

THE RELATIONSHIP BETWEEN BMI AND MOTOR COORDINATION IN 13-YEAR-OLD CHILDREN

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Abstract:

Monitoring and assessment of somatic parameters and motor coordination in children is an integral part of physical education process at schools. To assess the level of motor coordination of 13-year-old children, Kiphard-Schilling's body coordination test [Schilling, Kiphard 1974, 2007], a standardized test of motor coordination, was administered. The purpose of the study was to extend knowledge about somatic parameters and motor coordination in 13-year-old boys and girls. We tried to answer the following research question: Do children with higher BMI values show lower level of motor coordination? There was no correlation between BMI and motor coordination in 13-year-old boys and girls. Overall, children demonstrated good level of motor coordination.

The study was conducted within the project VEGA 1/0625/16 *The effect of physical activities on the development of motor abilities in intact and integrated children with behavior disorders.*

INTRODUCTION

Monitoring and assessment of somatic parameters and motor coordination in children is an integral part of physical education process at schools. To assess the level of complex motor coordination, we administered the KTK body coordination test [Schilling, Kiphard 1974, 2007]. We may state that this test battery has not been used yet to test motor coordination of Slovakian children. The test-retest reliability coefficient for the raw score on the total test battery is 0.97 while reliability coefficients for individual test items range from 0.80 to 0.96 [Kiphard, Schilling 2007]. This test battery allows a complex assessment of motor coordination [Vandorpe et al. 2011; Iivonen, Sääkslahti, Laukkanen 2015]. Several studies have shown negative correlation between BMI and gross motor coordination in children [DHondt et al. 2010, 2013, 2014; Lopes et al. 2011; Gentier et al. 2013; Antunes et al. 2015; Luz et al. 2015; Ružbarská, 2015; Chagas et al. 2016]. Psotta et al. (2010) who studied a sample of 404 students from Czech Republic found that 4.4% of the students showed a gross motor development disorder. The worldwide mean values range between 5% and 10%. However, BMI values for boys and girls with motor difficulties and their age- and gender-matched peers with normal motor functions did not differ. On the contrary, Lopes et al. (2011) who collected cross-sectional data from 7,175 children between the ages of 6 and 14 found a negative correlation between BMI and motor abilities for both boys and girls. The results of the study showed that overweight and obese children of both sexes demonstrated significantly lower motor coordination than normal weight children.

THE AIM AND METHODOLOGY OF THE STUDY

The aim of the study was to extend knowledge about somatic parameters and the level of motor coordination in 13-year-old boys and girls. We tried to answer the following research question: Will children with higher BMI show lower levels of motor coordination?

Sample characteristic

The study was conducted during the school year of 2015-2016. The sample consisted of children who attended 2 elementary schools in Margecany and in Sedlice. The students were selected intentionally in order to represent the Košice and Prešov regions. The sample comprised boys and girls aged 13 years. Of 113 students (51 boys and 62 girls), 63 students (29 boys and 35 girls; mean age: 12.6 years) attended Elementary School in Margecany, and 49 students (22 boys and 27 girls; mean age: 13 years) attended Elementary School in Sedlice. Children who participated in the study were neither active athletes nor performed regular physical activity in a sports club.

Methods of data collection

To collect data about motor coordination (MC), students performed tests included in the KTK test battery, which consists of 4 motor tests:

1. Walking backwards (WB; *dynamic balance*),
2. Hopping for height (HH; *coupling ability, kinesthetic-differentiation ability*),
3. Jumping sideways (JS; *lower-body frequency ability*),
4. Moving sideways (MS; *complex speed of total body coordination*).

Methods of data processing

Data for particular tests were recorded in KTK testing protocols, which we used to compare the level of motor coordination between 13-year-old boys and girls. The level of studied parameters was expressed using mathematical and statistical characteristics, that is, arithmetic average (*M*), median (*Mdn*) and standard deviation (*SD*). Statistically significant differences between sexes in parameters of motor coordination were determined at $p < .05$ using Mann-Whitney U-test and the statistical software STATISTICA v.12. The relationships between parameters were determined using Pearson's product-moment correlation.

RESULTS

Values of somatic parameters are presented in Table 1. Thirteen-year-old boys were 4 cm taller than girls of the same age. Mean body height for boys and girls was 1.63 m and 1.59 m, respectively. Boys showed higher values of body mass compared with girls (52.92 kg for boys compared with 49.5 kg for girls). Mean BMI values for boys and girls were 19.72 and 19.42, respectively. Higher value of standard deviation shows greater variability of data for girls. According to World Health Organization, BMI values for girls and boys included in the sample showed normal weight of children (Table 1).

Table 1. Somatic parameters

		<i>BH</i>	<i>BM</i>	<i>BMI</i>
<i>Boys</i>	<i>M</i>	1.63	52.92	19.72
	<i>SD</i>	0.08	10.69	2.93
<i>Girls</i>	<i>M</i>	1.59	49.5	19.42
	<i>SD</i>	0.07	10.74	3.74

Note. *M* - arithmetic average; *SD* - standard deviation; *BH* - body height; *BM* - body mass; *BMI* - Body Mass Index

Table 2 shows characteristics for particular test items. Boys (48.85) showed higher level of dynamic balance than girls (58.44). On the contrary, girls achieved better scores in tests that assess coupling ability, lower-body frequency ability and complex coordination. The lowest difference between mean scores was found for the lower-body frequency ability test.

Table 2. Scores for particular KTK test battery items

		<i>WB</i>	<i>HH</i>	<i>JS</i>	<i>MS</i>
Boys	<i>M</i>	48.85	73.69	66.62	55.92
	<i>Mdn</i>	52	78	70	56
	<i>SD</i>	11.37	11.44	14.47	8.81
Girls	<i>M</i>	58.44	68.94	66.28	51.61
	<i>Mdn</i>	62	77	66	52
	<i>SD</i>	9.3	14.86	9.4	7.63

Note. *M* - arithmetic average; *Mdn* - median; *SD* - standard deviation; *WB* - walking backwards; *HH* - hopping for height; *JS* - jumping sideways; *MS* - moving sideways

To assess complex body coordination, test scores achieved by boys and girls were converted to Motor Quotient (MQ). A global indicator of motor coordination adjusted for age and gender was calculated using the four items and used as indicator of motor coordination. Both boys and girls demonstrated the highest level of motor coordination for coupling ability. Boys showed the lowest level of motor coordination for complex coordination while girls achieved the lowest scores in the lower-body frequency ability test. To determine significant differences between girls and boys in individual test items and also in complex coordination, statistical tests were used (Figure 1). Boys showed significantly higher scores than girls in coupling ability test only. Girls achieved considerably higher but statistically nonsignificant scores in lower-body frequency ability. Differences between boys and girls in dynamic balance and complex coordination were nonsignificant as well (Figure 1). The comparison of overall profiles for individual test items according to the total MQ score showed no statistical difference between boys (406.93) and girls (410.46).

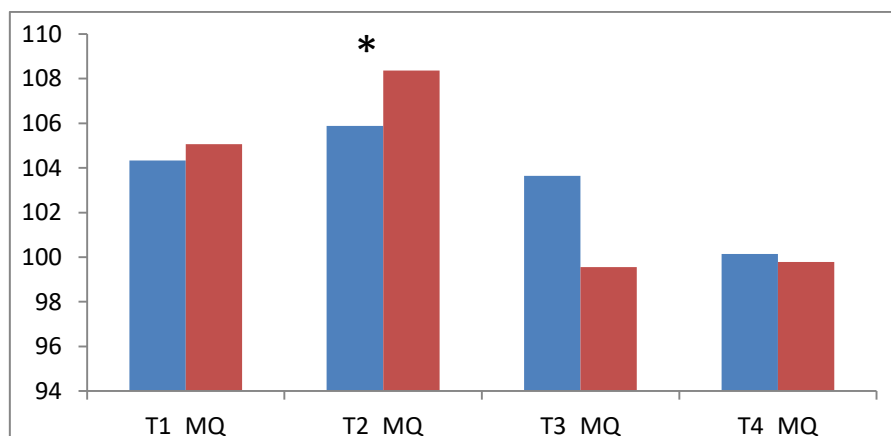


Figure 1. Significant differences in motor coordination between boys and girls

Correlation coefficients indicating relationship between BMI and motor coordination tests for boys ranged from -0.256 to 0.211. This means that higher BMI does not automatically demonstrate lower levels of motor coordination. There was a nonsignificant relationship between BMI and the total MQ score (Table 3).

For girls, coefficients of correlation between BMI values and test items ranged from 0.433 to -0.233. All correlation coefficients were negative, which showed an inverse relationship, that is, higher value of BMI indicated lower MQ scores. The “strongest” correlation (-0.433) was found between BMI and total MQ score (Table 3).

Table 3. Correlation between BMI and motor quotients

	<i>T1_MQ</i>	<i>T2_MQ</i>	<i>T3_MQ</i>	<i>T4_MQ</i>	<i>total MQ score</i>
<i>BMI_b</i>	0.211	-0.256	-0.022	-0.043	-0.043
<i>BMI_g</i>	-0.366	-0.357	-0.233	-0.332	-0.433

Note. *BMI_b* - BMI for boys; *BMI_g* - BMI for girls; *T1* - walking backwards; *T2* - hopping for height; *T3* - jumping sideways; *T4* - moving sideways

CONCLUSIONS

The aim of the study was to extend knowledge about somatic parameters and the level of motor coordination in 13-year-old boys and girls. To assess the level of motor coordination, students performed tests of the standardized KTK test battery [Schilling, Kiphard, 1974, 2007], which allows complex assessment of motor coordination. The results showed that girls had higher level of motor coordination than boys. There was no effect of BMI on motor coordination for boys. On the contrary, data for girls showed a significant relationship between BMI and balance, coupling ability, complex coordination, and complex coordination expressed as the sum of partial test item scores in KTK.

From the practical point of view, we recommend physical and sports educators to pay more attention to the development of children’s motor coordination, which is a factor limiting their motor behavior. The level of motor coordination is also important from the viewpoint of using the central nervous system when executing movements.

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