Physical Activity Review vol. 2, 2014

Original Articles

The effect of nontraditional sports games on coordination abilities and correction of behavior disorders in prepubertal integrated children

Authors' Contribution:

A – Study Design
B – Data Collection
C – Statistical Analysis
D – Manuscript Preparation
E – Funds Collection

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Abstracts. *Among factors that positively underlie physical education process, provide stimuli during exercise sessions, increase interest, effectiveness and esthetic character are various nontraditional games as well as nontraditional exercise equipment. Nontraditional sports games have effect on physical fitness and motor performance, promote health, social and moral development of children. We aimed to provide further evidence on nontraditional sports games, their rules, basic methods, forms and means used in teaching school physical education to prepubertal children. These means were used to develop coordination abilities of general population. The statistical significance of changes was determined using paired samples t-test for the following abilities: rhythmical abilities, reaction abilities, balance abilities, kinesthetic-differentiation ability (spatial, strength), frequency ability, coupling ability and reorganization ability. The use of nontraditional movement games was found to have effect on behavior change of children with ADHD. To determine changes in behavior, Vanderbilt rating scale was used. Statistically significant improvements determined by Wilcoxon test was found for the following subscales: following instructions/rules, assignment completion and organizational skills.*

Keywords*: nontraditional sports games, coordination abilities, integrated children with behavior disorders, hyperactivity, prepubertal age, assessment of behavior, Vanderbilt rating scale*

INTRODUCTION

Prepubertal children are most sensitive to motor skill acquisition and ability development. School age is a vital period of life and significant mobility of 6 to 8 years old children is accompanied by excessive movement. Coordination abilities considerably determine motor skills and abilities of children. Children learn to couple particular phases of movement and refine the spatial and temporal structure of movement. This development results in achieving harmonized movement [12,13,19,21].

The most appropriate age for the development of both motor and coordination abilities is the prepubertal age. The organism of a 7- to 10-year-old child responds to external stimuli in a most sensitive way. In school physical education, coordination abilities are developed according to the model based on natural movement. The development of coordination of

school-aged children has been studied by several authors [6,7,9,18,19]. Educational experiments conducted by authors mentioned have confirmed that the growth rate in experimental classes is higher by tens of percent (20% to 50%) compared to controls. Through their experimental studies Raczek [18,19] and Ljach [14] have found that a 6-week period suffices for the development of coordination abilities such as reaction speed, frequency ability and balance. Their studies showed little differences between genders. Some studies showed higher level of fine motor skills for girls; however, gross motor skills were more developed in boys [8,16,23].

In school age, coordination abilities are best developed through games and competitions. Nontraditional physical activities (also known as "less known", "less known games", "non/olympic sports games" or "nontraditional sports games and physical activities") are created through combining traditional activities and using various apparatus and equipment. In addition, less known activities are becoming popular and activities recommended by physicians, psychologists and sociologists are implemented [15].

Hyperactive children feel constant desire to move by being unable to rest and relax. Such children perform excessive movements and when made to relax tend to feel anxious and uncomfortable [4]. "Physical activities are beneficial for children with ADHD, they underlie their being: I move, therefore, I am." [10]. Most authors agree that children with ADHD should not be told not to move [1,10,11]. If such child focuses on sitting still, then he or she fails to focus on activities required by teachers or parents. They exert a great deal of effort in order to stay still and get fatigued very fast. Therefore, children should get the opportunity to move freely, ideally during school classes. What is recommended is to assign the child a task such as cleaning the blackboard, distributing notebooks, bringing teaching aids, or just to let the child maintain balance while standing one one foot, go round the class, etc. Among helpful aids are toys, nontraditional equipment, for instance antistress balls, cloth dolls, feathers, weaven handbands, the use of which does not make noise.

On the contrary, Prekopová, Schweizerová [17] consider failing to order children not to move one of the causes of hyperactivity. "*Hyperactivity will not originate at all if the child receives on time what he or she deserves*." Drtílková, Šerý [4] reported that similarly to normal children, children suffering with hyperkinetic disorder tend to engage in a popular rather than an unappealing activity for a longer time. These activities are not interesting and do not attract children's attention. According to the author, a lot of children, regardless of inattention, are able to play computer games and surf the internet for a long period of time. This may be explained by focusing their attention to virtual reality, where children are not disturbed by external stimuli. Among crucial factors are action and dynamics of games and opportunity to manage the situation actively and immediately. One of the undesirable manifestations of hyperactivity is that children get easily distracted and are unable to complete what they started. Educators are bothered by children not paying attention to tasks they are assigned. This leads to the incompletion of the task. Children tend to intersperse their task with other tasks not related to school. Even though the ability level of hyperactive children is usually average or sometimes above average, they have lower school achievement. Behavior of such children confirms lack of moral qualities as children do not try to do what they are asked to. A hyperactive student is unable to follow specific social norms and to behave as a regular student. Moreover, hyperactive children tend to exhibit experiential deviations, tend to be irritated and labile and to exhibit frequent mood swings.

School intervention is based on the diagnosis established according to information collected by all people involved. The strategies are targeted at children, aduls and peers. The intervention is based on the analysis of all information. The main objective of the first plan should not be "to change the child completely", but to devise steps leading to change of conditions, in which the child lives. The main purpose is the decline of negative simuli, which

may act as trigger mechanisms. If redirecting the stimulus does not work, the child should be allowed to move in a well controlled form.

According to Riefová [20] the most relevant principles applied when working with children with hyperkinetic disorder are:

- teacher's flexibility, interest and willingness to work with students,
- education of teachers and their knowledge about ADHD,
- cooperation between parents and school representatives,
- formation of approriate school setting,
- creative, attractive and interactive teaching methods.

Teachers have room for stimulating creativity. By taking into consideration the interests of students and conditions of particular schools teachers can design teaching programs for groups of both regular students and integrated students with behavior disorders. The role of every teacher is to follow the main objectives and to take into account the students' competences, dispositions, interests and school conditions. Teachers should also design teaching programs for particular groups of students while following rules set by curricular documents. A creative teacher may implement games with various sports and nontraditional equipment and incorporate different ways of manipulating such equipment. There is also room for using the effect of nontraditional sports games and physical activities with nontraditional exercise equipment on the level of skills and abilities and behavior disorders in integrated children.

Theoretical and practical evidence and knowledge of specialists in the field of motor coordination, level of coordination abilities, their development in school physical education of both prepubertal children and children with behavior disorders as well as in the field of the status of nontraditional sports games and physical activities in school physical education, were used to answer the following research questions:

1. Is it possible to develop motor coordination through development of coordination abilities in prepubertal children during physical education classes through playing nontraditional sports games and newly originating sports games ?
2. Is it possible to correct behavior disorders of integrated children through nontraditional sports games and newly originating sports games?

METHODS

The research findings related to the effect of nontraditional sports games on the development of coordination abilities in general population were supported by grant project of the Ministry of education, Science, Research and Sport VEGA 1/0594/08 "*The Effect of Nontraditional Sports Games on the Development of Coordination Abilities.*" The research was conducted at the first degree of fully organized primary elementary schools in the school year 2011/2012. Students attending schools located in Prešov and Košice self-governing regions participated in the study. Prior to conducting the experimental study, a written informed consent was obtained from parents. Of 374 children, 184 were boys and 190 were girls. Those who did not engage in regular sports training were excluded from the study. To identify children with ADHD, 8 teachers were asked to complete questionnaires. Questionnaire results were used to organize children with behavior disorders into a group, which consisted of 23 children. Of these, 16 were boys and 7 were girls. The questionnaire response rate was 100%.
At the time of experiment, schools were equipped with gyms, sports areas and sufficient material equipment.

The research and testing itself was conducted at 2 elementary schools, where teachers used nontraditional sports games and exercises with nontraditional equipment – experimental group. Testing followed regular testing guidelines. After pre-testing, teachers responsible for the experimental group received a list of nontraditional groups and exercises to be applied to develop coordination abilities of prepubertal children. The experiment was conducted over 22 weeks, i.e. 44 teaching units (classes). The effect of nontraditional movement and sports games on coordination abilities of children was verified by post-testing.

The main method of data collection in the study was a single-factor two-group parallel experiment. The experiment was conducted in the natural setting of gyms, natural environment and outdoor sports areas. Through personal contact with children, we tried to arouse their interest in the research through motivational talk.

Due to complexity of coordination abilities and availability of research results, for the purposes of the study, we decided to select tests recommended by Belej, Junger et al. [2]. The selected tests are included in a test battery used to assess the following abilities:

Test 1 (T1) – *Tapping hands and feet* (rhytmical abilities)
Test 2 (T2) – *Reaction speed test using two rulers* (reaction abilities)
Test 3 (T3) – *Single-leg stand (right, left), eyes closed* (balance abilities)
Test 4 (T4) – *Catching the hanging ball* (kinesthetic-differentiation abilities - spatial)
Test 5 (T5) – *Tennis ball accuracy throw* (kinesthetic-differentiation abilities - strength)
Test 6 (T6) – *Roll of three balls* (spatial-orientation abilities)
Test 7 (T7) – *Plate tapping* (frequency abilities)
Test 8 (T8) – *Complex motor test* (ability to couple acyclic movements)
Test 9 (T9) – *Throwing a ball at the target after running over the benches* (reorganization abilities).

The assessment was based on data without extreme test scores. Therefore, the sizes of subsamples vary according to the test used and age studied. To process and evaluate collected data, we used the following statistical methods:

descriptive methods: measures of location – arithmetic mean (central value of subsamples), measures of dispersion – standard deviation (measure of variability),

inductive statistics: normality of distribution – Shapiro-Wilk test. The difference between pre-testing and post-testing scores was determined using parametric paired samples t-test.

The effect of nontraditional sports games on the development of coordination abilities was determined using logical analysis and mathematical and statistical procedures. The correction of hyperkinetic disorders of children was studied within project VEGA 1/0769/13 "The Effectiveness of Specific Movement Reeducation Procedures on the Correction of Hyperkinetic Disorders of Prepubertal Children" conducted at the Faculty of Sports, University of Prešov in Prešov.

To identify children with behavior disorders at the primary level of education, we used Vanderbilt ADHD Diagnostic Teacher Rating Scale. This scale is reported to be the most frequently used scale for identifying children with ADHD [5]. The scale was designed by Mark Wolraich and is available in two versions: teacher rating scale and parent rating scale. Collected data can be used for screening purposes, designing recommendations and for establishing diagnosis in combination with other methods. The scale is based on the diagnostic criteria DSM – IV *(Diagnostic and Statistical Manual of Mental Disorders).* In addition to diagnosing the basic symptoms, the scale assesses other behaviors related to problematic domains such as behavior disorder, oppositional defiant disorder, anxiety and depression. The differences between rating scale scores between pre-testing and post-testing were determined using Wilcoxon test. Comparison of frequencies was based on relative frequencies between samples.

RESULTS

Coordination abilities were developed by applying nontraditional movement and sports games. The coordination of children not diagnosed with ADHD improved. Motor tests used to assess motor skills and abilities of children were complex. According to knowledge and experience, we recommended and considered all conducted tests to be appropriate for all age categories with regard to funding, material and organizational aspects. General knowledge that testing of coordination abilities is regarded problematic was confirmed during testing. Younger children found it difficult both to memorize the succession of activities and to perform the activities themselves. Accordintg to results presented in Table 1, statistically significant improvement of coordination in boys was found in 7-year-old children for the following abilities: balance abilities, frequency abilities and coupling abilities. The coordination of 8-year-old children improved for reaction abilities, balance abilities, spatial abilities, strength abilities, orientation abilities and frequency abilities. With 9-year-old boys, there were significant differences between pre-testing and post-testing for rhytmical, reaction, balance, strength, orientation and frequency abilities. The coordination of 10-year-old children improved in 8 coordination abilities. Statistically significant improvement was not found for reorganization ability (see Table 1).

In the experimental group, coordination abilities of prepubertal girls improved upon completion of intervention (see Table 2). The coordination improved for 7-year-old girls in balance abilities, frequency abilities and coupling ability. Similarly to 8-year-old girls, higher level of coordination for 9-year-old girls was found in reaction, balance, spatial, strength, orientation and frequency abilities. Similarly to age-matched boys, girls did not achieve significantly higher test scores for reorganization ability.

We also aimed to observe children diagnosed with behavior disorders. As mentioned, there were 23 children wih such disorders. Regaring their motor skills, they exhibited motor skills level comparable to that of their peers. Due to their number and age difference, this group was not tested alone in the movement domain. We wanted to know whether children with behavior disorders would change their behavior after "exhaustive" physical activity. We used the third subscale of the Vanderbilt rating scale to monitor children's behavior. We assessed their behavior prior to and after physical activity (see Table 3b). Significant changes were observed for *following directions/rules, assignment completion* and *organizational skills.* The behavior of integrated children was corrected by incorporating nontraditional sports games and newly originating sports games (see Figure 1 and 2).

Significant changes were observed for the number of assessed children relative to particular types of behavior (subscales). At pre-testing, more than fifth of ratings for following directions/rules were classified as unsatisfactory. However, there were no unsatisfatory ratings for following instructions post testing. There was a significant increase in the average level for *following directions/rules*, *assignment completion* and *organizational skills*. In two remaining types of behavior, i.e. relationships with peers and disrupting class, there was a higher percentage post testing (see Figure 1, 2 and Table 3a).

The results showed that physical activity had positive effect on the correction of behaviors of prepubertal integrated children. The most significant effect was found for following directions/instructions and assignment completion.

Table 1. Test scores of general population: boys

Test		7-year-old		8-year-old		9-year-old		10-year-old	
		PrT	PoT	PrT	PoT	PrT	PoT	PrT	PoT
T1	x	5.4	5.7	6.07	7.53	6.22	8.12	6.82	8.16
	s	4.2	4.1	4	3	4	2	3	2
	t	0.89		1.12		1.55*		1.56*	
T2	x	23.7	23.5	21.04	16.56	20.62	15.83	20.31	15.32
	s	12.9	9.82	16.34	9.62	13.93	9.11	10.36	7.67
	t	1.98		2.67**		2.68**		2.89**	
T3	x	8.71	9.99	10.95	13.13	11.24	16.16	13.11	17.6
	s	8.88	9.56	13.11	9.54	14.44	10.91	13.11	9.12
	t	2.04*		3.58**		6.32**		5.45**	
T4	x	2.08	2.15	3.11	4.57	2.74	3.5	2.99	5.76
	s	2.11	2.5	2.8	2.9	2.65	2.14	2.9	2.3
	t	0.325		2.03*		1.56		2.654*	
T5	x	39.5	37.5	38.41	32.52	35.42	29.41	32.55	25.15
	s	32	31	29	27	29	25	27	22
	t	1.63		2.87**		3.14**		2.99**	
T6	x	45.7	44.1	43.19	40.38	42.15	35.19	43.76	35.41
	s	17.4	17.2	19.2	14.96	16.91	13.52	16.58	11.49
	t	0.98		2.06*		2.65**		2.75**	
T7	x	16.4	15.3	16.74	13.84	15.96	13.54	16.51	13.89
	s	2.9	2.8	3.61	2.96	3.98	2.87	2.87	2,13
	t	1.89*		2.58**		2.59**		2.98**	
T8	x	23.5	22.2	22.36	21.52	21.39	20.63	19.88	18.38
	s	4.9	4.8	4.96	4.44	4.89	4.72	4.73	3.65
	t	1.98*		1.6		1.56		1.98*	
T9	x	1.22	1.4	1.25	1.52	1.31	1.62	1.41	1.68
	s	1.5	1.3	1.4	1.5	1.44	1.3	1.33	1.29
	t	0.89		1.1		1.65		1.49	

Note: Test 1 (T1) – *Tapping hands and feet* (rhytmical abilities), Test 2 (T2) – *Reaction speed test using two rulers* (reaction abilities), Test 3 (T3) – *Single-leg stand (right, left), eyes closed* (balance abilities), Test 4 (T4) – *Catching the hanging ball* (kinesthetic-differentiation abilities – spatial), Test 5 (T5) – *Tennis ball accuracy throw* (kinesthetic-differentiation abilities – strength), Test 6 (T6) – *Roll of three balls* (spatial-orientation abilities), Test 7 (T7) – *Plate tapping* (frequency abilities), Test 8 (T8) – *Complex motor test* (ability to couple acyclic movements), Test 9 (T9) – *Throwing a ball at the target after running over the benches* (reorganization abilities), x – arithmetic mean, s – standard deviation, t – t-test, PrT – pre-testing, PoT – post-testing

Table 2. Test scores of general population: girls

Test		7-year-old		8-year-old		9-year-old		10-year-old	
		PrT	PoT	PrT	PoT	PrT	PoT	PrT	PoT
T1	x	5.4	5.8	6.35	7.39	6.05	7.71	6.68	8.14
	s	4.3	3.9	3	3	4	3	3	2
	t	0.87		0.206		1.23		1.56*	
T2	x	24.7	24.4	22.38	18.13	21.68	16.29	20.43	16.11
	s	12.5	11.3	13.35	9.09	11.77	9.49	11.44	7.05
	t	0.99		2.42*		2.12*		2.31*	
T3	x	8.95	10.44	10.99	15.42	12.29	17.55	12.72	17.77
	s	9.12	12.5	14.1	9.67	11.58	10.63	10.41	9.37
	t	2.47*		5.56**		4.89**		6.78**	
T4	x	2.07	2.18	2.96	4	3.13	5.11	3.33	5.44
	s	2.3	2.1	2.6	3.1	2.9	2.1	3.1	2.5
	t	0.856		2.42*		3.15**		3.21**	
T5	x	39.5	37.2	39.62	33.41	39.3	30.16	35.55	29.36
	s	32	32	27	28	31	32	28	25
	t	1.65		3.12**		3.36**		3.16**	
T6	x	48.9	47.6	46.76	43.2	46.17	39.16	44.67	38.63
	s	18.7	18.6	19.6	18.9	21.44	17.66	18.6	13.65
	t	1.65		2.07*		2.87**		2.57**	
T7	x	18.3	17.1	17.27	15.06	16.33	14.19	15.86	13.7
	s	3.1	2.8	2.96	2.38	3.37	2.93	3.26	2.51
	t	1.98*		2.15*		2.34*		2.46*	
T8	x	23.4	21.9	22.02	21.34	20.73	19.99	20.14	18.72
	s	4.7	4.8	4.7	4.3	4.91	4.56	5.04	4.11
	t	1.99*		1.4		1.5		1.98*	
T9	x	0.82	0.84	1.12	1.31	1.28	1.46	1.3	1.48
	s	0.81	0.7	0.89	0.8	1	1.03	0.99	0.89
	t	0.67		0.98		0.97		0.97	

Note: Test 1 (T1) – *Tapping hands and feet* (rhytmical abilities), Test 2 (T2) – *Reaction speed test using two rulers* (reaction abilities), Test 3 (T3) – *Single-leg stand (right, left), eyes closed* (balance abilities), Test 4 (T4) – *Catching the hanging ball* (kinesthetic-differentiation abilities – spatial), Test 5 (T5) – *Tennis ball accuracy throw* (kinesthetic-differentiation abilities – strength), Test 6 (T6) – *Roll of three balls* (spatial-orientation abilities), Test 7 (T7) – *Plate tapping* (frequency abilities), Test 8 (T8) – *Complex motor test* (ability to couple acyclic movements), Test 9 (T9) – *Throwing a ball at the target after running over the benches* (reorganization abilities), x – arithmetic mean, s – standard deviation, t – t-test, PrT – pre-testing, PoT – post-testing

Table 3a. Significance of changes of average level

P1	P2	P3	P4	P5
8.623**	0.605	2096*	1.98*	0.88

Table 3b Significance of changes between pre-testing and post-testing

P1	P2	P3	P4	P5
4.197**	1.341	2.366*	2.008*	1.341

Note: P1 – follows directions/rules, P2 – disrupting class, P3 – assignment completion, P4 –organizational skills, P5 – relationships with peers

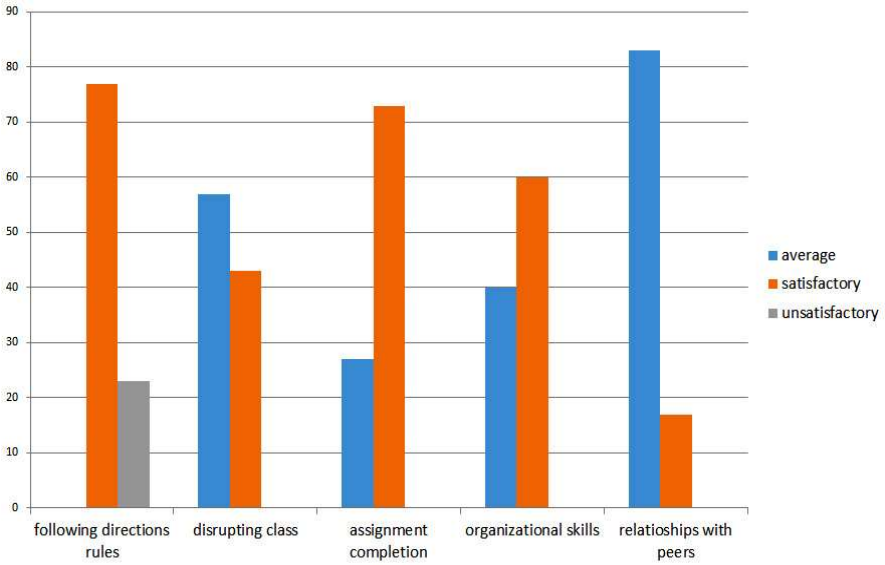

Fig. 1. Observation results prior to physical activity

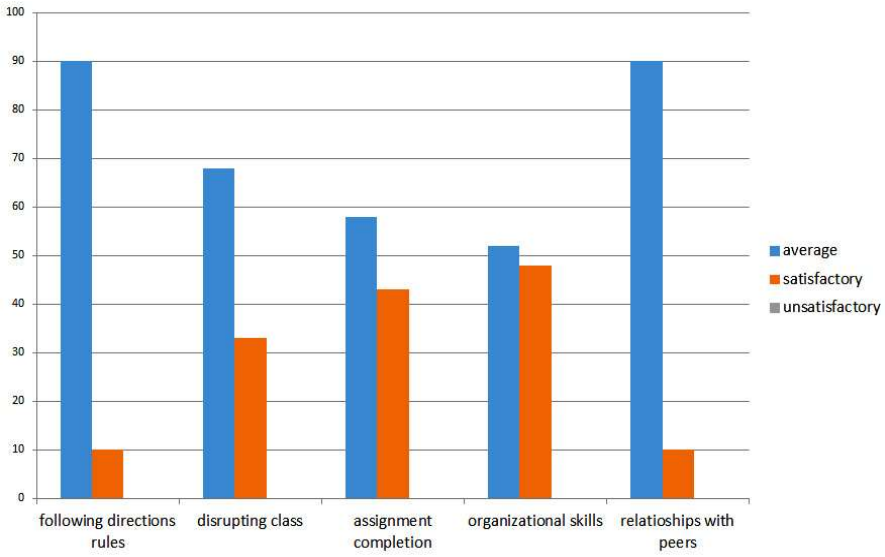

Fig. 2. Observation results after physical activity

DISCUSSION

Blahutková, Klenková, Zichová [3] have confirmed the relevance of attitude and approach towards children with ADHD. Teachers should not shout at children and assign tasks they would find hard to complete. Children should be praised for their effort and not be punished too often. Teachers should show children affection and assign children tasks that are easy to handle by adhering to the principle of *less and often is better*. What we demand from such a child should be proportionate to the child's abilities. Presented evidence was taken into consideration in the studied sample of children, which led to the fulfillment of our aim.

In the present study, we created educational creative stimuli. Increasing the attractiveness of physical activities had positive effect on children, whose level of motor coordination improved. The behavior of integrated children changed. Behavior disorders were corrected by improving classroom behavior and relationships with peers. Children started to follow directions and disruptive behavior in class declined. The results of the study showed that the study objectives were fulfilled. The application of nontraditional movement and sports games in physical education classes improved coordination abilities of 7 to 10 years old children. We recommend incorporating nontraditional movement and sports games into physical education classes. In addition, we recommend nontraditional movement and sports games due to their positive effect on the correction of behavior disorders of integrated children diagnosed with ADHD.

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Recevied: 9.07.2014; Accepted: 24.07.2014; Published online: 16.09.2014

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