



# The development of coordination abilities in non-integrated students and correction of behavior disorders in integrated students through engaging in movement games

Erika Chovanova 

University of Presov, Presov, Slovakia

*Authors' Contribution: A – Study Design, B – Data Collection, C – Statistical Analysis, D – Manuscript Preparation, E – Funds Collection*

## Abstract

**Introduction:** The primary aim of the study was to determine the effect of movement games on the development of motor coordination in prepubertal non-integrated students and the correction of behavior disorders in integrated students. **Material and Methods:** A randomly selected sample consisted of 7- to 10-year-old non-integrated and integrated students with behavior disorders attending elementary schools. To test motor coordination, Körperkoordinationstest für Kinder (KTK) was administered. Exercise programs that cover relatively the dominant areas of motor behavior can be an effective learning tool to be used with children. As part of our research, we have developed a model of movement games that are attractive to children. To monitor behavior of children, Vanderbilt assessment scale for the assessment of students' behavior was administered. The NICHQ scale is available in two versions – teacher informant and parent informant. To process and evaluate collected data, we applied the following statistical methods were used: descriptive statistical characteristics, normality of data distribution – Shapiro-Wilk test, parametric paired samples t-test, or non-parametric paired samples t-test, and a test of relative frequencies. **Results:** Non-integrated children – development of coordination: groups of girls showed higher levels of the following motor abilities: dynamic balance, ability to connect movements, and kinesthetic-differentiation ability. The group of boys reached higher levels of rhythmic ability. Integrated students with behavior disorders: Strengths and difficulties questionnaire provided information about students in five dimensions. Highest score was recorded for hyperactivity dimension, which is deviant from normal scores. Students did not achieve normal scores in conduct problems dimension. Normal scores were observed in dimensions: peer problems and prosocial behavior. **Conclusions:** We may conclude that movements games had a positive effect on the behavior exhibited by prepubertal children educated under the conditions of integration.

**Keywords:** KTK tests, Vanderbilt assessment scale, integrated children, 7-10 year-old children, exercise programs

Address for correspondence: Erika Chovanová – University of Presov, Department of Sport Educology and Humanistic, Presov, Slovakia, email: [petra.pacesova@uniba.sk](mailto:petra.pacesova@uniba.sk)

Received: 15.12.2018; Accepted: 4.04.2019; Published online: 6.11.2019

**Cite this article as:** Chovanova E. The development of coordination abilities in non-integrated students and correction of behavior disorders in integrated students through engaging in movement games. Physical Activity Review 2019; 7: 209-218. doi: 10.16926/par.2019.07.25

## INTRODUCTION

Movement and movement games are an integral part of healthy development, maturation and personality development, which is linked to not only physical development, but also to children's mental and social development. Physical activities need to be selected carefully, because in case of ignoring children's developmental process inadequate physical activities may have harmful effect on children. At this age, children should engage in all-round physical activities [1] and should enjoy movement based on game-like activities. School age is an appropriate period for adopting a positive attitude towards physical activities. Students should receive basic information about particular sports, their rules, and engage in critical physical activities [2]. There are various studies that deal with the selection of young ice hockey players [3-5], the issue of stimulating rhythmic abilities in aerobics [6,7], or motor educability and physical literacy of 9- and 10-year old children, especially those with special educational needs [8-10]. For instance, Kačúr et al. [11] focused on gender differences and associations between physical fitness levels and somatic parameters in children. Bendíková, Dobay [12] present evidence about the development of a positive attitude towards health and physical activity in adulthood. We focus in particular on the effect of various physical activities included in state educational program, on the treatment of hyperkinetic disorders in children. This issue has been addressed in a variety of studies [13-17].

At present the issue of coordination abilities is considered a topical and serious topic. This results from the fact that coordination abilities are an important determinant of human motor fitness. The demands placed on both athletes in sports and people in their lives are increasing [18]. Vandorpe et al. studied the suitability of the Körperkoordinations Test für Kinder (KTK). In this study, the suitability of the KTK as an assessment instrument for the gross motor coordination was evaluated in 2470 children from 26 elementary schools for general education spread over the Flemish and Brussels-capital region. The results of the study suggest that the KTK is a valuable instrument for the assessment of the gross motor coordination of Flemish children and efforts should be made in order to face the decline in coordination [19]. The suitability of the KTK test battery was also evaluated among Slovak school children [20].

When designing exercise programs, fundamental principles of exercise programming have to be applied. The principles should be based on meeting the organization and teaching requirements of optimal exercise programs for school-aged children. The effort should aim to increase the quality of physical education classes through application of game-based methods, use of technical tools, unconventional apparatus and equipment, and engagement in various physical activities. We have taken into consideration scholarly and scientific evidence reported by a variety of authors [21,22], who confirmed the effect of exercise programs.

The number of children diagnosed with behavior disorders is on the rise. Parents use this diagnosis as an adequate apology for the disobedience and little deficits in upbringing of their children and thus excuse their own feelings of guilt before themselves, the child and the teacher in the context of educational problems [20]. A screening tool that may be used for quick assessment of behavior shown by children aged 3 to 16 years is the Strengths and Difficulties Questionnaire (SDQ-Svk). Behavior disorders do not decrease the intellectual capacity of children and therefore such children may be fully integrated into the environment of regular school through appropriate educational strategies [23].

The issue has been addressed in a variety of studies [13-17]. Many research found that physical activities may enhance children's self-confidence and improve their academic and social skills [2,24,25].

The aim of the study was to determine the effect of movement games on somatic and motor parameters and on prepubertal children's behavior within the educational process and physical education classes.

## MATERIAL AND METHODS

### *Sample characteristics of non-integrated children: development of coordination*

The sample included 369 pupils: 104 seven-year-old pupils, (51 girls and 52 boys). 104 eight-year-old pupils (49 girls and 55 boys), 78 nine-year-old pupils of (44 girls and 34 boys) and 96 ten-year-old pupils (56 girls and 40 boys). We ensured that the safety requirements of the material conditions and the suitability of the premises were met before the testing to protect the health of the study participants. We eliminated all risks possible and excluded dangerous factors connected with the health issues or other barriers faced by respondents, which could have effect on the testing, causing imprecise data collection.

### *Sample characteristics of integrated children with behavior disorders: correction of behavior*

The educational research was carried out at elementary schools in the region of eastern Slovakia. Children's statutory representatives and school principals provided their consent to the study. The random sample consisted of 7- to 10-year-old 137 integrated students attending elementary schools. We administered the Vanderbilt Assessment Scale - NICHQ – teacher assessment scale to evaluate the behavior of integrated students. The teacher assessment scale includes 43 questions that allow the assessment of symptoms exhibited by students, school performance, and classroom behavior.

### *Körperkoordinations Test für Kinder*

To assess the level of children's motor coordination, we administered the KTK test battery [24] that consists of four complex tests: *Walking backwards (WB)* – balance, *Hopping for height (HH)* – ability to couple movements, kinesthetic-differentiation ability, *Jumping sideways (JS)* – lower-body frequency ability, sense of rhythm, *Moving sideways (MS)* – total body coordination.

The KTK test battery includes fitness tests that require a high degree of concentration. In order to complete all tests, children performed practice trials to adapt to the conditions necessary for the appropriate completion of the motor tasks and to achieve the highest level of execution possible. By having children perform the practice trials, we observed whether children precisely understood the requested instructions. The collected data were noted down in recording sheets prepared in advance of the testing.

The somatic parameters studied included body weight and body height, which we used to calculate the BMI values. According to their BMI, children were classified as normal-weight, overweight, or obese.

### *Statistical methods*

To process the data on somatic and motor parameters, we used arithmetic mean as a measure of central tendency and standard deviation as a measure of variation. To assess the normality of distribution of data collected, we used the Shapiro-Wilk test. To assess significant differences between girls and boys in KTK tests across ages studied, we used the *t* test for independent samples. Correlations were determined using the Pearson's correlation coefficient. The exercise program aimed to develop coordination abilities of non-integrated children and to correct behavior of integrated children:

The experimental factor in our research was the design of the intervention exercise program based on the use of movement games that were played by children from the experimental group. By engaging in these games, children developed their motor coordination. The movement games were played by the children at their elementary schools during a two-month period. The games were supervised by the physical education teachers, who were properly instructed about the movement games. The teachers were also provided with relevant and necessary material. When organizing and carrying out the exercise program, we took into consideration children's age, their physical and mental capacities and the number of students during the class. The program was designed for the needs of the entire class and also for integrated students with behavior disorders. We planned to have children engage in a sample of movement games over the period of 2 months – 16 teaching units. We followed the organization and teaching progression requirements in order to ensure the optimal effect of the

exercise program among school-aged children. We tried to increase the quality of physical education classes. By implementing the movement games, we also corrected the behavior disorders because the exercise program fulfilled the physical, emotional and social requirements. The designed exercise program based on physical activities is integrated in its nature because non-integrated and integrated students exercise together. Each teaching unit included 3 to 4 movement games that children played for 10 minutes. To achieve the highest efficiency of exercise during physical education classes, we changed the distribution of exercise apparatus, implemented short blocks of coordination exercises, which directly develop a particular coordination ability. Children played the games during the introductory section of the class: jumping games, carrying games, competition-based games in 2 minutes, and in the final section of the class: target games in 1.5 minutes.

Table 1 as an example, contain the recommended incorporation and use of movement games and exercises for the development of static and dynamic balance during the physical education classes.

Table 1. Static and dynamic balance

No.	Year				Section			Recommended volume			Teaching form
	1	2	3	4	Pr	Hl	Z	Time [s]	number	sets	
1.1.	*	*	*	*	*			30		2, 3, 4	H1
1.2.	*	*	*	*	*			30		2,3	H4
1.3.	*	*	*	*	*	*		30		2, 3, 4	H2
1.4.	*	*	*		*			30		2,3	H1
1.5.	*	*	*	*	*			30		2,3,4	H1
1.6.	*	*	*	*	*			30		2,3,4,	H1
1.7.	*	*	*	*	*	*			5	2, 4, 6	H2
1.8.	*	*	*	*	*	*			8, 10, 12	2, 4, 6	H2
1.9.	*	*	*		*		*		3, 4	2, 3	H4
1.10.		*	*	*		*			5, 8	3, 4	H4
1.11.	*	*	*	*	*		*	20		2, 4, 6	H4
1.12.	*	*	*	*	*	*	*		3, 4, 5	3, 5	H4
1.13.	*	*	*	*		*			3, 4, 5	2, 4, 5	H4
1.14.	*	*	*	*		*			3, 4, 5	2, 4, 5,	H2
1.15.	*	*	*	*		*			2, 3, 4	2, 3, 4	H2
1.16.	*	*	*	*	*				2, 3, 4	2, 3, 4	H2
1.17.	*	*	*	*	*	*			2, 3	2, 3	H4
1.18.	*	*	*	*	*	*	*		2, 3	2, 3	H
1.19.	*	*	*	*		*	*		2, 3	2, 4	H
1.20.	*	*	*	*		*	*		3	2, 4, 6	H
1.21.	*	*	*	*		*	*		3, 4	2, 3	H
1.22.	*	*	*	*	*		*		2, 3, 4	2, 3, 4	H
1.23.	*	*	*	*		*			2, 3, 4	2, 3, 4	H
1.24.	*	*	*	*	*		*		2, 4, 6	2, 3, 4	H2
1.25.	*	*	*	*		*	*		2, 3	2, 3	H2

H - group-based form of work (whole class); H 1 - group-based form of work (individuals); H 2 - group-based form of work, twos; H 3 - group-based form of work, threes; H 4 - group-based form of work, fours

## RESULTS

Seven- and eight-year-old boys showed the higher mean values of body height, body weight, and BMI than girls. Their body weight was classified as "normal" (Table 2). Seven-year-old boys and girls achieved lower scores in the walking backwards test than their eight-year-old counterparts. Of all children, the seven-year-old boys achieved the lowest scores in this dynamic balance test. Eight-year-

old boys achieved higher scores than their younger counterparts. However, according to the standard deviations, the performances of eight-year-old boys showed greater variability (Tables 3 and 4).

Seven-year-old girls found the motor task of hopping for height quite difficult, but they showed high levels of ability. Performances achieved by seven- and eight-year-old girls were not so different. Seven-year-old girls found this motor task of sideway jumping rather difficult, showing lack of frequency and speed of jumping.

There were significant differences between seven-year-old boys and girls in all KTK tests. It must be emphasized that girls achieved higher scores in all tests than boys. The differences between sexes were most significant in walking backwards and jumping sideways. Eight-year-old girls performed better than boys in walking backwards, hopping for height, and jumping sideways. Eight-year-old boys achieved higher scores than girls in the jumping sideways test. However, we may not state that boys achieved better scores because the data were quite heterogeneous, as indicated by the standard deviation.

Before all pupils included in the samples started to participate in the eight-week exercise program, written informed consents were obtained from parents and school principals. Resistance exercised and coordination exercises were adjusted for age and gender. Tables 5 and 6 show raw test scores for T1, T2, T3, and T4, including the significant differences between pretest and posttest.

Table 2. Somatic parameters

indicator	7 years		8 years	
	girls	boys	girls	boys
n	51	52	49	55
BW	28.12 ± 6.35	29.62 ± 6.44	28.64 ± 8.46	31.21 ± 7.33
BH	128.37 ± 7.49	129.84 ± 7.21	129.18 ± 7.67	130.85 ± 8.12
BMI	15.47 ± 4.67	17.12 ± 4.21	16.35 ± 4.83	17.92 ± 4.58

BW - body weight; BH - body height; BMI - Body mass index; n - sample size

Table 3. Motor parameters at pretest and posttest: girls

indicator	7 years			8 years		
	pretest	posttest	statistical significance	pretest	posttest	statistical significance
T1	43.9 ± 12.1	52.63 ± 10.17	$p < 0.01$	47.10 ± 13.61	56.64 ± 12.54	$p < 0.01$
T2	29.11 ± 10.88	32.17 ± 11.27	$p < 0.01$	31.66 ± 12.87	35.14 ± 12.54	$p < 0.01$
T3	38.32 ± 13.52	44.51 ± 12.87	$p < 0.01$	43.01 ± 12.7	46.47 ± 11.22	$p < 0.01$
T4	32.42 ± 5.00	33.98 ± 3.68	$p < 0.05$	35.12 ± 5.53	36.84 ± 6.75	$p < 0.01$

T1 - walking backwards (WB); T2 - jumping for height (JH), T3 - jumping sideways (JS); T4 - moving sideways (MS)

Table 4. Motor parameters at pretest and posttest: boys

indicator	7 years			8 years		
	pretest	posttest	statistical significance	pretest	posttest	statistical significance
T1	42.11 ± 11.11	48.76 ± 12.09	$p < 0.01$	48.62 ± 11.43	55.71 ± 10.33	$p < 0.01$
T2	27.32 ± 12.28	29.47 ± 11.87	$p < 0.05$	35.43 ± 9.34	37.14 ± 10.54	$p < 0.05$
T3	33.61 ± 8.93	38.54 ± 9.92	$p < 0.01$	43.81 ± 9.76	59.71 ± 11.55	$p < 0.01$
T4	33.21 ± 4.92	35.82 ± 7.12	$p < 0.01$	37.12 ± 4.97	38.84 ± 5.13	$p < 0.01$

T1 - walking backwards (WB); T2 - jumping for height (JH), T3 - jumping sideways (JS); T4 - moving sideways (MS)

Table 5. Somatic parameters

indicator	9 years		10 years	
	girls	boys	girls	boys
<i>N</i>	44	34	56	40
BW	27.75 ± 6.65	33.58 ± 5.42	36.28 ± 12.54	36.95 ± 7.23
BH	131.27 ± 6.56	133.94 ± 5.11	139.45 ± 8.48	137.85 ± 4.52
BMI	15.97 ± 2.67	18.74 ± 3.09	18.35 ± 4.88	19.41 ± 3.52

BW - body weight; BH - body height; BMI - Body mass index; *n* - sample size

Table 6. Motor parameters at pretest and posttest: girls

indicator	9 years			10 years		
	pretest	posttest	statistical significance	pretest	posttest	statistical significance
T1	47.27 ± 17.41	58.63 ± 12.17	$p < 0.01$	46.68 ± 16.21	51.82 ± 14.73	$p < 0.01$
T2	23.63 ± 8.98	25.27 ± 8.87	$p < 0.01$	23.03 ± 11.37	25.14 ± 11.44	$p < 0.01$
T3	49.05 ± 11.22	54.01 ± 11.95	$p < 0.01$	52.39 ± 15.61	55.71 ± 16.66	$p < 0.01$
T4	21.18 ± 3.74	22.91 ± 3.68	$p < 0.01$	21.07 ± 4.57	22.71 ± 4.69	$p < 0.01$

T1 - walking backwards (WB); T2 - jumping for height (JH), T3 - jumping sideways (JS); T4 - moving sideways (MS)

Table 7. Motor parameters at pretest and posttest: boys

indicator	9 years			10 years		
	pretest	posttest	statistical significance	pretest	posttest	statistical significance
T1	40.94 ± 18.31	47.82 ± 17.01	$p < 0.01$	40.35 ± 17.34	47.15 ± 17.21	$p < 0.01$
T2	23.94 ± 12.25	25.58 ± 12.25	$p < 0.01$	22.31 ± 9.73	23.75 ± 9.93	$p < 0.01$
T3	49.76 ± 14.54	54.65 ± 14.81	$p < 0.01$	55.59 ± 12.97	60.55 ± 14.14	$p < 0.01$
T4	19.53 ± 3.43	21.41 ± 2.83	$p < 0.01$	21.11 ± 4.37	22.89 ± 4.71	$p < 0.01$

T1 - walking backwards (WB); T2 - jumping for height (JH), T3 - jumping sideways (JS); T4 - moving sideways (MS)

Nine-year-old girls showed significant improvements in all motor abilities assessed by the KTK test battery. Most significant improvements were found for T1 (WB - walking backwards), which assesses dynamic balance. Ten-year-old girls showed improvements in all tested abilities at posttest as well. As with their nine-year-old counterparts, ten-year-olds improved most of their balance test scores as well (Table 6).

Nine-year-old boys showed significant improvements in all of the KTK test items. Most significant differences between pretest and posttest scores were found for T1 and T3 (walking backwards and jumping sideways), which assess dynamic balance and lower-body frequency ability. Less significant differences, even though significant, were recorded for T2 (hopping for height) and T4 (moving sideways), which assess kinesthetic-differentiation ability and total body coordination. Similar results were found for ten-year-old boys who improved significantly at posttest in all KTK test items, especially in T1 (WB - walking backwards), which assesses dynamic balance and T3 (JS - jumping sideways) (Table 7).

Table 8 contain correlation coefficients between BMI and KTK subtests. We found a negative correlation between BMI values and MQ, which means that children with higher BMI found it difficult to perform the tests. There was a significant correlation between BMI and MQ in 7 to 10 years old girls. A high degree of correlation was found in 7-year-old girls between BMI and MQ. BMI of eight-year-old girls significantly correlated with MQ as well. There was a significant correlation between walking

backwards and MQ in nine-year-old girls. We found that there were significant correlations between BMI and coordination abilities of 10-year-old girls.

Table 9 contain correlations between BMI, MQ scores for particular test items, and the total MQ. We found a negative correlation between BMI and MQ scores, which means that children with higher BMI, the heavier children, had more difficulties performing the test. Significant relationship between BMI and total MQ was found for both age groups and genders. Both nine-year-old girls and 10-year-old boys showed no correlation between T1 and T4. High degree of correlation found for ten-year-old girls and 9-year-old boys may be attributed to significant correlations among the KTK test items.

We found a negative correlation between BMI values and MQ, which means that children with higher BMI values had difficulties performing the test. There were significant correlations between BMI and total MQ in 9- and 10-year-old boys. The scores in the moving sideways test, significantly correlated with the MQ scores in all age categories of boys (Table 9).

A total of 137 integrated students with behavior disorders participated in the exercise program and coordination testing along with the students without disorders. The teachers observed changes in their behavior, which we also found by administering the Strength and difficulties questionnaire (SDQ-Svk) (Table 10).

The integrated students with behavior disorders achieved the highest scores in the hyperactivity subscale, which shows a deviation from normal values. These students showed higher values in the problematic behavior as well. However, the scores in the subscales of peer problems and prosocial behavior were normal. By engaging in physical activities during physical education classes, integrated students showed improved scores in individual subscales. There was a significant improvement in the hyperactivity and problematic behavior scores. This improvement was shown by all groups of students. We assume that the physical education classes caused moderate changes in the problematic behavior subscale because the students started to show more respect for other persons by behaving better.

Table 8. Correlations between BMI and KTK subtests: girls

Age	WB	JS	MS	HH	MQ
7	-0.327	-0.210	-0.167	<b>-0.397</b>	-0.310
8	-0.238	-0.291	-0.089	<b>-0.429</b>	<b>-0.363</b>
9	<b>-0.372</b>	-0.343	-0.295	-0.272	<b>-0.447</b>
10	<b>-0.603</b>	<b>-0.594</b>	<b>-0.545</b>	<b>-0.689</b>	<b>-0.736</b>

Table 9. Correlations between BMI and KTK subtests: boys

Age	WB	JS	MS	HH	MQ
7	-0.039	0.129	-0.170	-0.193	-0.088
8	-0.287	-0.049	<b>0.533</b>	0.307	0.325
9	-0.323	-0.246	<b>-0.472</b>	-0.328	<b>-0.384</b>
10	-0.306	-0.262	<b>-0.440</b>	-0.341	<b>-0.427</b>

Table 10. Strength and difficulties questionnaire: integrated students

Symptoms	Pretest	Posttest	statistical significance
Emotional symptoms	4.49	4.02	
Conduct problem	5.36	3.78	$p < 0.01$
Hyperactivity	8.29	7.25	$p < 0.05$
Peer problem	4.59	3.71	$p < 0.05$
Prosocial behavior	5.15	5.07	

## **DISCUSSION**

Girls have sense of responsibility, which is associated with a higher degree of concentration, thoroughness, and carefulness when completing tasks. Most of the boys tested wanted to perform the test as quickly as possible, showing spontaneous reactions and encouraging intensely. Boys were more competitive than girls, which may have resulted in their different scores in T1. By rushing to complete the walking backwards test, boys touched the floor next to the beam more frequently than girls. This was caused by their competitiveness and speed. Time did not have any effect on the score in this test, and this may be considered one of the qualitative criteria distinguishing girls from boys. In the jumping sideways test, there were several factors that may have certain effect on the final test scores. Children often found it difficult to keep their feet together when jumping sideways. Some children showed poor levels of spatial orientation while some always moved forward when jumping, failing to perform jumps within space marked by lines. We also found that a large number of children showed high levels of technical skills and jumping frequency. However, children became fatigued as the duration of the test increased. Some children finished the test before the time of 15 seconds elapsed. There may be several additional factors that may have affected the scores in the moving sideways test. One of the factors to be considered is the spatial orientation. For instance, boys moved in a circle despite the fact that we performed the test simultaneously with them. Children sometimes found it difficult to move a plate on sideways using a dominant hand. An interesting finding is that some children wanted to perform the test as quickly as possible and, therefore, jumped from one plate to another. We demonstrated the test and instructed the boys to step over from one plate to the other, as specified in the test instructions. On the contrary, girls did not make errors like this.

We agree with the view that children at this age should engage in all-round physical activities [1] and should enjoy movement based on game-like movements. By having children play movement games, we wanted to develop coordination abilities of non-integrated prepubertal children, as recommended by authors [18,20]. We also have found that movement games are one of the potential tools for the development of motor coordination. When designing our intervention exercise programs, we took into consideration the scientific findings reported by authors [21,22], who found that exercise programs were effective. As recommended by authors [19,26], the Körperkoordinations Test für Kinder (KTK) has shown to be a valid diagnostic tool in the school setting.

We also present intersexual differences in motor coordination levels. These findings may be beneficial in justifying the differences in the levels and development of coordination abilities.

We have found that behavior disorders do not decrease the intellectual capacity of integrated children. Therefore, integrated children may be integrated into the regular school setting by engaging in appropriate educational strategies as recommended by Train [23].

By having children play movement games, children felt more self-confident and improved their academic and social skills, as recommended in a variety of studies [13-17]. The screening tool we used to assess children's behavioral patterns was the Strengths and difficulties questionnaire (SDQ-Svk), which is recommended also by Train [23]. We found that hyperactivity and disruptive behavior scores decreased significantly. According to our experience, we recommend the questionnaire to scale the behavior of integrated children with behavior disorders.

McGraw, Burdette, Chadwick found that school age is an appropriate period for adopting a positive attitude towards physical activities. Students should be provided with the basic information about particular sports, their rules and engage in critical physical activities [2]. We accept this finding because implementing the movement games in our study contributed to the development of motor coordination of non-integrated children and the behavior patterns of integrated children were corrected within the educational process.

## **CONCLUSIONS**

We present knowledge about the effect of the engagement in physical activities on the state and changes in behavior disorders. We have found that participation in a targeted exercise program

improves motor coordination and attenuates behavior disorders among integrated children aged 7 to 10 years.

*On the basis of the results of the study, we have formulated the following recommendations:*

- to develop motor abilities continuously and on a long-term basis during the sensitive periods of their development.
- to develop motor abilities by applying a game-based intervention exercise program aimed to develop all motor abilities and to correct behavior patterns.
- to select and incorporate movement games that are age- and difficulty-appropriate.
- to have children play 4 to 5 games for 10 minutes during each physical education class.
- to incorporate movement games into the introductory warm-up section of the class, and also into the preparatory, main, and final sections of the class.
- to begin with simple exercises. placing emphasis on the precision of movement execution and gradual increase in complexity of exercise.
- to monitor the physical fitness levels on a regular basis. vary the movement games and exercise and make students aware that physical activity and health are related
- to use optimally designed and experimentally tested movement games as one of the possible portfolios for the physical education, aiming to exert effect on the correction of behavior disorders in integrated children.
- to promote the application of game-based intervention programs during physical education classes on the basis of positive findings of this study in terms of the motor coordination development in non-integrated population and the correction of behavior disorders correction in integrated children.

## ACKNOWLEDGMENTS

The study was supported from the grant project VEGA 1/0625/16 “The effect of physical activities on the development of motor abilities in integrated children with behavior disorders”.

## REFERENCES

1. Borova B, et al. Cvičení předškolních dětí a rodičů s dětmi. Praha: Česká asociace Sport pro všechny; 2000.
2. McGraw TM, Burdette K, Chadwick K. The effects of a consumer-oriented multimedia game on the reading disorders of children with ADHD. West Virginia: AEL; 2004.
3. Kokinda M. Assessment of speed and strength of ice hockey players throughout a three-year training cycle. *Sci Rev of Phys Cult* 2015; 5: 44-48.
4. Kokinda. M, Turek M. Výber a príprava mladých hokejistov. Prešov: Fakulta športu PU v Prešove a HC Košice; 2015.
5. Kokinda M, et al. Examination of age-related core stability and dynamic balance in hockey players. *Sport Mont* 2018; 16: 21-26. doi:10.26773/smj.180604
6. Lenkova R. The rhythmic stimulation diagnostics capabilities for ten year old girls. *Sci Rev of Phys Cult* 2013; 3: 56-61.
7. Lenkova R. Stimulácia rytmických schopností aerobikom. Prešov: Prešovská univerzita v Prešove; 2014.
8. Borzikova I. Determinanty rozvoja pohybovej gramotnosti detí v predškolskom veku. Determinants of physical literacy development of children in preschool age. Teória a prax trvalo udržateľného rozvoja v materských školách: zborník príspevkov z medzinárodnej vedecko-odbornej konferencie; 2015 5. - 6. október; Prešov, Slovensko. Prešov: Vydavateľstvo Prešovskej univerzity; 2015.
9. Borzikova I. Pohybová učelnivosť 9-10 ročných detí so špeciálnymi výchovno-vzdelávacími potrebami. *Acta Facultatis exercitationis corporis universitatis Presoviensis*. Prešov: Prešovská univerzita v Prešove. Fakulta športu; 2014.
10. Pavlova I, Bodnar I, Mosler D, et al. The influence of karate training on preparing preschool girls for school education. *Ido Movement for Culture Journal of Martial Arts Anthropology* 2019;19:12–20. Doi: 10.14589/ido.19.2.3

11. Kacur P, Cech P, Kandrak R, Dzugas D, Jesensky M, Jancosek M, Elias T, Ruzbarska B. The assessment of somatic parameters and physical fitness levels in prepubertal children. *Sci Rev of Phys Cult* 2016; 6: 27-32.
12. Bendikova E, Dobay B. Physical and sport education as a tool for development of a positive attitude toward health and physical activity in adulthood. *Eur J Contemp Educ: international bilingual scientific journal* 2017; 6: 14-21. doi: 10.13187/ejced.2017.1.14
13. Barkley RA. Attention deficit hyperactivity disorder: a handbook for diagnosis and treatment. New York: Guilford Press; 2006.
14. Blahutkova M, Klenková J, Zichová D. Psychomotorické hry pro děti s poruchami pozornosti a pro hyperaktivní děti. Brno: Masarykova univerzita; 2005.
15. Drtilkova I. "Možná ADHD!" Praha: Golén; 2007.
16. Payneová H. Kreativní pohyb a tanec ve výchově. sociální práci a klinické praxi. Praha: Portál; 1999.
17. Wolraich ML, Bard DE, Neas, B, Doffing M, Beck L. The psychometric properties of the Vanderbilt attention-deficit hyperactivity disorder diagnostic teacher rating scale in a community population. *J Dev Behav Pediatr* 2013; 34: 83-93. doi: 10.1097/DBP.0b013e31827d55c3
18. Lednický A. Koordinačné schopnosti. charakteristika. rozvoj. diagnostika. Bratislava: SVSPTVŠ; 2005.
19. Vandorpe B, Vandendriessche J, Lefevre J, Pion J, Vaeyens R, Matthys S, Philippaerts R, Lenoir M. The Körperkoordinations Test für Kinder: reference values and suitability for 6-12-year-old children in Flanders. *Scand J Med Sci Sports* 2011; 21: 378-388. doi: 10.1111/j.1600-0838.2009.01067.x
20. Ruzbarska I., Chovanova E. Motor abilities of prepubertal children – theoretical perspectives on physical and sports education at primary school. Lüdenscheid: RAM – Verlag; 2017.
21. Bendikova E, Palascakova Springrova I, Tomkova S, Vagner J. Effects of an exercise program on the dynamic function of the spine in female students in secondary school. *J Phys Educ Sport* 2018; 18: 831-839. doi:10.7752/jpes.2018.02123
22. Bendikova E, Stackeova D. Vplyv pohybového programu s kompenzačným zameraním na pohyblivosť chrbtice u žiačok stredných škôl. *Hygiena: časopis pro ochranu a podporu zdraví* 2015; 60: 4-9. doi: 10.21101/hygiena.a1330
23. Train A. Specifické poruchy chování a pozornosti. Praha: Portál; 1997.
24. Kavale KA, Steven RF, Hill MW. Interventions for oppositional defiant disorder and conduct disorder in the schools. In Quay HC, Hogan AE, editors). *Handbook of Disruptive Behavior Disorders*. New York: Academic/Plenum; 1999: 441-454.
25. Ortenburger D, Wąsik J, Góra T, et al. Taekwon-do: a chance to develop social skills. *Ido Movement for Culture Journal of Martial Arts Anthropology* 2017;17:14-8. doi: 10.14589/ido.17.4.3
26. Schilling F, Kiphard J. Körperkoordinationstest für Kinder KTK. Weinheim: Beltz Test GmbH; 1974.