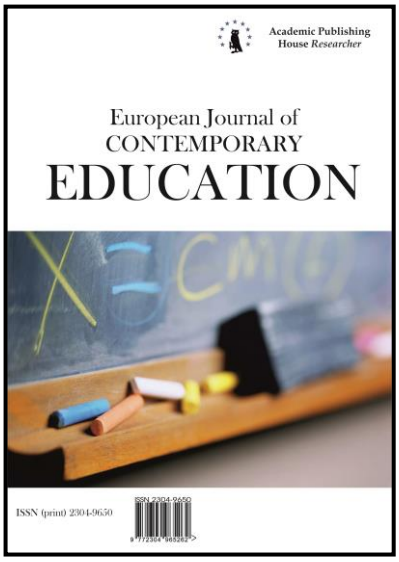
Published in the Slovak Republic
European Journal of Contemporary Education
E-ISSN 2305-6746
2018, 7(4): 717-727
DOI: 10.13187/ejced.2018.4.717
www.ejournal1.com



Effects of a 8-Month Exercise Intervention Programme on Physical Activity and Physical Fitness for First Grade Students

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Abstract

Background. The World Health Organization recommends that children should participate in sufficient PA by engaging in moderate-to-vigorous physical activity for at least 60 min daily per week. Schools are important settings for the promotion of children's physical activity. Through commuting, break times, and physical education lessons they provide regular opportunities for children to be active

Methods. The experimental group included 26 girls and 24 boys aged 6–7 years old, and the control group included adolescent girls (n=25) and boys (n=23). The experimental group included 26 girls 24 boys aged 6-7 years old. Their mean weight and height were 24.3±0.9 kg and 1.25±0.11 m for the girls, and 29.3±0.6 kg and 1.33±0.09 m for the boys. The control group included 25 girls and 23 boys aged 6-7 years old, attending the same school. Their mean weight and height were 22.3±0.7 kg and 1.24±0.1 m for the girls, and 28.4±0.7 kg and 1.36±0.07 m for the boys. The methodology of innovative physical education classes was based on the DIDSFA model (dynamic exercise, intense motor skills repetition, differentiation, reduction of parking and seating, physical activity distribution in the classroom).

The testing of physical fitness. The flexibility test, the long jump test, 3 × 10 m speed shuttle run test, a medical (stuffed) 1 kg ball pushing from the chest test. *The evulation of physical activity*.Children's Physical Activity Questionnaire (Corder et al., 2009) was used. It was also based on the Children's Leisure Activities Study Survey (CLASS) questionnaire,

Results. Experimental group (EG) (boys and girls) post-test results physical fitness (PF) tests, it turned out that the results of the long jump test ranged from 106.3 cm (girls) to 120.1 cm (boys), statistically significant differences were detected ($p < .05$). The girls (2.93 m) performed worse than the boys (3.64 m) ($p < .05$) in the medical (stuffed) 1 kg ball pushing from the chest test.

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The best score of the girls' 3 × 10 m speed shuttle run test was 8.55 s, for boys it was 8.8 s, the worst performance time for boys was 13.52 s, for girls 13.22 s ($p < .05$). Comparing the results of boys' and girls' flexibility, there were no statistically significant differences ($p > .05$): the girls' flexibility was about 0.06 cm, for boys -1.8 cm.

The post-test of the experimental group boys (1261.93 MET, min/week) was to analyze average physical activity in comparison with the girls of the experimental group (737.48 MET, min/week). Statistically significant difference was found during the analysis of average MET per boy (1390.45 MET, min/week) in comparison with the girls (880.27 MET, min/week, $p<0.05$).

Conclusion. Established that the properly construed and purposefully applied complex of the 8-month exercise intervention programme for first grade students caused the statistically significant changes in the dependent variables: increased physical activity and physical fitness for experimental group.

Keywords: physical activity, physical fitness, innovative physical education classes, primary education.

1. Introduction

As physical activity (PA) is beneficial for children's health (Baranowski et al., 2006; Xu, Xue, 2016) the promotion of PA is a useful and logical way to improve children's health and prevent chronic diseases. The World Health Organization recommends that children should participate in sufficient PA by engaging in moderate-to-vigorous physical activity for at least 60 min daily per week (WHO..., 2010; Teychenne, York, 2013) PA with moderate intensity is defined as an activity that increases breathing, sweating, and heart rate, while PA with vigorous intensity refers to an activity that substantially increases breathing, sweating, and heart rate (Landry, Driscoll, 2012).

Public health interventions in schools are important, as a large number of children can be reached (Dobbins et al., 2013); and there are key windows of opportunity in a primary school setting to increase children's PA levels such as: break times (Powell et al., 2015), in class activity breaks (McMullen et al., 2014) and Physical Education classes (McKenzie, Lounsbery, 2014). Schools are important settings for the promotion of children's physical activity. Through commuting, break times, and physical education lessons they provide regular opportunities for children to be active (Ridgers et al., 2006). Past work has found that children can acquire up to 40 % of their daily moderate-to-vigorous physical activity (MVPA) during school break times (Ridgers et al., 2006), and between 25 % and 40 % during travel to and from school (van Sluijs et al., 2009). Previous work has highlighted how alterations and additions to the physical school environment can increase children's activity levels (Harrison, Jones, 2012), and that the supportiveness of primary school physical activity environments is positively related to children's school-time activity levels (Jones et al., 2010).

The purpose of this study was to establish the effects of a 8-month exercise intervention programme on physical activity and physical fitness for first grade students

2. Methods

Participants. According to the SVIS data base statistics (URL: http://www.svis.smm.lt/), the number of first grade students in year 2017/2018 was 30.126 in total (14.609 of girls). All in all, 384 first form students had to be tested. This study was only observational and therefore a smaller number of respondents were selected.

The school was randomly selected from primary schools in Lithuania. With the approval of the parents, the time and place of the examination were agreed with the school administration in advance. The study took place in 2017 from September to November in four Lithuanian general education schools that had primary education and primary education classes. The time and place of the study, with the consent of the parents, were agreed upon in advance with the school administration.

The experimental group included 26 girls and 24 boys aged 6–7 years old, and the control group included adolescent girls (n=25) and boys (n=23). The experimental group included 26 girls 24 boys aged 6-7 years old. Their mean weight and height were 24.3±0.9 kg and 1.25±0.11 m for the girls, and 29.3±0.6 kg and 1.33±0.09 m for the boys. The control group included 25 girls and 23 boys aged 6-7 years old, attending the same school. Their mean weight and height were 22.3±0.7 kg and 1.24±0.1 m for the girls, and 28.4±0.7 kg and 1.36±0.07 m for the boys.

In the present research, we used a pre-test/post-test experimental strategy. That was chosen to avoid any interference with educational activities due to the random selection of children into the groups. The experimental group was under test during eight months. We developed the methodology of innovative physical education classes and created the model of educational factors stimulating pupils' physical activity. We identified relationships between the pupils' physical activities at school and learning achievements. We also prepared the methodical material for innovative physical education classes (Figure 1). The methodology was based on the DIDSFA model (dynamic exercise, intense motor skills repetition, differentiation, reduction of parking and seating, physical activity distribution in the classroom) (Powell et al., 2016; Bulioliene et al., 2017).

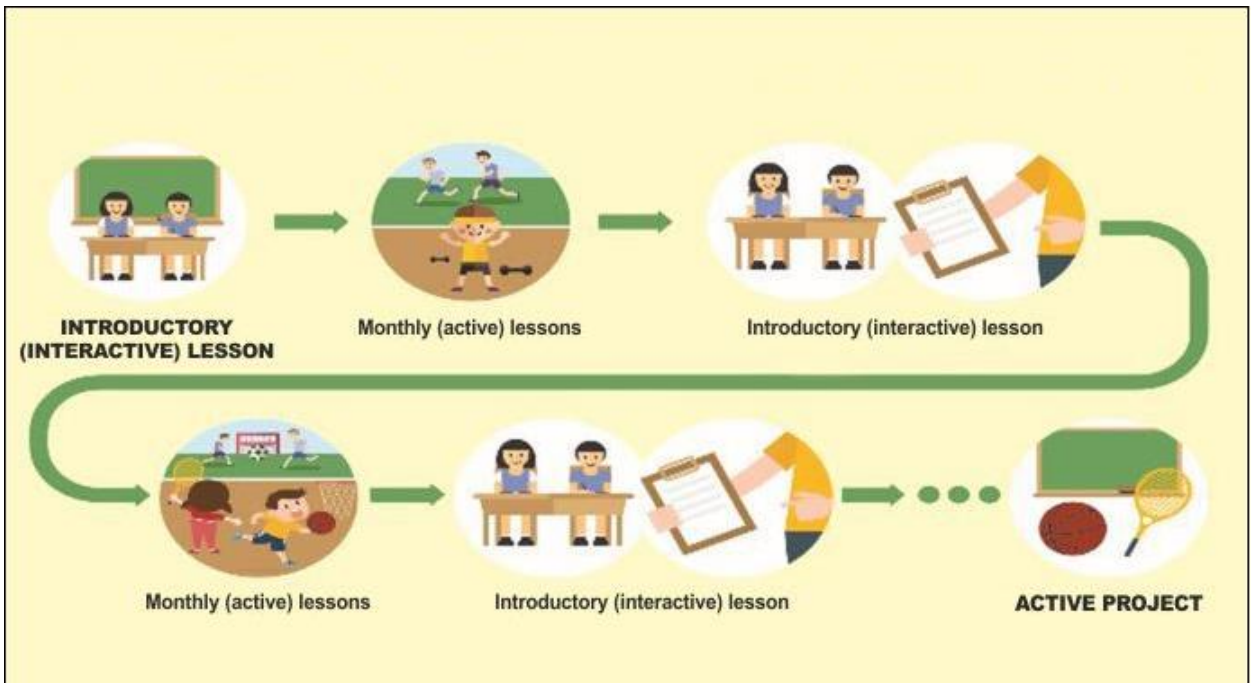

Fig. 1. Methodical material for innovative physical education classes

The girls and boys in the control group attended the same (non-modified) physical education lessons.

The testing of physical fitness. The students performed four physical fitness tests (PFT) during physical education lessons They performed the European Physical Fitness Test Battery (Eurofit) in the following test order: the long jump test to test explosive power of children's leg muscles; flexibility (sit and reach test) (Venckunas et al., 2017); 3 × 10 m speed shuttle run test – agility (Ivanovas, Paškevičienė, 2003); medical (stuffed) 1 kg ball pushing from the chest test explosive power of the hands (Fjørtoft et al., 2011).

The evaluation of physical activity. Children's Physical Activity Questionnaire (Corder et al., 2009) was used. It was also based on the Children's Leisure Activities Study Survey (CLASS) questionnaire, which included activities specific to young children, such as "playing in a playhouse." The original intent of the proxy-reported CLASS questionnaire for 6–7-year-olds was to assess type, frequency, and intensity of physical activity over a usual week.

Mathematical statistics. The arithmetic mean (x) and the average standard deviation (SD) were determined for comparison. Differences between different genders, age and physical fitness were estimated using one-factor dispersion analysis (ANOVA). The relationship between variables was calculated on the basis of the correlation coefficient of the Spearman correlation coefficient. Differences between different genders and physical activity were estimated using Mann-Whitney *U* test. The following reliability levels were used for statistical outputs: $p > .05$ – insignificant; $p < 05$ – significant. All calculations were performed using MS Excel and SPSS programs.

3. Results

Physical activity of 7-year-old children. On analyzing the pre-test results of physical activity of the 7-year-old students, it turned out that both the boys (98.30 MET, min/week) and girls (90.30 MET, min/week) in the experimental group were physically active during physical education classes ($p > 0.05$).

The analysis of physical activity types, such as cycling to school and walking to school showed that there were no differences in gender according to MET. In the context of average physical activity, a higher indicator (1086.21 MET, min/week) was detected in the boys of the experimental group in comparison with the girls (681.41 MET, min/week). Statistically significant differences were found in average MET per boy (1184.51 MET, min/week) in comparison with the girls (815.88 MET, min/week) ($p < 0.05$; Table 1).

The post-test of the experimental group boys (1261.93 MET, min/week) was to analyze average physical activity in comparison with the girls of the experimental group (737.48 MET, min/week). Statistically significant difference was found during the analysis of average MET per boy (1390.45 MET, min/week) in comparison with the girls (880.27 MET, min/week, $p < 0.05$; Table 1).

Table 1. The physical activity level using the MET method (the pre-test/post-test results of the experimental group)

Type of physical activity	MET	1 day/min	Days per week	MET, min/week
The experimental group pre-test				
Boys				
Physical Training lesson	3.5	31	1	98.30
Cycling to school	4	0	3	0.00
Walking to school	3.3	0	4	0.00
Sport groups (mean physical activity)	6	59	1	1086.21
			On average for one boy	1184.51*
Girls				
Physical Training lesson	3.5	31	1	90.30
Cycling to school	4	0.48	3	18.35
Walking to school	3.3	0.97	4	25.82
Sport groups (mean physical activity)	6	59	1	681.41
			On average for one girl	815.88*
Experimental group post-test				
Boys				
Physical Training lesson	3.5	31	1	128.52
Cycling to school	4	0	3	0.00
Walking to school	3.3	0	4	0.00
Sport groups (mean physical activity)	6	59	1	1261.93
			On average for one boy	1390.45*

		Girls		
Physical Training lesson	3.5	31	1	94.68
Cycling to school	4	0.48	3	18.50
Walking to school	3.3	0.97	4	29.61
Sport groups (mean physical activity)	6	59	1	737,48
			On average for one girl	880.27*

*– p<0,05 (according to the Mann-Whitney U test)

Analyzing the results of the 7-year-old students' physical activity, it turned out that in the control group, both the boys (93.86 MET, min/week) and girls (90.68 MET, min/week) were physically active in physical education classes ($p > 0.05$) during the pre-test.

The analysis of physical activity types such as cycling to school and walking to school found no differences in gender according to MET. A higher number of the boys in the control group (954.36 MET, min/week) was determined during the analysis of average physical activity compared to the girls of the same group (568.52 MET, min/week). Statistically significant differences were found during the analysis of average MET per boy in the control group (1070.90 MET, min/week) compared to the girls (691.69 MET, min/week, $p < 0.05$; Table 2).

The post-test results of the boys of the control group (1012.08 MET, min/week) were determined by the analysis of average physical activity in comparison with the girls of the same group (598.03 MET, min/week). Statistically significant differences were found in average MET per boy (1130.23 MET, min/week) in comparison with the girls (723.17 MET, min/week, $p < 0.05$; Table 2).

Table 2. Physical activity level using the MET method (the pre-test/post-test results of the control group)

Type of physical activity	MET	1 day/min	Days per week	MET, min/week
		Control group pre-test		
		Boys		
Physical Training lesson	3.5	31	1	93.86
Cycling to school	4	0.70	3	22.68
Walking to school	3.3	0	4	0.00
Sport groups (mean physical activity)	6	59	1	954.36
			On average for one boy	1070.90*
		Girls		
Physical Training lesson	3.5	31	1	90.68
Cycling to school	4	0,51	3	12.28
Walking to school	3.3	0,57	4	20.21
Sport groups (mean physical activity)	6	59	1	568.52
			On average for one girl	691.69*

Control group post-test				
		Boys		
Physical Training lesson	3.5	31	1	94.02
Cycling to school	4	0.70	3	24.13
Walking to school	3.3	0	4	0.00
Sport groups (mean physical activity)	6	59	1	1012.08
			On average for one boy	1130.23*
		Girls		
Physical Training lesson	3.5	31	1	91,45
Cycling to school	4	0,51	3	13,41
Walking to school	3.3	0,57	4	20.28
Sport groups (man physical activity)	6	59	1	598.03
			On average for one girl	723.17*

Note. *$p < .05$ (according to Mann-Whitney U test).

Physical fitness of 7-year-old children. While analysing the results of 7-year-old students' experimental group (EG) (boys and girls) pre-test results physical fitness (PF) tests, it turned out that the results of the long jump test ranged from 105.2 cm (girls) to 118.3 cm (boys), statistically significant differences were detected ($p < .05$) (Table 3). The girls (2.73 m) performed worse than the boys (3.35 m) ($p < .05$) in the medical (stuffed) 1 kg ball pushing from the chest test. The best score of the girls' 3 × 10 m speed shuttle run test was 9.55 s, for boys it was 9.2 s, the worst performance time for boys was 13.68 s, for girls 13.54 s ($p < .05$). Comparing the results of boys' and girls' flexibility, there were no statistically significant differences ($p > .05$): the girls' flexibility was about 0.05 cm, for boys -1.6 cm (Table 3).

Control group (CG) (boys and girls) pre-test results physical fitness (PF) tests, it turned out that the results of the long jump test ranged from 101.5 cm (girls) to 113.3 cm (boys), statistically significant differences were detected ($p < .05$) (Table 3). The girls (2.31 m) performed worse than the boys (3.05 m) ($p < .05$) in the medical (stuffed) 1 kg ball pushing from the chest test. The girls' 3 × 10 m speed shuttle run test was 12.73 s, for boys it was 10.09 s, ($p < .05$). Comparing the results of boys' and girls' flexibility, there were no statistically significant differences ($p > .05$): the girls' flexibility was about 0.04 cm, for boys -1.7 cm (Table 3).

Table 3. Comparison of 7- year-old boys' and girls' indicators of physical fitness (the pre-test/post-test results of the Experimental group)

Test	Girls	Boys	F criterion value; p level	Observed Power
		Experimental group pre-test		
Long jump (cm)	105.2 (12.1)	118.3 (9.8)	28.017 .000	1.000
Medical (stuffed) 1 kg ball pushing from the chest (m)	2.73 (0.27)	3.35 (0.65)	73.460 .000	1.000
3 × 10 m speed shuttle run	11.61 (0.914)	10.99 (1.06)	21.082 .000	0.996
Sit and reach (cm)	0.05 (7.09)	–1.6 (6.25)	3.475 .064	0.459

Relationships between students' physical fitness				
	Long jump (cm)	3 × 10 m speed shuttle run	Medical (stuffed) 1 kg ball pushing from the chest (m)	Sit and reach (cm)
Long jump (cm)	1			
Medical (stuffed) 1 kg ball pusshing from the chest (m)	−.939**	1		
3 × 10 m speed shuttle run	.945**	−.960**	1	
Sit and reach (cm)	.945**	−.949**	.942**	1
Experimental group post-test				
Long jump (cm)	106.3 (11.5)	120.1 (7.6)	28.524 .000	1.000
Medical (stuffed) 1 kg ball pushing from the chest (m)	2.93 (0.17)	3.64 (0.52)	74.324 .000	1.000
3 × 10 m speed shuttle run	10.59 (0.91)	10.05 (1.06)	21.025 .000	0.985
Sit and reach (cm)	0.06 (7.05)	−1.8 (6.05)	3.841 .064	0.478
Relationships between students' physical fitness				
	Long jump (cm)	3 × 10 m speed shuttle run	Medical (stuffed) 1 kg ball pushing from the chest (m)	Sit and reach (cm)
Long jump (cm)	1			
Medical (stuffed) 1 kg ball pusshing from the chest (m)	−.912**	1		
3 × 10 m speed shuttle run	.895**	−.915**	1	
Sit and reach (cm)	.982**	−.892**	.953**	1

Note. **$p < .01$.

Experimental group (EG) (boys and girls) post-test results physical fitness (PF) tests, it turned out that the results of the long jump test ranged from 106.3 cm (girls) to 120.1 cm (boys), statistically significant differences were detected ($p < .05$) (Table 4). The girls (2.93 m) performed worse than the boys (3.64 m) ($p < .05$) in the medical (stuffed) 1 kg ball pushing from the chest test. The best score of the girls' 3 × 10 m speed shuttle run test was 8.55 s, for boys it was 8.8 s, the worst performance time for boys was 13.52 s, for girls 13.22 s ($p < .05$). Comparing the results of boys' and girls' flexibility, there were no statistically significant differences ($p > .05$): the girls' flexibility was about 0.06 cm, for boys -1.8 cm (Table 4).

Control group (CG) (boys and girls) post-test results physical fitness (PF) tests, it turned out that the results of the long jump test ranged from 101.7 cm (girls) to 114.9 cm (boys), statistically significant differences were detected ($p < .05$) (Table 4). The girls (2.42 m) performed worse than the boys (3.59 m) ($p < .05$) in the medical (stuffed) 1 kg ball pushing from the chest test. The girls' 3 × 10 m speed shuttle run test was 12.23 s, for boys it was 12.09 s ($p < .05$). Comparing the results of boys' and girls' flexibility, there were no statistically significant differences ($p > .05$): the girls' flexibility was about 0.05 cm, for boys -1.9 cm (Table 4).

Table 4. Comparison of 7- year-old boys' and girls' indicators of physical fitness (the pre-test/post-test results of the Control group)

Test	Girls	Boys	F criterion value; p level	Observed Power
Control group pre-test				
Long jump (cm)	101.5 (9.3)	113.3 (9.2)	25.032 .045	0.825
Medical (stuffed) 1 kg ball pushing from the chest (m)	2.31 (0.52)	3.05 (0.31)	69.581 .023	0.932
3 × 10 m speed shuttle run	12.73 (0.54)	12.09 (0.86)	21.082 .000	0.901
Sit and reach (cm)	0.04 (2.86)	−1.7 (3.25)	3.475 .064	0.529
Relationships between students' physical fitness				
	Long jump (cm)	3 × 10 m speed shuttle run	Medical (stuffed) 1 kg ball pushing from the chest (m)	Sit and reach (cm)
Long jump (cm)	1			
Medical (stuffed) 1 kg ball pusshing from the chest (m)	−.856**	1		
3 × 10 m speed shuttle run	.923**	−.910**	1	
Sit and reach (cm)	.749**	−.891**	.899**	1
Control group post-test				
Long jump (cm)	101.7 (9.1)	114.9 (5.2)	25.059 .049	0.865
Medical (stuffed) 1 kg ball pushing from the chest (m)	2.42 (0.49)	3.59 (0.21)	69.641 .035	0.961
3 × 10 m speed shuttle run	12.23 (0.32)	12.09 (0.52)	21.023 .000	0.938
Sit and reach (cm)	0.05 (2.79)	−1.9 (1.48)	3.628 .034	0.648
Relationships between students' physical fitness				
	Long jump (cm)	3 × 10 m speed shuttle run	Medical (stuffed) 1 kg ball pushing from the chest (m)	Sit and reach (cm)
Long jump (cm)	1			
Medical (stuffed) 1 kg ball pusshing from the chest (m)	−.862**	1		
3 × 10 m speed shuttle run	.945**	−.911**	1	
Sit and reach (cm)	.863**	−.898**	.901**	1

Note. $^{**}p < .01$.

4. Discussion

It was established that the properly construed and purposefully applied complex of the 8-month exercise intervention programme for first grade students caused the statistically significant changes in the dependent variables: increased physical activity and physical fitness for experimental group.

Physical Activity. The main aim of this research was to evaluate a one-year teaching strategy intervention, which supported teachers in increasing children's active learning time during primary physical education classes (PEC). Our results indicated that the intervention programme was effective. Thus, teachers were provided with a new platform that raised awareness, provided a clear focus and re-directed their approach to teaching primary PEC. It was evident from the qualitative data that teachers began to think about primary PEC in a very different way, in short their approach to PE at baseline did not align with their new awareness of increasing active learning time at post intervention programme. Powell et al. (2016) found that proportion of time children were engaged in moderate to vigorous physical activity during PE lessons in the intervention school increased significantly between baseline (M = 42.51 % SD = 12.41 %) and post-intervention (M = 72.59 %, SD = 10.05 %). As a result, it seems effectively increase children's active learning time in PE. Sallis et al. (1997) evaluated a health-related physical education program for fourth- and fifth-grade students designed to increase physical activity during physical education classes and outside of school. Scientists found, that students spent more minutes per week being physically active in specialist-led (40 min) and teacher-led (33 min) physical education classes than in control classes (18 min; P < .001). After 2 years, girls in the specialist-led condition were superior to girls in the control condition on abdominal strength and endurance (P < .001) and cardiorespiratory endurance (P < .001). There were no effects on physical activity outside of school (Sallis et al., 1997). Children's moderate and vigorous physical activity significantly increased in the intervention group (moderate: from 38 to 50 %, vigorous: from 10 to 11 %), while it decreased in the control group (moderate: from 44 to 39 %, vigorous: from 11 to 5 %). At morning recess, providing game equipment was effective in increasing children's moderate physical activity (from 41 to 45 %), while it decreased in the control group (from 41 to 34 %). Finding suggests that promoting physical activity through game equipment provision during recess periods can contribute to reach the daily activity levels recommended for good health (Stefanie et al., 2006). Kliziene et al. (2018) found that both boys and girls were physically active in physical education lessons (p > 0.05).

Physical Fitness. Poor scoring in physical fitness is an important risk factor for cardiovascular disease (Timpka et al., 2014), type 2 diabetes (Lee et al., 1999), hypertension (Faselis et al., 2012), stroke (Högström et al., 2015). Venckunas et al. (2017) carried out the study about Lithuanian children physical fitness The study has shown loss of flexibility, leg muscle power, upper body strength and cardiorespiratory fitness between 1992 and 2012, although there was an improvement in abdominal muscle strength in girls, agility in boys and balance in both genders during the same period. At large, negative trends in aspects of fitness seen between 1992 and 2002 have not slowed down between 2002 and 2012. Positive trends in agility and abdominal muscle strength seen before 2002 have regressed or were reversed between 2002 and 2012, while balance continued to improve at increased pace (Venckunas et al., 2017). Sallis et al. (1997) estimated, that applying a health-related physical education program for girls in the specialist-led condition improved substantially in mile-run time. On the sit-up test, girls in the specialist-led condition improved more than those in the control condition. Kliziene et al. (2018) found that long jump results ranged from 105.2 cm (girls) to 118.3 cm (boys), statistically significant differences were detected (p < 0.05) The best score of the girls' shuttle running 3 × 10 m was 9.55 s, for boys it was 9.2 s, the worst performance time for boys was 13.68 s, for girls – 13.54 s (p < .05).

5. Conclusion

Established that the properly construed and purposefully applied complex of the 8-month exercise intervention programme for first grade students caused the statistically significant changes in the dependent variables: increased physical activity and physical fitness for experimental group.

6. Acknowledgements

The research is supported by a research grant from the Lithuanian Research Council, Promotion of Students' Scientific Activities, sponsored by the European Union Structural Funds (09.3.3-LMT-K-712-03-0101).

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