GROSS MOTOR COORDINATION AND PHYSICAL DEVELOPMENT IN PRIMARY SCHOOL-AGED GIRLS AND BOYS

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Keywords:
- KTK test battery,
- motor competence,
- physical education,
- prepubertal children.

Abstract:

Introduction: Regardless of motor assessment tool and classification method being used, lower fundamental motor skill mastery, as well as poorer performances on coordination tests have been reported in overweight and obese children as compared to healthy-weight peers or health-related standards.

Aim: The aim of the study was to analyze the association between gross motor coordination and somatic parameters in primary school-aged girls and boys. There were also investigated gender differences in gross motor coordination and somatic parameters of primary school-aged children.

Material and methodology: Data were collected from 436 primary school-aged children (214 boys; 222 girls) in Slovakia. To determine the level of gross motor coordination, children performed Kiphard-Schilling body coordination test, Körperkoordination-Test-für-Kinder (KTK). Body height and body weight were measured and body mass index (BMI) was calculated. Thickness of five skinfolds was measured. One-way ANOVA was applied to identify gender differences in examined somatic and motor indicators. The relationships between physical development indicators and the motor test items were analyzed by the Pearson correlation (r_p). The significance level established was 5 % ($p < 0.05$) and 1% ($p < 0.01$).

Results and discussion: Research results revealed significantly higher level of sum of skinfolds in girls. On the other hand, boys performed better in two of the four KTK subtests. Results of this cross-sectional study clearly indicate statistically significant inverse association between somatic parameters and almost all motor coordination indicators in primary school-aged boys and girls.

Conclusions: It may be concluded that the excess body weight has probably a negative effect on the domain of motor coordination at this age.

INTRODUCTION

High degree of neural plasticity and the ability to alternate between excitation and inhibition, and the activity of analyzers, together form basic preconditions for effective development of motor coordination. As regards the developmental maturity, girls and boys show sensitive periods between 7 and 11 years of age and 7 and 12 years of age, respectively [Perič 2008].

There has been an increasing interest in studying associations among motor competences, motor coordination and physical parameters in early childhood over the past decade. However, from the long-term perspective, determining the associations among motor competences, physical activity and overweight has received little attention due to generally accepted stereotypes of child behaviour characterized by constant activity of children [Pate et al. 2004; Wearimg et al. 2006].

Scientific evidence from several cross-sectional studies clearly indicates an inverse association between weight status and motor competences of preschool and prepubertal children [Lubans et al. 2010; Nervik et al. 2011]. A longitudinal study on gross motor coordination among children aged 6 to 13 has showed that children with higher BMI demonstrated low gross motor coordination levels during the entire monitoring period [Lima et al. 2017].

Longitudinal studies show a risk that obese children will become obese adults who are consequently exposed to increased risk of comorbidity and premature mortality [D´Hondt et al. 2011]. It has been confirmed that obese children display lower fitness levels and motor competences. Overweight or obese children are less fit and are more likely to experience less positive experiences and success when performing physical activities. Consequently, their motivation, participation and preferences related to physical activity will reduce, which may naturally lead to decline in fitness, motor competences and formation of a sedentary and less active lifestyle [Stodden et al. 2009].

AIM

The aim of the study was to analyze the association between gross motor coordination and somatic parameters in primary school-aged girls and boys. There were also investigated differences between girls and boys in examined parameters.

MATERIAL AND METHODOLOGY

Data were collected from 436 children (boys n = 214; girls n = 222) between 7 and 10 years of age. All children were attending primary schools in the region of the East Slovakia. Parents and children were informed about the aims of the research project and gave their consent.

Body height (BH) was measured using a portable stadiometer (Harpenden, Holtain Ltd.) and *body weight (BW)* using a digital scale (Omron HN-286). Values were recorded to the nearest 0.1 cm and 0.5 kg, respectively. *Body mass index (BMI)* was calculated using the following formula: BMI = weight (kg)/height (m^2). Five skinfolds were measured with a

skinfold caliper (GIMA; Italy) on the right side of the body to the nearest 0.1 mm. The sum of 5 skinfolds was calculated.

Gross motor coordination was evaluated with the Kiphard-Schilling body coordination test, Körperkoordination-Test-für-Kinder (KTK) [Schilling, Kiphard 2007]. The test battery includes the following items: *Balancing backwards (BAB), One-legged obstacle jumping (OJ), Laterally jumping (LJ), Sideways movements (SM)*. The motor quotient *(MQ)* adjusted for age and gender was calculated using the four items. Reliability coefficients for KTK subtests range from 0.80 to 0.96.

The normality test by *Shapiro Wilk* was used to verify the data distribution. One way ANOVA was applied to identify gender differences in examined somatic and motor indicators. The relationships between somatic parameters and motor coordination abilities and MQ were analyzed by the Pearson correlation (r_p). The significance level established was 5% ($p < .05$) and 1% ($p < .01$). The data were processed in the software IBM SPSS Statistics Version 20.

RESULTS AND DISCUSSION

Descriptive characteristics and results of gender differences in physical and motor parameters are presented in Tables 1 and 2.

Research results revealed statistically significant differences between girls and boys in *Thickness of five skinfolds (5SFs), One-legged obstacle jumping (OJ), Sideways movements (SM),* and *Motor quotient (MQ)*. Girls demonstrated significantly lower level in kinaesthetic differentiation, speed of locomotor coordination (OJ, SM) and also in the overall coordination parameter – motor quotient (MQ: $F = 25.49$; $p = 0.000$; $\omega^2 = 0.04$). However, the results showed that both boys and girls achieved normal level of motor quotient (MQ 86-115) with a slightly more favorable trend in boys.

Table 1

Descriptive characteristics and gender differences in somatic parameters of primary school-aged children

Indicator	7 up to 10 years of age		$F_{(1.428)}$	Sig.	ω^2
	Girls	Boys			
	Mean ± SD	Mean ± SD			
BW *(kg)*	30.31 ± 8.23	30.55 ± 8.38	0.072	0.788	0.00
BH *(cm)*	133.25 ± 9.73	134.18 ± 9.87	1.52	0.218	0.00
SUM 5SFs *(mm)*	45.05 ± 10.29	41.42 ± 10.99	13.25	**0.000**	0.02
BMI *(kg.m^{-2})*	16.83 ± 2.86	16.72 ± 2.88	0.23	0.630	0.01

Table 2

Descriptive characteristics and gender differences in motor parameters of primary school-aged children

Indicator	7 up to 10 years of age		$F_{(1.428)}$	Sig.	ω^2
	Girls	Boys			
	Mean ± SD	Mean ± SD			
BAB *(n)*	45.03 ± 13.96	44.17 ± 15,56	0.65	0.422	0.00
OJ *(n)*	47.03 ± 16.44	52.86 ± 17.27	21.65	**0.000**	0.02
LJ *(n)*	49.43 ± 15.44	49.64 ± 15.20	0.01	0.953	0.00
SM *(n)*	38.86 ± 8.87	40.76 ± 9.61	7.17	**0.008**	0.01
MQ	93.21 ± 13.51	99.67 ± 14.74	25.49	**0.000**	0.04

The results of correlation analysis are presented in Tables 3 and 4. Only statistically significant correlations (Pearson's coefficient r_p) determined at 1% and 5% level of statistical significance are shown for girls and boys, respectively.

The correlation analysis of scores achieved by both girls and boys showed relative homogeneity of internal associations among particular KTK subtests. The relations of the individual test items of the KTK test battery indicate their common coordination basis.

Similar logic consistency of reciprocal dependences is proved also in the sphere of somatic parameters. Results of the correlation analysis showed an inverse association between motor coordination and physical parameters (BW, SUM 5SFs, and BMI) for both girls and boys. This trend which is more evident in boys probably indicate that an unfavorable trend in physical parameters leads to lower levels of motor coordination.

The interpretation of analysis on this level has become complicated by a number of significant correlates defining only existence of dependence, but expressing the causal relation on their basis is not possible. Many correlations can be right the consequence of effect of particular latent quantities which occur in the background and cause the dependence

of some variables. Due to the aforementioned the presented interpretation of the results of correlation analysis is limited.

Negative dependence of motor and somatic indicators of our study corresponds to the results of several authors. A cross-sectional study by Lopes et al. [2012] showed that boys and girls aged 6 to 14 years demonstrated a significant inverse relationship between body mass index and motor coordination. The study findings showed that overweight and obese children of both sexes demonstrated significantly lower motor coordination levels than normal weight children. The strength of this relation increased mostly during childhood, but decreased through early adolescence.

Table 3

Significant correlations of examined indicators in girls

	BAB	**OJ**	**LJ**	**SM**	**MQ**	**BW**	**BH**	**SUM 5SFs**	**BMI**
BAB	1								
OJ	**0.36**	1							
LJ		0.34	1						
SM			**0.55**	1					
MQ	**0.62**	**0.72**	**0.74**	**0.69**	1				
BW				-0.27		1			
BH						**0.81**	1		
SUM 5SFs		**-0.39**				**0.72**	**0.56**	1	
BMI		-0.30				**0.91**	**0-50**	**0.68**	1

Note: Significant correlation coeficients (p < 0,05; ***p < 0,01 – bold****)*

Table 4

Significant correlations of examined indicators in boys

	BAB	**OJ**	**LJ**	**SM**	**MQ**	**BW**	**BH**	**SUM 5SFs**	**BMI**
BAB	1								
OJ	**0.75**	1							
LJ	**0.57**	**0.40**	1						
SM	**0.52**	**0.53**	**0.76**	1					
MQ	**0.87**	**0.83**	**0,80**	**0.84**	1				
BW	**-0.39**	**-0.42**	-0.30		**-0.42**	1			
BH	-0.32				**-0.38**	**0.78**	1		
SUM 5SFs	**-0.39**		-0.29	-0.28		**0.58**	**0.46**	1	
BMI	-0.37	**-0.43**			**-0.38**	**0.91**	**0.47**	**0.43**	1

*Note: Significant correlation coeficients ($p < 0,05$; **$p < 0,01$ – bold**)*

D´Hondt et al. [2011] found that childhood overweight and obesity contribute to lower levels of motor coordination assessed by KTK test battery. The study revealed that overweight and obese children in the 10 to 12-year-old group showed significantly poorer motor coordination performance compared with the corresponding 5- to 7-year-old group. This confirms that differences in the level of motor abilities in relation to BMI increase with age. Therefore, early and sensitive movement education directed towards promotion of physical activity is beneficial especially for overweight and obese individuals.

CONCLUSIONS

To conclude, the results of this study revealed significantly higher level of sum of skinfolds in girls and better coordination performance in boys. Research results also indicate significant inverse associations between weight status, BMI and skinfold thickness and coordination indicators in primary school-aged children.

The trend of negative correlation of the weight status and of motor abilities indicates that within the frame of context of motor education at this age it is important to create adequate space for playing as well as direct learning situations focused on formation of motor development of children.

Monitoring of physical development and motor abilities needs to be an integral part of a complex physical education program directed towards both systemic education of children about the health benefits of the required level of motor abilities and physical activity

throughout the entire lifetime and the development of necessary movement skills and habits to promote health.

Coordination abilities probably play an important role in preventing, or moderating the so-called negative trajectory leading to childhood overweight and obesity. At this age, the development of coordination abilities should become a key strategy targeted at long-term prevention of obesity and promotion of active lifestyle in adulthood.

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