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Fundamental movement skills of six- to seven-year-old children in the first grade of elementary school: A pilot study

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Fundamental movement skills of six- to seven-year-old children in the first grade of elementary school: A pilot study

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B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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abstract

Background The aim of the study was to determine fundamental movement skills of elementary school first-graders and to seek whether fundamental movement skills correlate with the pupils' age and gender.

Material/Methods The study involved students in the first grade of elementary school in Krosno. The study was conducted at the beginning of the 2015/2016 school year. A total of 98 pupils (43 girls and 55 boys) aged six and seven were tested, using the Test of Gross Motor Development–2nd Edition.

Results The study showed that the results of fundamental movement skills depend on the children's age and gender. Older girls achieved better results in locomotor and object control skills than six-year-old girls. The analysis revealed that boys achieved better scores than girls in the object control skills subtest.

Conclusions The findings of this study demonstrated that the results can serve as an argument in the debate on the validity of reducing the school age in Poland. Understanding the importance of fundamental movement skills and awareness of irregularities in motor skills may help to prevent children's later school problems.

Key words fundamental movement skills, locomotor skills, object-control skills, children, elementary school

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INTRODUCTION

The beginning of learning in the first grade of elementary school is one of the most important moments in a child's development. In recent years, in Poland there has been a public debate on reducing children's school age. The validity of a mandatory introduction of a reduced school age has caused great controversy among its advocates and sceptics alike. School maturity is a significant argument in the discussions if a six-year-old child is well prepared to attend school. A certain degree of mental, emotional, social and physical development is prerequisite for participating in school life and grasping the curriculum content [1].

The purpose of early childhood education is to support the child in his/her intellectual, emotional, social, ethical, physical and aesthetic development [2]. According to Pawłucki [3], achieving motoric maturity at the start of school education positively affects pupils' learning achievements. As shown previously [4–10], an adequate level of motor development is important for proper cognitive development (in writing, reading and mathematics). Research confirms the relevance and importance of proper motor development for the child's education at an early-school age.

Motor skills are one of the foundations of human behaviour [11, 12]. They represent potential conditioning, readiness or disposition for effective performance of a specific type of motor task. Motor skills are generally divided into two groups: the fundamental and the special ones [13, 14]. Gross motor skills and fundamental movement skills (FMS) are referred to as motor skills, which activate large muscle groups of the trunk, upper limbs and lower limbs [15]. The FMS are associated with the basic forms of natural movements, which are the basis for more complex and specialized movement skills. The FMS can be divided into three categories: locomotion, stability and object control (manipulation) [7, 16, 17].

In the first grade of school, a child is in the period of younger school age, at which children are more effectively in motor learning [7]. One of the elements of proper physical development of the child is learning FMS, which help a child learn new skills and develop independence to deal with the surrounding environment [11, 12, 18, 19, 20]. Fundamental movement skills play an important role in proper health and social development as well as in participation in sport and physical activity throughout one's life [6, 16, 21, 22, 23, 24].

Therefore, it is important to determine motor skills, because their evaluation may help in the early identification of learning difficulties and disorders that can affect the proper and holistic development of the child [6, 25].

In view of the above, the aim of the study was to determine fundamental movement skills of first-graders attending elementary school. In addition, the study aimed at seeking whether fundamental movement skills correlate with the pupils' age and gender.

The following research questions were formulated:

1. What is the level of fundamental movement skills of first-graders aged six and seven years attending elementary school?
2. Does the age and gender of these first-graders determine their level of fundamental movement skills?

MATERIAL AND METHODS

PARTICIPANTS

The study sample consisted of first-graders of the elementary school in Krosno (the Podkarpackie Province, Poland). The study involved 64 pupils aged six years (29 girls and 35 boys) and 34 pupils aged seven (14 girls and 20 boys). The study was approved by the institutional Ethics Committee, and an informed written consent was obtained from the school's headmaster and children's parents/guardians. The study used observation and direct measurement techniques.

INSTRUMENTS

In order to determine fundamental movement skills, a Test of Gross Motor Development – Second Edition (TGMD-2) [35] was used. The equipment used for the test is part of the facilities of the certified Ball Games Research Laboratory of the Team Sports Department at the University of Physical Education in Wroclaw, which has been certified with the Quality Management System (PN-EN ISO 9001: 2009). The Test of Gross Motor Development (TGMD) –Second Edition is a qualitative measure for assessing fundamental movement skills. The test is divided into two subtests: locomotor skills (run, gallop, hop, leap, jump and slide) and object control (strike, dribble, catch, kick, throw and roll). Each skill is evaluated based on three to five performance criteria. Each subtest includes 24 performance criteria. The participant has to perform the task twice. For each trial a score of1 is given, if the criterion is performed correctly, and 0, if performed incorrectly. The highest total raw score for both subscales is 48. The higher the total score, the better the performance. The raw scores can be converted into standardized scores per age [26].

PROCEDURES

The tests were carried out at the beginning of the 2015/2016 school year (in September). Prior to data collection, the performance criteria have been translated into Polish. The TGMD-2 testing was conducted by a research team consisting of one supervisor and three testers (doctoral students of the University School of Physical Education). The testers graduated from Physical Education studies and were familiar with motor learning and motor development. Prior to proper measuring, the testers were specially trained in the TGMD-2 procedures, scoring and data recording.

The tests were conducted during school hours at Physical Education class in a large school sports gym. The tests were performed in two subscales: locomotor and object control skills. Participants completed the test in the same order. All children completed locomotor skills and then object control skills trials. After a warm-up, the testers provided verbal instructions and demonstrated each trial to participants. After the demonstration, each child was given a practice

trial. Then participants performed two test trials one after another. All testers observed and scored all participants' performance to assure measurement consistency. Testers scored each performance criteria for each trial on the spot.

Statistica 10.0 software was used for analysis, with basic calculations and Pearson's correlation. Due to the normal distribution in the group, the ANOVA variance analysis was carried out. A two-factor analysis of variance (2 x 2) model was used to perform statistical analysis. Post hoc Duncan's test was applied to confirm the significant differences between the groups. The statistical significance was set at $p \leq 0.05$. In this study, raw TGMD-2 scores were used, because the normative data collected from children in the USA may not be valid for Polish children.

RESULTS

Table 1 shows the results of TGMD-2 locomotor and object control skills depending on children's age and gender.

Table 1. TGMD-2 locomotor and object control scores by gender and age group

	6-YEAR-OLDS			7-YEAR-OLDS		
	TOTAL	Girls	Boys	TOTAL	Girls	Boys
Locomotor	31.53 ±5.85	30.14 ±5.93	32.69 ±5.61	33.41 ±6.00	34.07 ±5.88	32.95 ±6.19
Run	5.68 ±1.75	5.42 ±1.59	5.89 ±1.87	6.07 ±1.93	6.42 ±1.98	5.83 ±1.92
Gallop	5.50 ±1.29	5.32 ±1.05	5.65 ±1.46	5.50 ±1.14	5.58 ±1.17	5.44 ±1.15
Hop	6.10 ±2.21	6.39 ±2.12	5.86 ±2.29	6.03 ±2.50	6.42 ±2.75	5.78 ±2.37
Leap	4.15 ±1.52	3.52 ±1.50	4.68 ±1.33	4.43 ±1.38	4.25 ±1.14	4.56 ±1.54
Jump	4.82 ±2.10	4.35 ±2.40	5.21 ±1.75	5.53 ±1.87	6.08 ±1.44	5.17 ±2.07
Slide	5.44 ±1.36	5.39 ±1.48	5.49 ±1.28	5.40 ±1.57	5.33 ±1.56	5.44 ±1.62
Object control	27.22 ±6.95	23.21 ±5.47	30.54 ±6.30	31.24 ±5.20	29.07 ±4.39	32.75 ±5.28
Strike	5.63 ±2.27	4.45 ±1.77	6.62 ±2.18	5.80 ±1.86	5.33 ±2.27	6.11 ±1.53
Dribble	3.01 ±2.06	2.61 ±1.73	3.35 ±2.26	4.20 ±2.28	5.00 ±2.09	3.67 ±2.30
Catch	4.28 ±1.47	4.32 ±1.56	4.24 ±1.42	4.80 ±1.16	5.17 ±0.83	4.56 ±1.29
Kick	5.57 ±1.71	4.84 ±1.63	6.19 ±1.54	5.90 ±1.45	5.00 ±1.04	6.50 ±1.38
Throw	4.16 ±2.13	2.68 ±1.38	5.41 ±1.85	4.90 ±2.09	3.75 ±1.82	5.67 ±1.94
Roll	4.82 ±1.73	4.42 ±1.75	5.16 ±1.66	5.70 ±1.56	5.42 ±1.68	5.89 ±1.49

LOCOMOTOR SKILLS OUTCOMES

The ANOVA showed non significant main effects of age ($F(1,90) = 1.37$, $p = .25$) and gender $F(1,90) = 0.64$, $p = .08$). The post hoc analysis of locomotor skills x age group revealed no significant differences between children. The analysis of age x gender interaction showed significant differences between the groups: seven-year-old girls achieved significantly better results than younger girls ($p = .05$) (Fig. 1, Table 1).

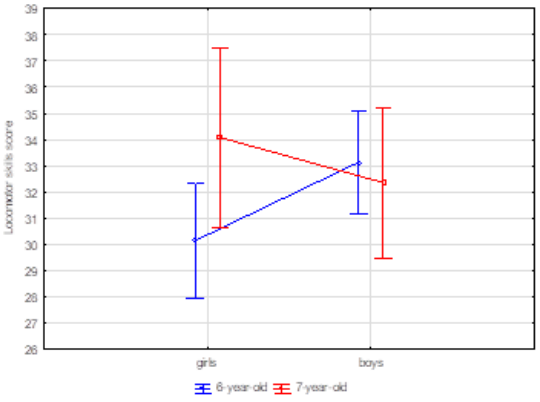

Fig. 1. Total locomotor skills scores by age and gender

The analysis of variance for each of the six trials for locomotor skills revealed certain significant differences within groups. In the leap trial, six-year-old boys achieved significantly better scores than six-year-old girls ($p = .02$). Significant differences in the jump trial were also noted: seven-year-old girls achieved significantly better scores than the six-year-old girls ($p = .03$) (Fig. 2, Table 1–2).

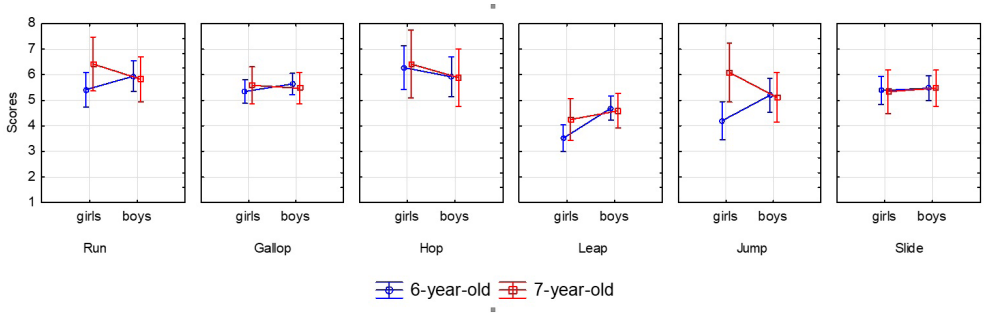

Fig. 2. Locomotor skills scores in each trial by age and gender.

Table 2. Relationships between the TGMD-2 locomotor skills by age and gender

			7-YEAR-OLD													
			1		2		3		4		5		6		7	
			A	G	A	G	A	G	A	G	A	G	A	G	A	G
6-YEAR-OLD	1 LOC	A	NS													
		G		NS												
	2 Run	A			NS											
		G				NS										
	3 Gallop	A					NS									
		G						NS								
	4 Hop	A							NS							
		G								NS						
	5 Leap	A									NS					
		G										.02*				
	6 Jump	A											.05*			
		G														
	7 Slide	A													NS	
		G														NS

A – age; G – gender; LOC – locomotor skills; * significant at the level p ≤ 0.05; NS – no significant

OBJECT CONTROL SKILLS OUTCOMES

The ANOVA for object control skills revealed significant differences in gender ($F(1,90) = 9.69$, $p = .00$). The boys had significantly better results than girls ($F(1,90) = 16.46$, $p = .00$), both in the group of six-year-olds ($p = .00$), and the seven-year-olds ($p = .04$). The post hoc analysis of age x gender interaction revealed significant differences in girls. The older girls had significantly better results than the six-year-old girls ($p = .00$) (Fig. 3, Table 1).

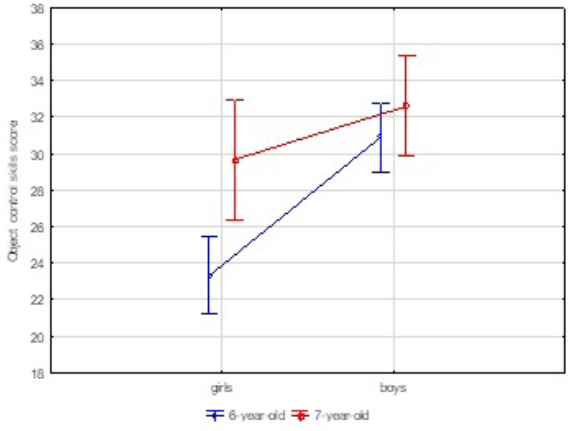

Fig. 3. Total object control skills scores by age and gender

The analysis for each of the six trials showed significant differences between groups in age and gender. The post hoc analysis revealed significant differences between six- and seven-year-old children. Seven-year-old pupils had better results than younger pupils in dribble ($p = .04$) and roll ($p = .03$). The analysis also revealed significant differences between gender. Boys scored significantly better results than girls in strike ($p = .00$), kick ($p=.00$) and throw ($p = .00$). However, in dribble girls achieved better scores than boys ($p = .00$) (Fig. 4, Table 1, 3).

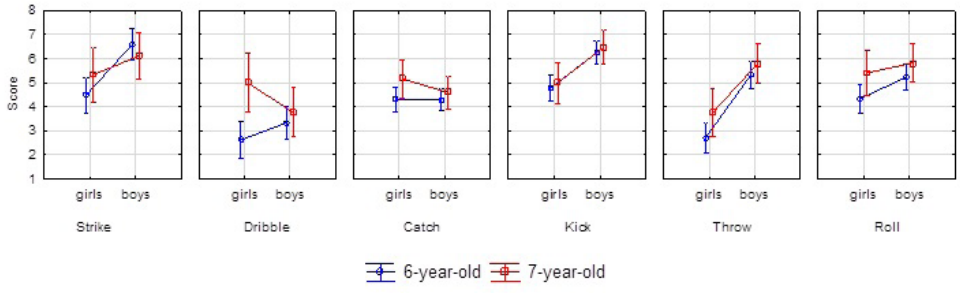

Fig. 4. Object control skills scores in each trial by age and gender

Table 3. Relationships between the TGMD-2 object control skills by age and gender

			7-YEAR-OLD													
			1		2		3		4		5		6		7	
			A	G	A	G	A	G	A	G	A	G	A	G	A	G
6-YEAR-OLD	1 OC	A	.00**													
		G		.00**												
	2 Strike	A			NS											
		G				.00**										
	3 Dribble	A					.00**									
		G						.03*								
	4 Catch	A							NS							
		G								NS						
	5 Kick	A									NS					
		G										.00**				
	6 Throw	A											NS			
		G												.00**		
	7 Roll	A													.00**	
		G														NS

A – age; G – gender; OC – object control skills; * significant at the level p ≤ .05; **significant at the level p ≤ .01; NS – no significant

Relationship between fundamental movement skills and age and gender in first-grade children

Table 2 presents correlations between the results of the TGMD-2 and the pupils' age and gender. In the locomotor skills a significant correlation was observed only between gender and leap skill. In object control skills, significant correlations were found between the object control and children's age and gender. In the object control subscale, significant correlations between pupils' age and dribble and roll skills, and their gender and leap, strike, kick, throw and roll skills were also noted (Table 4).

Table 4. Correlations between TGMD-2 locomotor and object-control scores, age and gender

	Locomotor	Run	Gallop	Hop	Leap	Jump	Slide	Object control	Strike	Dribble	Catch	Kick	Throw	Roll
Gender	-.11	-.05	-.08	.12	-.31*	-.09	-.03	-.47**	-.41**	-.04	.08	-.43**	-.59**	-.20*
Age	.09	.10	-.00	-.01	.09	.16	-.01	.27**	.04	.25*	.17	.09	.16	.24*

* significant at the level p≤.05; ** significant at the level p≤.01

DISCUSSION

The aim of the study was to determine the fundamental movement skills of elementary school first-graders and to seek correlations between FMS and children's age and gender. The study showed that age and gender do not determine children's locomotor skills. However, significant differences were observed between pupils' age and gender in object control skills. The results indicate better scores by older pupils, which confirms numerous studies [8, 26, 27, 28]. This study has also confirmed the results of previous research that motor skills depend on gender. Boys achieved better results than girls in the object control skills subscale [29–34].

The TGMD-2 is an objective and normalized tool which is widespread in extensive research conducted in preschool and early childhood education [26–40]. Similarly to other researchers [26, 27, 28, 39], we also analysed the raw scores of the TGMD-2 locomotor and object control skills subscales. The current results were compared to the studies carried out by other researchers around the world. We noted that American pupils achieved better results than those in our study in both subtests [26], whereas Brazilian pupils obtained lower results [39]. In studies by Farrokhi et al. [27], in the locomotor skills

subtest, similar results were obtained, and in the object control subtest Iranian pupils achieved significantly lower results. The study also showed that the results of fundamental movement skills of Polish, Portuguese [28], and Australian [34] pupils were at a similar level. It seems that the results may be affected by the research year or the examined pupils' country of origin. In the cited studies, including ours, the pupils' results for given populations have not been normalized; therefore, when comparing the results a certain degree of caution is required.

The Test of Gross Motor Development – 2nd Edition has standardized norms for the US population [26]. Reviewing the literature, we noticed that other researchers verified the reliability and validity of the TGMD-2 test for their populations. Studies were conducted, *inter alia*, in Belgium [35], China [36, 38], the Czech Republic [37], Brazil [39] and South Korea [40]. In Poland there is a lack of diagnosis of fundamental movement skills of children in preschool and elementary school. The research is non-systematic and usually only pupils' physical fitness is examined. Tests such as the European Test of Physical Fitness 'Eurofit' [41] and the International Test of Physical Fitness [42] as well as the Wroclaw Test of Physical Fitness for Children Aged Three to Seven Years [43] are predominantly used to diagnose children's physical fitness. It seems that this is due to the lack of a standardized research tool, i.e. TGMD-2, which could assess the FMS of children in preschool and early childhood education. Therefore, the current study represents a foundation for a pilot study for TGMD-2 for children from the Polish population.

CONCLUSIONS

The current study showed that the results of fundamental movement skills depend on children's age and gender. As shown previously [8, 26, 28], older girls achieved better results in locomotor and object control skills than six-year-old girls. The results also agree with previous studies that claimed that boys achieve better results than girls in the object control skills subtest [32, 33, 34].

The study results can also serve as an argument in the debate on the validity of reducing the school age in Poland. The development of proficient FMS is not automatic; it requires sufficient time, instruction, practice and reinforcement [20]. At the beginning of the school year, older children achieved better results in FMS than younger children did. However, it seems necessary to conduct the same measurements at the end of the school year to examine if the differences between children have decreased or increased.

The fundamental movement skills play an important and necessary role in the proper and comprehensive development of a child. Researchers suggest that pupils most effectively learn new motor skills during preschool and early school age [44]. According to the research on the relationships between pupil's motor and cognitive development, it seems reasonable to verify the relationships between pupils' FMS and academic achievements. The higher children's motor skills outcomes, the better their schooling achievements [4–10]. Understanding the importance of FMS and awareness of irregularities in motor skills may help to prevent later school problems as well as to prepare and implement intervention programs.

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