

The Effect of Physical Exercise on the Development of Gross Motor Skills in Children with Attention Deficit / Hyperactivity Disorder

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Article information	Abstract
<p>Article history: Received: 22 Feb 2011 Accepted: 23 Apr 2011 Available online: 28 Oct 2012 ZJRMS 2013; 15(2): 74-78</p> <p>Keywords: Attention Deficit / Hyperactivity Disorder Physical activity Gross motor skills Bruininks- Oseretsky test</p> <p>*Corresponding author at: Department of motor behavior, Faculty of Physical Education and Sport Science, University of Tehran, Iran E-mail: Saeedkosari@alumni.ut.ac.ir</p>	<p>Background: The study is about to examine the effect of the selective physical exercises on gross motor activities of children with attention deficit hyperactivity disorder (ADHD).</p> <p>Materials and Methods: In this quasi-experimental study out of 120 students with ADHD who were studying under supervision of Tehran Department of Education of Exceptional Children, a number of 20 children (8.8±0.7 years old) with ADHD were selected randomly and based on pre-test. The measuring tool was the Bruininks-Oseretsky test of motor proficiency. The selected motor program (SPARK physical education program) including reinforcement activities, playing and sporting for children was repeated for 18 sessions by our subjects. The Kolmogorov-Smirnov test (KS-test) was used to check normal data distribution and the correlative t-test and independent t-test were used to compare mean values.</p> <p>Results: Eighteen sessions of the selected motor activities for the experiment group made significant differences in all variables of the study, but it was not the case for the control group. The experiment group's differences were running speed and agility ($p=0.001$), balance ($p=0.001$), bilateral coordination ($p=0.001$) and strength ($p=0.001$).</p> <p>Conclusion: With regard to results of the study, it can be claimed that the selected physical education program which has been inspired by Spark physical education program is able to improve gross motor skills in children with ADHD.</p> <p>Copyright © 2013 Zahedan University of Medical Sciences. All rights reserved.</p>

Introduction

Attention deficit hyperactivity disorder (ADHD) is a developmental disorder in attention, impulse, restlessness and directed behavior control which is developed naturally and is mainly due to major, sensory, motor or emotional neurological disorders [1]. According to the Diagnostic and Statistical Manual of Mental Disorders criteria published by the American Psychological Association (APA), symptoms must be displayed before the child reaches seven years and behaviors that are indicator of the disorder must be seen at least through two different fields and destruct considerably social, occupational or educational performance of the patient. Alizadeh had put the outbreak rate of the disorder in Iran at 10-20 percent of school children. The patients suffer from problems in coordinating upon learning new motor skills, they conduct the learnt skills in poorer quality than their peers and show slower response and action in all assignment levels [1- 6].

Harvey et al. showed that there were not any significant difference between children with ADHD and normal children in taking balls and kicking them [7]. Sepeshri-Bonab took advantage of Lincoln-Oseretsky Motor Developmental Scale (LOMDS) to show that children with ADHD took lower scores than the normal children in subtests of LOMDS [3]. Pashazadeh used LOMDS to show that children with ADHD were weaker than normal

children in most analyzed skills [2, 3]. Children with ADHD who suffer from low preparation level may be exposed to motor, cardiovascular diseases and weak motor skills and physical preparation as the result of inactivity decrease the self-confidence which in turn decline participation level and low participation will be followed by weak motor performance and physical preparation [6, 8].

Barkley analyzed motor activities of children with ADHD and found that 62% of the children suffer from weak skills in coordinating their activities and the inability is completely evident in their gross and fine skills. In other words, they are clumsy and gawky [6, 9], hence, regarding the evident influence of sport in improving the people's life, our objective in this study is to analyze the effect of the physical activity on motor skills of children with ADHD.

Materials and Methods

In this quasi-experimental study out of 124 male students with ADHD who were studying under supervision of Tehran Department of Education of Exceptional Children, a number of 20 children (8.8±0.7 years old) with ADHD were selected randomly and based on pre-test. Regarding the population's size and the current limitations, our questionnaires were distributed

among 54 samples. Subsequent to collecting and analyzing the questionnaires based on the research territory and objectives, 20 samples finally were selected who were divided into two 10-member groups after practicing the pre-test (based on the pre-test results).

Bruninks-Oseretsky Test of Motor Proficiency (BOTMP) is a set of reference normal test which examines motor performance of individuals (4.5-14.5 years old). The full set of the test is comprised of 8 subtests (including 46 separated parts) which evaluate motor proficiency or gross and fine motor disorders. The summarized form of the test includes eight subtests and 14 separate sections. Bruninks has devised the new version in 1978 after reforming Oseretsky motor proficiency test. The full application of the tests lasts for 45-60 minutes. Four gross motor subtests, three fine motor subtests and a mixed motor subtests are evaluated. Bruninks went forward the test over a population including 756 children who had been selected based on age, sex, race, population size and the geographical region according to census in year 1970. The reliability coefficient of the retest has been reported 0.87 [6].

Classifying people in to experimental and control groups was done regarding the gained results from the BOTMP pretest. The experimental group members undertook 18 sessions of the selected exercise program and the control group members was conducting their routine activities. At the end of the 18th session both groups started to perform post-test procedure. 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 four parts: the first 15 minute is allocated to warming up, then 10 minutes playing including motor displacement activities, then 10 minutes is allocated to manipulative motor skills 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. K-S and independent and correlated *t*-test were used to test assumptions.

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. Regarding the achieved *p* from the correlated *t*-test, it can be seen that there is no significant difference between average score of pre-test and post-test of control group in the subscale of running speed and agility, balance, bilateral coordination and strength, while there was a significant difference between pretest and post test scores of the experimental group in all 4 mentioned subscales ($p=0.001$) (Table 2).

Table 1. Demographic information of groups

Groups	Age(year)	Weight(Kg)	Length(cm)	IQ
Exp	8.9±0.8	26.25±1.9	126.5±2.6	94±7.63
Con	8.8±0.7	27.9±2.3	128±4.5	90±4.67

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

Variables			Mean±SD	<i>p</i> -Value
Running Speed & Agility	Con	pre	9.10±0.73	0.052
		post	9.60±0.84	
	Exp	pre	9.10±0.87	0.001
		post	13.70±1.49	
Balance	Con	pre	18.30±0.94	0.811
		post	18.40±1.50	
	Exp	pre	18.30±1.56	0.001
		post	23.90±2.46	
Bilateral Coordination	Con	pre	9.90±0.87	0.052
		post	10.40±0.84	
	Exp	pre	9.80±0.78	0.001
		post	13.50±1.26	
Strength	Con	pre	20.50±3.43	0.726
		post	20.60±3.46	
	Exp	pre	20.80±3.48	0.001
		post	31.60±3.83	

Discussion

The results of comparing the average values of running speed and agility, balance, bilateral coordination and strength showed that in pretest in contrast to the post test, scores of the control group have not increased significantly; however, they have been increased significantly for the experiment group.

For the subscale of running speed and agility, the results indicate that the physical exercises used in this study have been succeeded to affect the subscale in the subjects of the experiment group. The results are not consistent with the Hodge et al [10]. Hodge et al, did not show any performance difference between the groups during 40-yard sprint and the assignment of taking the ball and it was the case for the sex criterion as well [10]. Age was one of the most important factors in this study, and another possibility was the concurrent disorders with ADHD which could affect the results of this study. Likewise, the Hodge's subjects had been selected of both female and male patients and it must be keep in mind that naturally males in contrast females carry out better the gross motor activities such as running and agility. Our results are consistent with Reid and Harvey [11], Youn and Youn [12], Rohbanfard [13], Sheikh et al. [14], Nazarian [15], Mottaharian [16] and Mola-Norouzi [17]. According to these authors and our results it can be say that exercising, physical activity and playing affect considerably the cognitive-motor abilities and can lead to the motor growth. The results suggest that playing, exercising and physical activities can enhance people's speed and agility.

For the subscale balance, the weaker fine motor skills in children with ADHD are related with the fact that "fine motor skills create bigger needs to keep attention and doing effortful activities". People's ability to maintain balance is almost necessary for successful conduction of all daily activities. Systems' theory is a novel theory which recently has become the base of authors who are active in movement and balance field. Accordingly, the

ability to maintain and control our posture in space is the result of application of a complicated action which occurs among muscular, skeletal and nervous systems and their importance varies based on the objective to perform the action and the environmental condition. In this model, using information collected by visual, vestibular and proprioception senses, the central nervous system gets informed about body's center of mass to the gravity ratio and also support condition and provides a proper motor response which has been planned as motor patterns. On the other hand, a number of studies have shown that athletes enjoy better balance than the people who do not exercise, but the main reason for this has not been known yet [18, 19].

The results are not consistent with the Rohbanifard, it can be due to type of the motor program which unlike the games has failed to affect the balance and another reason may be Rohbanifard's selected samples who were mainly educable mentally retarded children, hence we know that the intelligence quotient (IQ) somehow affects the children balance [13].

On the other hand, our results are consistent with Pan et al. [20], Flapper et al. [21], Piek et al. [1], Wade [22], Harvey et al. [23], and Wang [24]. Over 50 % of children with ADHD suffer from motor coordination problems which bring them in the category of individuals with Developmental Coordination Disorders. Piek et al. found that the balance skills of their subjects based on severity of ADHD subtypes are different, as there is a converse relationship between the severity of ADHD subtypes and the balance scores which would be due to the disorder severity influence on the attention and concentration mechanisms which play very important roles in the balance skills [1].

Although the effect of ADHD drugs was not controlled in the study, regarding that most children with ADHD at least use methylphenidate (Ritalin), as Wang [24] has pointed in his own study it would be one of reasons of the improved scores of balance [22]. For the bilateral coordination, our results were inconsistent with Hodge et al. [10] and McKenzie et al. [25] Hodge et al. found that children showed significantly better throwing accuracy than their congeners [10]. McKenzie et al. indicated that children manipulative skills can be improved through high-quality physical training plans provided by the skilled physical trainers [25]. Practice and experience affect people's coordination skills and the more the practices are, the stronger the people's coordination will be.

Our results are consistent with Rohbanifard [13], Hosseinkhani [26], Piek et al. [1], Wang [24], Whitmout and Clark [27]. The program used by Rohbanifard affected positively the balance skill and its possible reason would be the type of the used program by the author which has been exactly for the tested skills. It is the case for Hosseinkhani, as well. Witmout and Clark found a strong relationship between lack of the fine and gross motor skills and the severity of ADHD symptoms [27]. Piek et al. found that type and degree of the motor inability was different among various subtypes. The

weaker fine motor skills in children with ADHD are related to the fact that "fine motor skills bring about greater needs for keeping attention and effortful activity" [1]. Wang concluded that conducting the innovative programs has a significant positive influence on the growth of manipulative and displacement motor skills. The justification expressed in this study is designing the innovative motor program which has been particularly designed for the tested skills [24].

For strength subscale, our results are consistent with Rohbanifard [13], Sheikh et al. [14], Pan et al. [20], Harvey et al. [23], and Wang [24]. Study of Sheikh showed that any applied factor in the primary school game programs affect the correspondent factor in LOMDS test. Harvey et al. concluded that children with ADHD were not as successful as their congeners in terms of the motor efficiency [23]. Pan et al. found that autism and ADHD groups gained significantly lower scores in contrast to the control groups in growth of the gross motor growth as well as in displacement and thing control subtypes; the autism group was significantly weaker than ADHD group in displacement and thing control subtypes [20]. In this study, weak motor performance can be related to the low self-confidence, high stress levels and weak social functioning. Wang concluded that performing innovative programs affect positively the various skills of subjects [24]. The designed program for the subjects was the main factor and strength training has been used to improve the strength of subjects.

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 [8]. 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 gross motor skills in children with ADHD.

Because of their active memory disorders, children with ADHD need external and immediate control and are unable to keep the information for designing and predicting exercise in their mind, hence they suffer from further problems in the behaviors related to timing. Probably it is the main cause of their problem in coordinating their eye and hand tasks and upper and lower limbs which are related to timing. Deficit in behavioral inhibition cause problem in self-regulation ability of emotions (excitation, motivation etc.), then, the child's

excited responses to severe stimuli and the mind's excitement effect decreases ability which in turn weakens the hyperactive child in doing fine skills and skills which need to fine muscular control. Attention deficit hyperactivity disorder varies from moderate to severe and it seems that regarding keeping the children in exceptional school, their disorder is severe, so they are weak either in gross or fine motor skills. In studies which do not show any difference in gross skills and other skills, the subjects possibly suffered from moderate or mild disorders. Without medications, children with ADHD may find problem in concentrating their attention on their necessary requirements or showing proper motor responses; but when the children are treated with Methylphenidate, their ability to concentrate on the necessary requirements may get improved, therefore they will show more precise activities [6, 8, 28].

With regard to the fact that the subjects of our study all were children with ADHD, 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. To take advantage of the results of the study practically, the exceptional education organizations of the country are suggested to devise special physical activity programs for upgrading the motor skills level of such individuals along with other education plans, also formation of special centers to cover children with motor problems and cognitive-motor problems is proposed.

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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.

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