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IMPROVING PHYSICAL FITNESS LEVELS AMONG 6- AND 7-YEAR-OLD CHILDREN AS A RESULT OF PHYSICAL AND SPORTS EDUCATION

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Summary. The purpose of the study was to extend knowledge about physical fitness levels and their development among first-grade elementary school students as a result of school physical and sports education. A total of 23 children participated in the study, and nine physical fitness tests were administered to determine their physical fitness levels (Měkota & Blahuš, 1983; Šimonek, 2015). The *t* test for dependent samples was used to determine changes in physical fitness levels for both sexes. Boys showed significant improvements in the 20-meter dash, repeated routine with a pole, standing long jump and 4 x 10 m shuttle run. Girls showed significant improvements in the 20-meter dash test and a repeated routine with a pole. The results have confirmed the necessity to enhance physical fitness levels in children and systematically develop all motor abilities in physical and sports education classes.

Key words: physical education process, physical fitness, prepuberty

Introduction

The issue of motor abilities and physical fitness levels among prepubertal students has been addressed in numerous studies (Hands & Larkin 2006; Adamčák et al. 2007; Haga 2008, 2009; Novotná et al. 2009; Antala 2010, 2014; Mužík et al. 2010; Fransen et al. 2012; Podstawski & Boryslawski 2012; Eather et al. 2013; Čillík et al. 2013, 2015; Krull & Novotná 2015; Sujová & Vladovičová 2016; Mandzák & Bujdoš 2018; Mandzák & Mandzáková 2018; Chovanová & Majherová 2018), highlighting the benefits of physical and sports education for healthy development of children.

Motor and physical fitness are determined by the developmental rate of particular motor abilities. Prepubertal age is the most appropriate period for the development and refinement of motor abilities and skills. However, developing abilities and skills is not equally effective, and not every motor ability may be perfectly developed. Prepuberty refers to the time appropriate for developing speed and motor coordination, aerobic endurance, and explosive and dynamic strength (Ružbarská & Turek 2007; Perič et al. 2012; Laczo et al. 2013; Čillík et al. 2014).

Physical and sports education within primary education aims to develop motor, physical, and functional parameters. Most children become familiar with physical exercises during prepuberty, being the most appropriate period for taking up regular exercise. According to Antala (2012), the purpose of school-based physical and sports education is to develop motor abilities, acquire and refine motor skills and habits, promote physical literacy, enhance general physical fitness levels, and have children adopt positive attitudes towards physical activity through performing physical activities. In addition, Dvořáková (2012) states that physical and sports education should aim to promote physical activity levels among all children, not only the athletically gifted individuals.

At present, there are several test batteries that primary education teachers may use to test and monitor children's physical fitness levels. Tests are administered to determine current motor ability levels, assess age- and gender-specific differences in physical fitness, and compare the effects of a variety of physical fitness interventions on physical fitness components. Teachers may find the information about physical fitness levels helpful when developing students' motor abilities and physical fitness. The testing results may also change the attitude towards physical activity adopted by students and their parents (Podstawski & Boryslawski 2012; Sujová & Vladovičová 2016).

Based on the results reported in numerous studies conducted to date, multiple authors have stated that physical fitness levels play an essential role in promoting physical activity levels among prepubertal children. According to the studies, youth with better motor abilities may find it easier to be physically active and may be more likely to engage in physical activity compared with peers with poorer motor competence. The relationship between motor abilities and physical activity is probably one of the critical factors that significantly forms and determines lifestyle during childhood (Losse et al. 1991; Bouffard et al. 1996; Piek & Skinner 2001; Reed et al. 2004; Wrotniak et al. 2006; Vandorpe et al. 2011).

The current trend in physical fitness changes among school populations points to stagnating or decreasing physical fitness levels. Students' fitness parameters in physical and sports education are influenced by various factors, including leisure-time physical activities

(Adamčák & Nemec 2010; Šimonová & Vladovičová, 2010; Lednický & Doležajová, 2011). In their studies, Antala et al. (2010, 2014) emphasize that in recent years the number of children who are active in physical and sports education classes only and do not engage in any other physical activity outside these classes is increasing. The authors emphasize that both the general population and physically active children and adolescents demonstrate declining levels of physical fitness.

The purpose of the study was to extend knowledge about physical fitness levels and development among first-grade elementary school students as a result of school physical and sports education classes.

The following research questions have been formulated to increase the research objectiveness: What are the physical fitness levels of 6- and 7-year-old children? How do physical and sports education classes affect physical fitness components among 6- and 7-year-old children?

Methods

The study sample included 23 first-grade students (9 boys and 14 girls) aged 6 and 7 years (M = 7.35; SD = 0.28 years) from the Šrobárova elementary school in Prešov. The children who participated in this study did not engage in any after-school or club-based organized sports activity. The research lasted for 10 months, from September 2021 to June 2022. As set out in the Framework Teaching Plan for Elementary Schools, students attended 2 physical education classes per week. The testing sessions took place during physical and sports education classes in the school gym. Before administering physical fitness tests, basic somatic parameters were measured. Body height was measured in centimeters to the nearest tenth using a digital stadiometer SECA 217 (Medical Measuring Systems and Scales, Hamburg, Germany). Body weight was measured in kilograms to the nearest tenth using a digital scale (Diagnostic scale, Bosogramm 4000, Bosch + Sohn, Germany). Body height and weight were used to calculate BMI indices for all children.

The following nine physical fitness tests were administered to determine children's physical fitness levels: 20-meter dash (T1), three-ball rolling (T2), repeated stick routine (T3), sit-and-reach (T4), flexed arm hang (T5), standing long jump (T6), 4 x 10 m shuttle run (T7), sit-ups in 1 min (T8), and multi-stage shuttle run (T9).

The Shapiro-Wilk test was used to assess the normality of data distribution. The descriptive statistics were used to compute the mean and standard deviations for particular

somatic parameters and physical fitness tests. The *t* test for dependent samples was used to determine significant differences in physical fitness levels with $p < .05$ considered statistically significant.

Results

Descriptive statistics for children's somatic parameters are presented in Table 1. Measuring somatic parameters is currently considered an integral part of athletes and general population testing. Somatic characteristics are one of the basic parameters indicating the physical growth and development of an individual. Individual growth curves and changes in somatic parameters may either positively or negatively affect physical fitness levels (Jesenský 2018). Somatic parameters after 10 months increased significantly, which may be attributed to natural development. Body height for girls and boys is increased by 4.71 cm and 4.4 cm. Mean increases in body weight for girls and boys were 2.66 kg and 2.63 kg, respectively.

Table 1
Descriptive statistics for somatic parameters

		Boys (*n* = 9)		**Girls (*n* = 14)**	
		Pretest	**Posttest**	**Pretest**	**Posttest**
BH (cm)	*M* ± *SD*	122.00 ± 4.79	126.40 ± 478	125.65 ± 4.62	130.36 ±4.83
	p	**0.00**		**0.00**	
BW (kg)	*M* ± *SD*	22.41 ± 2.97	25.04 ± 3.32	25.15 ± 4.02	27.81 ± 4.68
	p	**0.00**		**0.00**	
BMI	*M* ± *SD*	14.99 ± 0.97	15.61 ± 1.11	15.87 ± 1.86	16.29 ± 2.00
	p	**0.04**		**0.02**	

Note. BH = body height; BW = body weight; BMI = body mass index; cm = centimeter; kg = kilogram; *n* = sample size; *M* = arithmetic mean; *SD* = standard deviation; $p < .05$

Gender differences in physical fitness levels of physically inactive children are presented in Table 2. Boys showed statistically significant improvements in the 20-meter dash (T1), repeated stick routine (T3), standing long jump (T6), and 4 x 10 m shuttle run. Girls showed statistically significant improvements in 20-meter dash (T1) and repeated stick routine (T3). Apart from the three-ball rolling test, the improvements between pretest and posttest were statistically nonsignificant. The results showed that at the end of first grade, boys showed improved levels of running speed and running speed with changes of direction, explosive leg power, and motor coordination. Girls showed significantly improved levels of running speed and motor coordination.

Table 2

Physical fitness levels of physically inactive children by gender

		Boys (*n* = 9)		Girls (*n* = 14)	
		Pretest	**Posttest**	**Pretest**	**Posttest**
T1	*M* ± *SD*	4.57 ± 0.24	4.20 ± 0.22	4.58 ± 0.36	4.38 ± 0.29
	p	**0.00**		**0.01**	
T2	*M* ± *SD*	31.39 ± 8.71	33.77 ± 9.93	32.94 ± 9.31	30.40 ± 5.09
	p	0.38		0.24	
T3	*M* ± *SD*	30.56 ± 4.29	24.01 ± 4.49	30.89 ± 8.81	25.14 ± 4.57
	p	**0.00**		**0.03**	
T4	*M* ± *SD*	2.22 ± 2.44	2.89 ± 2.71	7.71 ± 2.92	9.14 ± 4.99
	p	0.37		0.13	
T5	*M* ± *SD*	10.36 ± 6.54	10.87 ± 4.96	7.72 ± 7.05	9.60 ± 5.45
	p	0.73		0.27	
T6	*M* ± *SD*	110.33 ± 16.86	129.78 ± 7.97	121.21 ± 18.97	126.00 ± 13.31
	p	**0.00**		0.22	
T7	*M* ± *SD*	14.08 ± 1.10	13.32 ± 0.70	14.01 ± 0.91	13.69 ± 0.71
	p	**0.04**		0.06	
T8	*M* ± *SD*	22.67 ± 7.76	26.67 ± 10.04	22.43 ± 10.14	26.00 ± 9.07
	p	0.18		0.20	
T9	*M* ± *SD*	199.56 ± 69.75	188.33 ± 47.38	169.64 ± 68.67	165.21 ± 53.95
	p	0.45		0.83	

Note. T1 through T9 = physical fitness tests; *n* = sample size; *M* = arithmetic mean; *SD* = standard deviation; $p < .05$

Discussion

Monitoring children's somatic parameters is essential in particular for enhancing sports performance and observing healthy physical growth and development in children and youth during various stages of ontogeny (Grasgruber & Cacek 2008). The somatic parameters of physically inactive children included in this study were compared with the data collected within the nationwide survey Physical development in children and youth in the Slovak Republic conducted in 2011. Compared with the nationwide survey data, boys' mean body height and body weight at pretest was 5.46 cm and 5.05 kg lower, respectively. Compared with their age-matched peers, girls' mean body height and body weight was 0.81 cm and 1.35 kg lower, respectively.

During the early years of life, body height and weight increase at a steady rate. According to Perič et al. (2012), body height increases by 6 to 8 cm per year. For this age group, Horváth et al. (2010) found that body height and body weight increased by 5 to 6 cm and 2.3 to 2.9 kg per year, respectively. The body height increments observed for the children included in this study were higher than those reported in other studies. Body height increments for boys

and girls were 4.4 cm and 4.71 cm, respectively. Body weight increments between pretest and posttest corresponded with the above-mentioned norms. Mean body weight of boys and girls increased by 2.63 kg and 2.66 kg, respectively.

At the ages of 6 and 7 years, children are becoming more responsive to motor coordination, movement combination, movement frequency, relative strength, and endurance training. It is critical that children acquire as many motor skills as possible to form a basis for their future specialized activity and performance. Physical fitness levels between pretest and posttest improved, especially in physical conditioning and motor coordination tests. As data presented in Table 2 show, boys and girls showed improved levels of running speed and running speed with changes of direction. For the 20-meter dash, the differences between the pretest and posttest scores for boys were 0.37 s and 0.20 s, respectively. At posttest, children improved considerably in the 4 x 10 m shuttle run, with boys and girls improving by 0.76 s and 0.32 s, respectively.

There were no significant improvements in the motor abilities reliant on physical conditioning, except for explosive leg power at posttest in boys. The difference between pretest and posttest mean scores in the standing long jump was 19.45 cm. Table 2 shows that there were no statistically significant changes in other physical conditioning tests. For the flexed arm hang, which tests endurance, upper-body strength and mean scores for boys and girls improved by 0.51 s and 1.88 s, respectively. Similarly, the improvements in the sit-up test, which assesses abdominal muscle strength and endurance, observed for boys and girls were minimal. The differences in mean scores for boys and girls between pretest and posttest were 4 repetitions and 3.57 repetitions, respectively. The multi-stage shuttle run was administered to test children's cardiovascular fitness. The differences in children's endurance levels between pretest and posttest were statistically nonsignificant. However, at this age, children find it challenging to follow the test instructions. During the test, some children stopped running at the early stages, although they could run more 20-meter shuttles.

There were statistically significant changes between pretest and posttest for the motor coordination tests, which assessed complex motor coordination. The differences in the mean scores for the complex motor coordination test was 6.55 s for boys and 5.75 s for girls. On the contrary, children's spatial orientation levels, demonstrated while rolling three balls, declined at posttest, especially for boys. Girls improved by 2.54 s, but this difference was statistically nonsignificant. Table 2 shows differences in the mean scores for the sit-and-reach test, which assesses children's lower-back and hamstring flexibility. At posttest, mean test scores for boys

and girls improved by 0.67 cm and 1.43 cm, respectively. However, the differences were statistically nonsignificant.

We compared the results of our study with other studies (Šimonek 2017; Moravec 2002; Sedláček 2009; Čillík et al. 2016) on physical fitness of children aged 6 and 7 years. The comparisons are presented in Table 3.

Table 3

Physical fitness levels reported for boys in previous studies

	T1	T2	T3	T4	T5	T6	T7	T8	T9
Šimonek (2017)	-	114.87	32.11	1.45	7.07	120.10	15.67	21	19.03
Moravec (2002)	-	-	-	19.85	9.90	132.52	-	19.01	31.70
Sedláček (2009)	-	-	-	18.00	8.50	125.00	13.60	17	31.00
Čillík et al. (2016)	-	-	-	18.70	16.20	120.50	14.64	13.87	20.45

Note. T1 = 50-meter dash; T2 = three-ball rolling; T3 = repeated stick routine; T4 = sit-and-reach; T5 = flexed arm hang; T6 = standing long jump; T7 = 4 x 10 m shuttle run; T8 = sit-ups in 1 min; T9 = multi-stage shuttle run

Table 3 shows that physical fitness levels demonstrated by the boys from our study were higher than those reported for their peers from Nitra (Šimonek 2017). Compared with the results reported by Moravec (2002), boys did not demonstrate the physical fitness levels of their peers tested 20 years ago. However, we could not compare the scores for the 20-meter dash, three-ball rolling, and repeated stick routine because scores for these tests have not been reported in any of the studies above.

Table 4

Physical fitness levels reported for girls in previous studies

	T1	T2	T3	T4	T5	T6	T7	T8	T9
Šimonek (2017)	-	114.4	30.52	3.73	6.92	110.67	16.23	23	18.3
Moravec (2002)	-	-	-	20.83	8.92	123.46	-	17.61	27.31
Sedláček (2009)	-	-	-	19.00	8.5	120.50	14.10	16.00	26
Čillík et al. (2016)	-	-	-	20.84	14.43	112.00	15.10	12.23	18.39

Note. T1 = 50-meter dash; T2 = three-ball rolling; T3 = repeated stick routine; T4 = sit-and-reach; T5 = flexed arm hang; T6 = standing long jump; T7 = 4 x 10 m shuttle run; T8 = sit-ups in 1 min; T9 = multi-stage shuttle run

Table 4 shows that physical fitness levels demonstrated by the girls from our study were higher than those reported for their peers from Nitra (Šimonek 2017). Mean scores for girls in

this study were similar to those reported for the girls in the studies by Moravec (2002) and Čillík et al. (2016). However, we could not compare the scores for the 20-meter dash, three-ball rolling, and repeated stick routine because scores for these tests have not been reported in any of the studies above.

Conclusion

The research studies on children's physical fitness levels have shown that a child's organism needs sufficient variety of physical activities. By performing physical activities at a sufficient intensity, children develop their inborn motor abilities.

There were statistically significant differences in the explosive leg power for the motor abilities reliant on physical conditioning. The differences in the tests of upper body strength and endurance, abdominal muscle strength and endurance, and running endurance levels were statistically nonsignificant. The results for the conditioning and coordination tests showed statistically significant differences for running speed and running speed with changes of direction. For the motor coordination tests, differences were statistically significant only for the repeated stick routine. There were no statistically significant differences in other motor coordination tests.

The school setting is considered an ideal environment for various physical activity programs for promoting physical activity and fitness in children and youth (Cavill et al. 2001; Dobbins et al. 2009). Therefore, it is essential to build a school environment that promotes everyday physical activity, quality-based physical education, and participation in sports activities. According to the results of our research, we recommend that ISCED 1 thematic units be used to develop students' physical fitness levels in physical and sports education classes. Physical education teachers are encouraged to regularly test students' physical fitness levels and form children's attitudes towards physical activity.

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