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Research article

DIFFERENCES IN THE MOTOR COMPETENCE OF YOUNGER SCHOOL AGE CHILDREN

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Abstract. *The aim of this study was to examine the differences in motor competence among children of different school ages, as well as whether there is a negative trend in the decline of these values with increased age. The research was conducted in a school environment, the sample consisted of 151 male and female children, age 7-11 years, divided into four approximately equal subsamples: first grade children N=36 (7.4±0.3 years, Mean±SD), second grade children N=41 (8.5±0.3 years, Mean±SD), third grade children N=40 (9.4±0.3 years, Mean±SD) and fourth grade children N=34 (10.4±0.3 years, Mean±SD). The Körperkoordinations test (KTK) assesses the coordination of the whole body and is intended for children aged 5-14 years. The test is internationally standardised and consists of 4 subtests from which the following variables emerged: single-leg hopping, walking backwards, two-legged lateral jumping, lateral movement platforms and Total KTK. The multivariate analysis of variance (MANOVA) revealed statistically significant differences between children of all ages in all tested variables, in the total (P=.00) and individual (p=.00) system of variables. These findings also indicated a negative trend of declining motor competence of children with increasing age. A similar trend was observed in the individual variables of the KTK battery. The increased involvement of physical education teachers and children in physical education classes is recommended in order to increase the development of children's motor competence through regular physical activities on a daily basis.*

Key words: *Motor Competence, KTK, Primary School Children*

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INTRODUCTION

The ability to perform different motor tasks is defined as motor ability. when performing motor tasks children develop different motor skills that present a movement pattern which develops through physical activity and excercise. Motor skills that are manifested during physical activities are locomotor skills, manipulative skills and balance skills (Lubans, Morgan, Cliff, Barnett, & Okely, 2010). Locomotor skills represent movements that include different activities in the pattern (running, single and double leg hopping, jumping), manipulative skills are abilities to maintain objects (catching and throwing objects of different sizes and shapes), and balance skills are those referring to balance of the whole body and extremities in space and time (Lubans et al., 2010). For the locomotor skills, coordination that represent synergic work of muscles or muscle groups is essential; it creates a movement, which can be defined as a motor competency (Magill, 2011). Previous research shows the decay of the motor competence of younger school age children (Vandrope et al., 2011; Hardi, Barnett, Espinel, & Okely, 2013; Tester, Ackland, & Houghton, 2014). These findings can potentially create a problem in the further development of motor skills since motor competence is related to health and obesity (Logan, Robinson, Rudisill, Wadsworth, & Morera, 2014; Cvejić, & Ostojić, 2017; Batez, Milošević, Simić, & Obradović, 2019) and can negatively affect success in school, participating in physical activity and social interactions (Piek & Skinner, 2001). On the other hand, high motor competence can be a positive predictor of physical activity and a good Body Mass Index (Boreham, & Riddoch, 2001; Lubans et al., 2010; Batez et al., 2019) as well as adopting good lifestyle habits in further development. Motor competence can be estimated by many tests (Cools, Martelaer, Samaey, & Andries, 2009; Klingberg, Schranz, Barnett, Booth, & Ferrar, 2018), while some authors state that the two most common tests are (Logan et al., 2017): the Körperkoordinations test (KTK) and The Test of Gross Motor Development-2 (TGMD-2). The selection of tests depends on the aim and whether the goal is a qualitative (TGMD-2) or quantitative (KTK) outcome. One of the tests that is widely used in European research and which can accurately estimate the status of the motor competence of kids (5-14 years) is the standardised KTK battery of tests (Kiphard & Schilling, 1974; 2007). The KTK test estimates the ability to control the whole body and coordination, it is a simple test and it is easy to conduct it (Cools et al., 2009). Data collection takes approximately 20 minutes and the reliability of the test is high (Valaey, & Vandroemme, 1999; Bardid, Rudd, Lenoir, Polman, & Barnett, 2015; Batez et al., 2019). The aim of this study was to examine the differences in motor competence among children of different school ages, as well as whether there is a negative trend in the decline of these values with increasing age among children from Serbia.

METHODS

The sample

The research was conducted in a school environment, and the sample consisted of 151 males and females, age 7-11, divided into equally distributed subsamples: first grade N=36 (7.4±0.3 years, Mean±SD), second grade N=41 (8.5±0.3 years, Mean±SD), third grade N=40 (9.4±0.3 years, Mean±SD) and fourth grade N=34 (10.4±0.3 years, Mean±SD) schoolchildren. The number of children was limited by the current capacities of the primary school "Laza Kostić" in Kovilj. The parents and guardians of the children signed a written consent of

participation. All of the tests and procedures were performed according to the Declaration of Helsinki. Children with an acute and chronic health issues did not participate in the tests.

Table 1 Decimal age of the sample by grades

Class	N	Min	Max	M	SD
1	36	7.0	8.0	7.4	0.3
2	41	7.9	9.1	8.5	0.3
3	40	9.1	9.9	9.4	0.3
4	34	9.5	11.0	10.4	0.3

Legend: N-number of participnats; Min-minimum values; Max-maximum values; M-mean, SD-standard deviation.

The sample of variables and measuring instruments

The instrument that has been used in the data collection is the KTK battery of tests and it has high reliability (r=0.90-0.97) (Batez et al., 2019) as well as intra reliability (r=0.80-0.96) (Bardid et al., 2015). The test is internationally standardised and if has subtests from which the variables that have been used later in the data analysis were derived:

- single-leg hopping over a 5 cm high foam obstacle (frequencies);
- walking backwards three times along three different wooden beams (frequencies);
- two-legged lateral jumping over a low obstacle within a 15-second time frame (frequencies);
- lateral movement platforms across the floor for 20 seconds (frequencies) and
- Total KTK (frequencies).

Organization of measurements

Well trained scientists collected the data. The participants wore sport clothes and they were barefoot during the tests. Each test was explained verbally and demonstrated before the execution. Children had a chance to take several trials before the data collection. Evaluation of the results of all four KTK subtests was carried out by adding up the points from every test individually. The values were converted into the MQ (motor coefficient) value (depending on the gender and the decimal age of the participants). Each subtest represents an individual value that added up together make the Total KTK. Based on the Total KTK, the MQ of children was graded into one of the five groups:

- very low level of coordination (MQ≤70);
- low level of coordination (MQ=71-85);
- normal level of coordination (MQ=86-115);
- high level of coordination (MQ=116-130);
- very high level of coordination (MQ≥131).

Data processing methods

For all the variables, minimum (Min) and maximum (Max) values, mean values (M), standard deviation (SD), skewness (Sk) and kurtosis (Ks) were calculated. The normality of the distribution was conducted using the Shapiro-Wilk test (SW). To test the differences between the motor competence of children of different ages, the MANOVA and LSD post hoc test were used. The data analysis was conducted using IBM SPSS Statistics, version 20.0 (Inc., Chicago, IL, USA). The level of significance was set at $p \leq .05$.

RESULTS

The results presented in Table 2 show that the motor competence data were normally distributed, and this is supported by the lower values of the SW test. Based on the average values of the variable Total KTK, a low level of coordination among first grade children was observed. By individually investigating the variables of the KTK battery test, it is obvious that Walking backwards, Lateral movement platforms are in this category but they have a bormal level of coordination in the other two variables (Single-leg hopping, Two-legged lateral jumping). Children in the second grade showed better results, where in the Total KTK they showed normal coordination. In the rest of the four variables, the lowest values were in the variables Walking backwards (MQ=77.1) while the best results were in the variable Two-legged lateral jumping (MQ=109). Children in the third grade have decay of MQ values compared to other ages. Total KTK variable shows that children have a low level of coordination (MQ=74) and that value has been observed in other variables (Single-leg hopping, Walking backwards and Lateral movement platforms) while the best scores were obtained for Two-legged lateral jumping (MQ=94.2) as well as among second grade children. Fourth grade children indicate a similar trend, Total KTK indicates that they are in the category of low coordination, except the variable Two-legged lateral jumping (MQ=88.5) where higher values like in the other age groups were noticed.

Table 2 The main descriptive indicators of the motor competence of younger school age children

Class	Variable	Min	Max	M	SD	Sk	Ks	SW	p
1	Single-leg hopping (freq.)	65	108	87.1	9.8	-0.2	-0.3	0.9	.79
	Walking backwards (freq.)	64	106	81.0	9.8	0.1	-0.2	0.9	.37
	Two-legged lateral jumping (freq.)	74	120	93.3	12.2	0.5	-0.5	0.9	.07
	Lateral movement platforms (freq.)	60	107	80.0	12.4	0.3	-0.5	0.9	.19
	Total KTK (freq.)	61	100	81.0	10.5	0.0	-0.8	0.9	.63
2	Single-leg hopping (freq.)	65	105	82.8	10.9	0.1	-0.4	0.9	.14
	Walking backwards (freq.)	57	110	77.1	12.3	0.7	0.6	0.9	.11
	Two-legged lateral jumping (freq.)	62	136	109.0	17.9	-0.5	-0.4	0.9	.04
	Lateral movement platforms (freq.)	58	123	92.7	15.2	-0.4	-0.0	0.9	.39
	Total KTK (freq.)	51	118	87.3	15.4	-0.4	-0.0	0.9	.36
3	Single-leg hopping (freq.)	48	93	75.1	11.3	-0.5	-0.1	0.9	.17
	Walking backwards (freq.)	51	100	71.7	13.6	0.3	-0.8	0.9	.11
	Two-legged lateral jumping (freq.)	50	130	94.2	17.7	-0.4	-0.2	0.9	.35
	Lateral movement platforms (freq.)	51	114	78.7	15.1	0.0	-0.1	0.9	.27
	Total KTK (freq.)	42	102	74.0	13.8	-0.3	-0.1	0.9	.74
4	Single-leg hopping (freq.)	44	94	71.7	11.9	-0.4	-0.2	0.9	.70
	Walking backwards (freq.)	52	105	81.5	11.6	-0.4	0.9	0.9	.24
	Two-legged lateral jumping (freq.)	58	115	88.5	14.7	0.0	-0.5	0.9	.69
	Lateral movement platforms (freq.)	45	97	73.9	12.4	-0.4	0.1	0.9	.35
	Total KTK (freq.)	48	97	72.7	10.9	-0.3	0.3	0.9	.47

Legend: Min- minimum values; Max-maximum values; M-mean; SD-standard deviation; Sk-skewness; Kz-kurtosis; SW-Shapiro-Wilk test of normality of distribution; p-significance of the SW test set at level $p \leq .05$.

Table 3 shows the differences in the variables among different grades. The results show significant differences in the total system (F=8.3; P=.00). Moreover, there are differences in

the individual variables: Single-leg hopping (f=15.0; p=.00), Walking backwards (f=5.3; p=.00), Two-legged lateral jumping (f=11.7; p=.00), Lateral movement platforms (f=12.7; p=.00) and Total KTK (f=10.5; p=.00). The interesting detail observed in the means is a plateau, a slight increase followed by a decrease in the MQ values with an increase in age. The Total KTK for the first grade (MQ=81.0), the second grade (MQ=87.3), the third grade (MQ=74.0) and the fourth grade (MQ=72.7) schoolchildren show this finding. These findings indicate a negative trend of decline in the motor competence of children with increasing age. A similar trend was observed in the individual variables of the KTK battery.

Table 3 Differences in the motor competence between children of different ages

Variable	Class	M	SD	f	p
Single-leg hopping (freq.)	1	87.1	9.8	15.0	.00
	2	82.8	10.9		
	3	75.1	11.3		
	4	71.5	11.9		
Walking backwards (freq.)	1	81.0	9.8	5.3	.00
	2	77.1	12.3		
	3	71.7	13.6		
	4	81.5	11.6		
Two-legged lateral jumping (freq.)	1	93.3	12.2	11.7	.00
	2	109.0	17.9		
	3	94.2	17.7		
	4	88.8	14.8		
Lateral movement platforms (freq.)	1	80.0	12.4	12.7	.00
	2	92.7	15.2		
	3	78.7	15.1		
	4	73.8	12.6		
Total KTK (freq.)	1	81.0	10.5	10.5	.00
	2	87.3	15.4		
	3	74.0	13.8		
	4	72.7	10.9		
F=8.3 P=.00					

Legend: M-arithmetic mean; SD-standard deviation; F-Wilks test of multivariate analysis of variance; P-statistical significance of multivariate analysis of variance; f-univariate analysis of variance test; p-statistical significance of univariate analysis of variance.

The differences between the pairs of all age groups (grades) are presented in Table 4 with the aim of finding significant differences. The post hoc LSD test shows the presence of differences in all the age groups. For the variable Single-leg hopping significant differences were found among first, third and fourth grade schoolchildren in the favour of first graders. Similar differences were found between second and fourth grade schoolchildren in favour of the second graders. For the variable Walking backwards significant differences were found between first and third grade schoolchildren in favour of the first graders. Similar results were found between second and third grade schoolchildren with better results for those in the second grade. For the variable Two-legged lateral jumping significant differences were found between first and second graders in favour of the older children. Furthermore, second grade schoolchildren were better than children in the third and fourth grade. For the variable Lateral movement platforms significant differences were found between first and second graders.

High values on this test were achieved by the second graders which influenced the differences with third and fourth graders in favour of the younger children. For the variable Total KTK, significant differences were found between first and second graders in favour of the second graders as well as differences between first and third and fourth graders, respectively, in favour of the younger children. Higher values achieved by second graders caused bigger differences compared to third and fourth graders in favour of the second graders.

Table 4 Differences between pairs of all ages of children in motor competence

Variable	(I) Class	(J) Class	MD (I-J)	SE	p
Single-leg hopping (freq.)	1	2	4.2	2.5	.09
		3	12.0	2.5	.00
		4	15.6	2.6	.00
	2	1	-4.2	2.5	.09
		3	7.7	2.5	.00
		4	11.3	2.6	.00
	3	1	-12.0	2.5	.00
		2	-7.7	2.5	.00
		4	3.6	2.6	.16
	4	1	-15.6	2.6	.00
		2	-11.3	2.6	.00
		3	-3.6	2.6	.16
Walking backwards (freq.)	1	2	3.8	2.7	.16
		3	9.3	2.8	.00
		4	-0.4	2.9	.88
	2	1	-3.8	2.7	.16
		3	5.4	2.7	.04
		4	-4.3	2.8	.12
	3	1	-9.3	2.8	.00
		2	-5.4	2.7	.04
		4	-9.7	2.8	.00
	4	1	0.4	2.9	.88
		2	4.3	2.8	.12
		3	9.7	2.8	.00
Two-legged lateral jumping (freq.)	1	2	-15.7	3.7	.00
		3	-0.8	3.7	.81
		4	4.5	3.8	.24
	2	1	15.7	3.7	.00
		3	14.8	3.6	.00
		4	20.2	3.7	.00
	3	1	0.8	3.7	.81
		2	-14.8	3.6	.00
		4	5.3	3.7	.15
	4	1	-4.5	3.8	.24
		2	-20.2	3.7	.00
		3	-5.3	3.7	.15

Variable	(I) Class	(J) Class	MD (I-J)	SE	p
Lateral movement platforms (freq.)	1	2	-12.6	3.2	.00
		3	1.3	3.2	.68
		4	6.2	3.4	.07
	2	1	12.6	3.2	.00
		3	14.0	3.1	.00
		4	18.8	3.3	.00
	3	1	-1.3	3.2	.68
		2	-14.0	3.1	.00
		4	4.8	3.3	.14
	4	1	-6.2	3.4	.07
		2	-18.8	3.3	.00
		3	-4.8	3.3	.14
Total KTK (freq.)	1	2	-6.2	3.0	.04
		3	7.0	3.0	.02
		4	8.3	3.1	.01
	2	1	6.2	3.0	.04
		3	13.3	2.9	.00
		4	14.6	3.0	.00
	3	1	-7.0	3.0	.02
		2	-13.3	2.9	.00
		4	1.2	3.0	.67
	4	1	-8.3	3.1	.01
		2	-14.6	3.0	.00
		3	-1.2	3.0	.67

Legend: MD-differences of arithmetic means; SE-standard error; p-statistical significance of LSD post hoc test.

DISCUSSION

After completing the research, which aimed to determine whether there are differences in motor competence between children of different school ages, as well as whether there is a negative trend of a decrease in these values with an increase in age in the population of children from Serbia, the results showed that there are statistical significant differences in all variables between children of different ages. Further analyses revealed that the differences were mainly observed in favour of younger children (first and second graders) compared to older (third and fourth graders). The second part of the research established a negative trend i.e. decay of the motor competence of children with increasing age, where younger children obtained better results compared to older ones, in the Total KTK variables. This has also been found in the previous studies (Vandorpe et al., 2011; Hardi et al., 2013; Tester et al., 2014; Ushtelenca, & Jarani, 2017; Adriyani, Iskandar, & Camelia, 2020). One of the reasons for these findings can be the lack of physical activities, insufficient physical education classes and lack of care of the whole society to solve this problem (Milojević, Marković, Gadžić, & Stanković, 2014). Another important piece of data is the MQ value, which is worse at all ages in relation to the average level of motor competence (MQ≈100) (Bardid et al., 2016; Škrkar, 2020), according to the standards found 45 years ago (Kiphard & Schilling, 1974). Our findings indicate that it is essential to develop a strategy that will allow bigger participation of children in order to stop this negative trend and bring children to at least an average level of development of motor competence. One

very important factor is more active participation and activation in the physical education classes of all teachers where they should have a careful and strategic development of individual classes in terms of planning and programming the teaching units (Zrnzević & Zrnzević, 2017). Therefore, changing the frequency and concept of its content could affect the improvement of children's motor competence, which could quickly and efficiently solve the set motor tasks in class. Other factors that would increase the motor competence of children are enrolment in sport clubs and decreasing the sedentary way of life. If that does not happen, technological development of the modern age will affect children's motor development and will cause even less physical activity (Kowalski, Crocker, & Donen, 2004) where children will develop more problems with cognitive development and social aspects of life (Piek, & Skinner, 2001).

CONCLUSION

The main finding of this research is that we have shown the presence of differences in motor competence in favour of younger children. Also, a negative trend of decay of the competences with increased age has been established, as well as a lower level of the competences compared to the standards set 45 years ago. It is highly recommended to increase the participation of teachers and children during physical education classes with the aim of improving the development of the motor abilities and competences of children through regular classes on a daily basis. We would like to acknowledge several limitations of this study. The sample size could be larger and could include more schools and more children. We did not have any insight into the efficiency of the physical education classes and the compliance. The last limitation is that we used only certain tests. Future studies could include more tests to confirm the reliability of these tests. The KTK battery of tests can be used to identify individuals that are experiencing delayed motor development and based on that can be prescribed individual work in terms of improving their motor competence.

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RAZLIKE U MOTORIČKIM KOMPETENCIJAMA DECE MLAĐEG ŠKOLSKOG UZRASTA

Cilj rada bio je da se utvrdi da li postoje razlike u motoričkim kompetencijama između dece različitog školskog uzrasta, kao i da li postoji negativan trend u opadanju tih vrednosti sa povećanjem uzrasta dece iz Srbije. Istraživanje je realizovano u školskoj sredini, uzorak ispitanika sačinjavalo je 151 učenik muškog i ženskog pola, uzrasta 7-11 godina, podeljenih u četiri približno jednaka subuzorka: učenici prvog razreda N=36 (7.4±0.3 years, Mean±SD), učenici drugog razreda N=41 (8.5±0.3 years, Mean±SD), učenici trećeg razreda N=40 (9.4±0.3 years, Mean±SD) i učenici četvrtog razreda N=34 (10.4±0.3 years, Mean±SD). Instrument koji se koristio u istraživanju je KTK baterija testova, koja procenjuje koordinaciju celog tela, a namenjena je za decu uzrasta 5-14 godina. Test je međunarodno standardizovan i sastoji se od 4 podtesta iz kojih su proistekle sledeće varijable: Jednonožno preskakanje, Hodanje unazad, Bočni sunožni skokovi, Bočno premeštanje platforimi i Ukupan KTK. Multivarijatna analiza varijanse (MANOVA) pokazala je da postoje statistički značajne razlike između učenika svih uzrasta u svim testiranima varijablama, u ukupnom (P=.00) i pojedninačnom sistemu varijabli (p=.00). Ovi nalazi su takođe ukazali i na negativan trend opadanja motoričkih kompetencija dece sa povećanjem uzrasta. Sličan trend je primećen i u pojedinačnim varijablama KTK baterije. Preporuka je da je evidentno potrebno veće angažovanje nastavnika i učenika na časovima fizičkog vaspitanja sa ciljem pospešavanja razvoja motoričkih kompetencija dece kroz redovne fizičke aktivnosti na nastavi.

Ključne reči: *motoričke kompetencije, KTK, osnovna škola*