

## Effect of a Selected Physical Exercise on the Development of Displacement Movement Skills in Highly Functional Autistic Children

Fatemeh Keyhani,\*<sup>1</sup> Rasool Hemayat-Talab,<sup>1</sup> Mahmoud Sheykh,<sup>1</sup> Saeed Kosari<sup>1</sup>

1. Department of Motor Behavior, Faculty of Physical Education and Sport Science, University of Tehran, Tehran, Iran

### Article information

#### Article history:

Received: 11 June 2012

Accepted: 2 Aug 2012

Available online: 10 June 2013

ZJRMS 2014 Sep; 16(9):18-21

#### Keywords:

High Functioning Autistic (HFA)

Physical Activity

Displacement skills

Test of Gross Motor

Development-2 (TGMD-2)

#### \*Corresponding author at:

Department of motor behavior,  
Faculty of Physical Education  
and Sport Science, University  
of Tehran, Iran.

Email:

keihani.f@gmail.com

### Abstract

**Background:** The study is about to examine the effect of the selective physical exercises on the development of displacement skills in High Function Autistic (HFA) children.

**Materials and Methods:** In this research, 10 children ( $7.9 \pm 1.4$  years) among of 33 children with HFA in Sahr-e-Kord city (in Iran) based on their pre-test scores randomly were selected. The measuring tool was Test of Gross Motor Development-2000 (TGMD-2). Selected motor program (SPARK motor program) in this research includes motor strengthening activities, games and sports for children that were performed for 12 sessions by our subjects. Normal distribution of data checked by K-S test and appropriate statistical Levine's and ANOVA tests (dependent and independent types) were used for compare mean values ( $\alpha=0.05$ ).

**Results:** Twelfth sessions of selected physical exercises training in experiment group made significant differences in some research variables but it was not the case for the control group. There were significant differences in running ( $p=0.002$ ), trotting ( $p=0.08$ ), jumping ( $p=0.002$ ) and gliding ( $p=0.004$ ) and there were non-significant differences in hop ( $p=0.035$ ) and leaping ( $p=0.02$ ).

**Conclusion:** According to the results of this research we suggest that the selected physical exercise programs that derived from SPARK motor program can improve displacement motor skills in children with HFA.

Copyright © 2014 Zahedan University of Medical Sciences. All rights reserved.

### Introduction

High Function Autism (HFA) disorder is a spectrum disorder with deferent symptoms that create disability in different dimensions such as social relationship skills, gross and fine motor skills and maybe in mental skills. This unhealthy is a spectrum of disorders and it means that a person can be with mild or very severe autism. At the highest end of the spectrum, is Asperger's syndrome or high-functioning autism disorder that sometimes called the Little Professor Syndrome [1]. Lowest end of the spectrum, often called classic autism, which is usually associated with mental retardation. There are few disorders among these disorders, such as Rett syndrome, childhood disintegrative disorder and non-specific pervasive developmental disorders [2]. Prevalence of these disorder 3 to 6 cases per 1000 children was estimated and 4 times more prevalent in boys than girls. Whatever is common to all people diagnosed with autism disorder is delay or failure in social skills such as everyday conversation, eye contact and emotional understanding of others. These problems lead to impaired social interaction, verbal problems, disturbance in nonverbal communication, and limitations in daily activities. Most people with autism also suffer from developmental delay in gross and fine movements skills [3]. Baranek reported that the sensory and motor difficulties often manifested in autism, Prupas and Reid and Levinson and Reid, in the investigation of physical activity on stereotyped behaviors of children with Autism

Spectrum Disorders (ASD), showed that physical activity leads to a reduction in stereotyped behaviors. In addition, Barkeley et al. reported that physical activity promoted ability to communicate and social interaction [4-7]. Despite the importance of fundamental skills in children, a few studies examined the effects of motor activities and physical games on fundamental skills in these children and most studies that have been done about these filed were investigated the effect of physical activities on other aspects of children's behavior, such as stereotyped behaviors [8]. Because the children with autism disorders have problem in fundamental motor skills, especially in displacement skills, games and play may be able to have the main role in rehabilitation of this disorder. Due to the power of plays as a valuable educational tool in the growth and development of human and Included in this item, investigation of its effects on movement skill development in children with HFA was considered in this study.

### Materials and Methods

In the present semi-experimental study 10 children ( $7.9 \pm 1.4$ ) among children's with autism in education and rehabilitation center of HFA children of Shahr-e-Kord were selected randomly and based on pre-test. After distributing the questionnaires to the subjects and analyzing them based on the research scopes and

purposes, the children were divided into two similar groups after pre-test. The consent of the children's parents were taken before the test by the agreement of the research vice-president of Exercise Department of Tehran University and the person in charge of the education and rehabilitation center of Shahr-e-Kord.

Test of Gross Motor Development-2000 (TGMD-2) is one of the reliable tools for evaluating development of gross motor skills; that was provided by Ulrich (1985) in the United States of America for the first time and reported its stability and justifiability for 3-10 years old American children. The test reliability was 96% and the stability was 87%. Movement test included 6 skills: running, trotting, hopping, skipping, jumping, sliding. Subjects were divided into two groups: control and experimental group, uniformly considering the results [9]. The experimental group members undertook 12 sessions of the selected exercise program and the control group members were conducting their routine activities. Classifying people into experimental and control groups was done regarding the gained results from the TGMD-2 pretest. The selected exercise program of the study has been adopted from the Spark physical education program which deals with development of the basic skills of children including sporting, playing and active reaction for children.

The program is 45-minute sessions including three parts: the first 15 minutes is allocated to warming up, then 20 minutes for playing fundamental movement activities and finally ten minutes is spent on cooling off. The descriptive statistics to measure the central and dispersion indexes of the quantitative scales, depicting diagrams and tables and inferential statistics were used to test the outlined assumptions. Levine test was utilized for investigating variances while in covariance test, the differences among the values in pre-test of control and experimental groups were determined as intervening variable and its effect on the test was eliminated. All the statistical analyses were carried out by SPSS-16.

## Results

In this part, the demographic information such as age, weight, height, and IQ of both experimental and control groups are proposed in table 1 (Table 1). Regarding the achieved P-value it can be seen that there is no significant difference between average score of pre-test and post-test of control group while there was a significant difference between pretest and post test scores of the experimental group about most of subscales of experimental group ( $p=0.001$ ) (Table 2).

**Table 1.** Demographic information of groups

Groups	Age(yr)	Weight (kg)	Length (cm)	IQ
Exp	7.8±1.3	27±9.9	126.6±15.6	93.4±7.09
Con	8±1.5	26.2±8.1	127.2±15.6	95.6±4.78

**Table 2.** Pretest and post test results of control and experiment groups in all subscales

Variables			Mean±SD	p-Value
Running	Con	pre	3.20±1.64	0.02
		post	3±1.73	
	Exp	pre	4±1.58	0.002
		post	5±1	
Trotting	Con	pre	1.20±0.84	0.08
		post	1.20±1.30	
	Exp	pre	1.20±0.84	0.002
		post	3.8±0.45	
Hopping	Con	pre	3±1	0.28
		post	2.80±1.64	
	Exp	pre	2.40±1.52	0.35
		post	3.60±0.89	
Skipping	Con	pre	2	0.002
		post	2	
	Exp	pre	1.20±0.84	0.002
		post	2.60±0.55	
Jumping	Con	pre	3.20±2.30	0.10
		post	4±2	
	Exp	pre	2.20±1.92	0.02
		post	4.20±1.92	
Sliding	Con	pre	3.20±1.30	0.01
		post	2.80±1.79	
	Exp	pre	2±1.87	0.004
		post	4.20±2.59	

## Discussion

Findings about the effects of a period of physical exercise on children with autism revealed that there were significant differences between the mean values of children's movement skills of both experimental and control groups. In other words, exercises related to running, trotting, hopping, skipping, jumping and sliding skills have caused the movement skills of children with autism to grow and improve appropriately. Since children with autism suffer from brain failure, so these failures would have negative impacts on their motor functions; that case was reported in Berkeley et al. [8], Pan et al. [11], Staples and Reid [12], Green et al. [13], Ghaziuddin and Bulter [14], and Manjiviona and Prior [15] where movement skills of children with autism had problems and those children were weaker than the children in the same age range. So giving motor training which strengthens the fundamental skills would cause the motor skills to improve; this study had the similar results. Besides the present paper, Fragala-Pinkham et al. [16], Lochbaum and Crews [17], Prupas and Reid [5], Reid et al. [18], Rosenthal and Mitchell [19], Levinson et al. [6], Kern et al. [20], Kosari et al. [20] and Best and Jones [1] reported the same results; each of those papers could to some extent improve those children's motor weaknesses using motor-skill-related training. Because of aligned findings of the present paper with those of the aforementioned papers it can be concluded that for developing motor skills and removing the motor weaknesses of children with autism it is recommended to use motor exercises. The results of the selected physical exercise on running subscale in children with autism (HFA) showed a significant difference between experimental and control groups. In other words, doing

some activities like moving the legs and arms in the opposite sides, exercising with toes, moving with toes, jumping (separating your legs from the ground), and bending the non-supporting leg at 90 degrees would cause those weak body parts of children with autism to improve and the children would be able to run better. Running is one of the important movements for the children in different ages, since the base of playing game in children is running; Staples and Reid [11] believed that running is the most required part of a happy life for children and they also claimed that if children are weak at running, they have problems in doing many games. As a result of weakness in running, children with autism may prefer seclusion and isolation, so it is required to fortify running skill using a systematic and scientific training program [11].

The present study could improve running skill in children with autism and its results were in line with the findings of the works of Fragala-Pinkham et al. [15], Lochbaum and Crews [16], Prupas and Reid [5], Reid et al. [17], Rosenthal and Mitchell [18], Levinson et al. [6], Kern et al. [19], Kosari et al. [20], and Best and Jones [1]. That good agreement showed that the children with autism needed special training program for normal developing of motor skills; this issue should be considered in the schools and other places for retarded children. For trotting training, children should practice activities like bending arms in the beginning of the movement, continuous walking with forward and backward movement of the legs, separating both legs (jumping with both legs), and preserving balanced and consecutive pattern for doing four trotting skills together. Since the children with autism have movement failure and are weak in motor functions besides it was reported in the works of Pan et al. [10], Reid and Staples [11], Manjiviona and Prior [14] and Dy Myer [21] that children with autism have problem in motor skills, the selected training program can improve their motor skills; the case was confirmed in the present paper. The experimental group improved very well in trotting activities and there was a significant difference between their mean with that of the control group. So the selected training program in the present paper could improve the trotting skill of children with autism.

Comparing the results of hopping skill of children in both groups revealed no significant differences between their means. Although the selected training program could fortify the hopping skill of children in the experimental group, but such growth was not meaningful considering the control group. Those findings revealed that for improving hopping skill it is required to have the training for a longer duration. Since hopping skill needs balance and power, it can be said that the selected training program couldn't improve these two factors in the children; while Fragala-Pinkham et al. [15] could improve these two factors by aerobics in water. Comparing the mean of subscales of jumping in children with autism in control and experimental groups, the findings revealed that there was significant difference between them. In other words, the selected training program considered for

the children could improve their jumping skill and make them able to represent better jumping function. Barkley et al. [4] considered the coordination of arms and legs a requisite skill of jumping and believed that children with autism for the weakness in motor skills needed to be trained more in this skill in order to have the sufficient coordination of arms and legs to be able to do jumping skill. Levinson et al. [6] considered the jumping skill an essential cause for making the children happy and increasing their motivation for movement and endeavor. Development of this skill in children with autism requires special training program which was attained here in the preset paper with a logical and systematic training program. Jumping is one of the skills which need preserving balance of body in ideal conditions; children need to have good conceptual understanding for jumping so this is a difficult skill for them. Since children with autism face a lot of difficulties for their brain failure, they need to practice a lot for doing jumping skills. In the present paper, there were no significant statically differences between the averages of experimental and control group; though, the children in experimental group had a mean much larger than on the pre-test, this difference was not significant. So regarding the larger mean of post-test than the pre-test, if children are trained more, the probability of optimal growth of jumping skill is more. Best and Jones [1] showed if the training program of children with autism is longer and more continuous, their motor skills improve more and children can remedy their motor weaknesses [1]. Mitchell and Rosenthal [18] also believed that continuous training is one of the success factors in motor training of the children with autism [18].

The results of comparing the subscale means of sliding of children with autism of control and experimental groups showed a significant difference. In other words, the training in the present paper for sliding in HFA children caused them to learn the skill very well. These findings are in good agreement with those of Fragala-Pinkham et al. [15], Lochbaum and Crews [16], Prupas and Reid [5], Reid et al. [17], Rosenthal and Mitchell [18], Levinson et al. [6], Kern et al. [19], Kosari et al. [20], Best and Jones [1], since in the above mentioned papers, the given training program to the children with autism could improve their motor skill. The whole gained results can be treated under the framework of the dynamic systems theory. As you know, according to the dynamic systems theory, the environment is an important factor for growth of the motor skills. The theory poses that the factors which affect the motor growth including the motor task interact with individual (biologic and heritage factors) and the environment (experience and learning factors) and such factors are effective in growth of strong, displacement motor skills, gross and fine motor skills and manipulative motor skills. Unlike the clinical viewpoint in which the only growth factor is growth and development of the motor skills, as you saw the researcher has affected considerably the growth of motor skills of children through manipulating the environment on the one hand and minimizing the effect of growth and development via

homogenization of groups; such results verify the dynamic systems theory.

Finally it can be concluded that the selected physical training program of the study, which is copied from SPARK physical education program possibly can improve the motor skills in children with HFA. With regard to the fact that the subjects of our study all were children with HFA, conducting some similar studies but over subjects with multiple disorders is suggested in order to find that whether the similar results are obtained. Likewise, the used physical activities in this study are mainly based on hobbies and entertainment of subjects on the designed physical activity, so formal and purposeful activities and sports are suggested for the next studies.

## References

- Best JF, Jones JG. Movement therapy in the treatment of autistic children. *Aust Occup Ther J* 1974; 21(2): 72-86.
- Rafie T. Autism, evaluation and treatment. 1<sup>st</sup> ed. Tehran: Danzheh Press; 2006.
- Ghanizadeh A. A preliminary study on screening prevalence of pervasive developmental disorder in schoolchildren in Iran. *J Autism Dev Disord* 2008; 38:759-763.
- Ozonoff S, Dawson G, McPartland J. A Parent's guide to Asperger syndrome and high-functioning autism: how to meet the challenges and help your child thrive. 1<sup>st</sup> ed. New York: Guilford Press; 2002.
- Baranek G. Efficacy of sensory and motor interventions for children with autism. *J Autism Dev Disord* 2002; 32(5): 397-422.
- Prupas A, Reid G. Effects of exercise frequency on stereotypic behaviors of children with developmental disorders. *Educ Training Ment Retard Dev Disord* 2001; 36(2): 196-206.
- Levinson L, Reid G. The effects of exercise intensity on the stereotypic behaviors of individuals with autism. *Adapt Phys Activ Q* 1993; 10(3): 255-268.
- Berkeley S, Zittel L, Pitney L, Nichols S. Locomotor and object control skills of children diagnosed with autism. *Adapt Phys Activ Q* 2001; 18(4): 405-416.
- Lang R, Koegel LK, Ashbaugh K, et al. Physical exercise and individuals with autism spectrum disorders: A systematic review. *Res Autism Spectr Disord* 2010; 4(4): 565-576.
- Zare-Zadeh M. [Normalization and determination of test reliability and validity of motor development for children 3 to 11 years in Tehran] Persian [dissertation]. Tehran: Tehran University; 2009.
- Pan CY, Tsai CL, Chu CH. Fundamental movement skills in children diagnosed with autism spectrum disorders and attention deficit hyperactivity disorder. *J Autism Dev Disord* 2009; 39(12):1694-1705.
- Staples KL, Reid G. Fundamental movement skills and autism spectrum disorders. *Autism Dev Disorder* 2010; 40(2): 209-217.
- Green D, Charman T, Pickles A, et al. Impairment in movement skills of children with autistic spectrum disorders. *Dev Med Child Neurol* 2009; 51(4): 311-316.
- Ghaziuddin M, Butler E. Clumsiness in autism and Asperger syndrome: A further report. *J Intellect Disabil Res* 1998; 42(Pt 1): 43-48.
- Manjiviona J, Prior M. Comparison of Asperger's syndrome and high-functioning autistic children on a test of motor impairment. *J Autism Dev Disord* 1995; 25(1): 23-39.
- Fragala-Pinkham M, Haley SM, O'Neil ME. Group aquatic aerobic exercise for children with disabilities. *Deve Med Child Neurol* 2008; 50(11): 822-827.
- Lochbaum M, Crews D. Viability of cardio-respiratory and muscular strength programs for the adolescent with autism. *J Evid Based Complementary Altern Med* 2003; 8(3): 225-233.
- Reid PR, Factor DC, Freeman NL and Sherman J. The effects of physical exercise on three autistic and developmentally disordered adolescents. *Ther Recreat J* 1998; 22(2): 47-56.
- Rosenthal-Malek A, Mitchell S. Brief report: The effects of exercise on the self-stimulatory behaviors and positive responding of adolescents with autism. *J Autism Dev Disord* 1997; 27(2): 193-202.
- Kosari S, Hemayat-talab R, Aram-Ameri E and Kehani F. The effect of physical exercise on the development of gross motor skills in children with attention deficit / hyperactivity disorder. *Zahedan J Res Med Sci* 2013; 15(2): 74-78.
- Dy Myer Mk. Motor perceptual-motor and intellectual disabilities of autistic children. In: Wing L. *Early childhood autism*; New York: Pergamon Press; 1976: 15-65.

## Acknowledgements

Hereby the research deputy of Physical Education Faculty of Tehran University for its pervasive support of the study is appreciated. The article is the fruit of thesis no. 803. All subjects who voluntarily participated in this study are highly appreciated and we wish luck for them.

## Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

## Conflict of Interest

The authors declare no conflict of interest.

## Funding/Support

Tehran University.