowledge of differences in both fine and gross motor skills in adolescents with DS adolescents should be of great interest to physical educators and could be of benefit in the designing and planning of physical activity programs or sports according to the adolescents' abilities, thereby improving both fine and gross motor skills. With better fine and gross motor skills, adolescents with DS could participate more in daily living activities, in addition to physical and sporting activities. Although individuals with DS show slower motoric development than their non-disabled peers (Aksay, 2014; Fidler et al., 2008; Block, 1991), they could participate in many exercise or sportive activities.

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