Original Article

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Differences in motor coordination levels between the Slovak and Portuguese school-aged populations

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Abstract

Introduction: The purpose of the study was to assess the levels of motor coordination among 11- and 12-year-old Slovak school-aged children and to determine differences in motor coordination levels between the Slovak and Portuguese school-based populations. *Methods:* To assess motor coordination, we administered the standardized KTK (Körperkoordinations für Kinder) test battery, which allows complex evaluation of coordination abilities. The level of parameters studied was expressed using mathematical and statistical characteristics of median (*Mdn*), arithmetic average (*M*) and standard deviation (*SD*). Statistically significant differences between boys and girls in parameters of motor coordination were determined at $p<0.05$ using the Mann-Whitney U test. *Results:* The results showed that eleven-year-old and twelve-year-old Slovak students showed higher levels of motor coordination than their age-matched counterparts. *Conclusions:* Slovak children achieved higher scores in the KTK subtests that their and Portuguese counterparts. data from this pilot study will be beneficial for future monitoring of motor coordination.

Keywords: KTK test battery, school age, motor abilities

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INTRODUCTION

The issue of motor coordination physical fitness among children and students has been address in a variety of studies [1-5]. Harmonious functioning of parts for effective results have many aspects in sport, survival abilities and rehabilitation [6]. Iivonen, Sääkslahti, Laukkanen [7] reviewed the KTK test battery as a tool for the assessment of children's movement skills, stating that motor coordination plays a crucial role in the overall development of children's motor skills. Motor coordination is the ability to integrate sensory perception and motor activity into efficient movements. The authors recommend testing children's motor skills by administering the Körperkoordinations für Kinder test battery (KTK) [8,9], which was developed in Germany in 1970. The suitability of the KTK test battery was studied by Vandorpe et al. [10] in 2008. The primary purpose of the study was to produce current gender- and age-specific reference values for the gross motor coordination of Flemish children between 6 and 12 years old. The results showed that the KTK test battery is a sufficiently discriminating instrument for the developmental evaluation of the gross motor coordination of Flemish children. Vandorpe et al. [10,11] found that, overall, the children in the Flemish sample scored generally lower on the total KTK than the German standardization sample from 1974. The mean MQ (all age groups, both genders) of the German sample was 100±15. The mean result of the total test battery (MQ KTK) for the Flemish sample (96.50±14.3) was significantly lower than the mean of the German sample (t=-12.029, p<0.001). The Flemish boys scored significantly better than the Flemish girls (boys: 98.03±14.10, girls: 94.86±14.49, p<0.001), with both genders scoring significantly worse than their counterparts (girls: t=-12.165, P <0.001; boys: t = -5.029; p<0.001). A more comprehensive picture of the developmental trajectory of gross MC has recently been provided by Chaves et al. [12] and Vidal et al. [13] in Portuguese children, aged 6–11 years. Boys and girls not only demonstrated improved MC scores with increasing age, but also showed a large inter-individual variability, i.e., a wide absolute range between the 3rd and 97th percentiles. Similar results were found by Valdivia et al. [14] in Peruvian children, aged 6–11 years, using KTK and the same statistical method to derive gross MC curves.

The purpose of the study was to extend knowledge about the levels of motor coordination among Slovak school-aged children and to compare their coordination levels with Portuguese age-matched population.

MATERIAL AND METHODS

The participants were 97 students aged 11 and 12 years from the region of eastern Slovakia. The sample included 29 boys and 22 girls aged 11 and 24 boys and 22 girls aged 12. The children who participated in the study were from general population, did not play sports on a regular basis and were not members of sports clubs. Written informed consents were obtained from children's parents and school officials prior to the study.

To assess the level of children's motor coordination, we administered the KTK test battery that included four complex tests: walking backwards (WB) – balance, hopping for height (HH) – ability to couple movements, kinesthetic-differentiation ability, jumping sideways (JS) – lower-body frequency ability, sense of rhythm, moving sideways (MS) – total body coordination.

The Slovak population of children was compared with the Portuguese population of children, a sample of about 100 boys and 100 girls aged 10 to 14 years, from the Autonomous Region in Madeira tested in 2005 and 2006 [15]. We noted down the raw test scores for each of the KTK subtests. The raw scores from each of the four tests were subsequently transformed into the equivalent scores of the so-called motor quotient (MQ). MQs for each of the tests were adjusted for sex and age of the child. The MQs were referred to as MQ1 through MQ4. The total sum of the scores was used to determine the total MQ for the KTK, which is derived from the norm-references table and forms the basis for complex practical interpretation. The level of studied parameters was expressed using mathematical and statistical characteristics of median (Mdn), arithmetic average (M), and standard deviation (SD). Statistically significant differences between boys and girls in parameters of motor coordination were

determined at $p<0.05$ using the Mann-Whitney U test (STATISTICA v.12). The data are presented in tables and graphs.

RESULTS

The sum of MQ scores for particular subtests are presented in Table 1. The total MQ score shows the complex level of students' coordination abilities. The value of the arithmetic mean in both age groups exceeded 400 points. Therefore, if the median value is higher than the arithmetic mean, the particular sample shows higher levels of coordination abilities. Using the median and standard deviation, we found that 11-year-old girls showed the highest levels of motor coordination and 12-year-old girls showed the lowest levels of motor coordination. This shows that younger girls achieved higher scores in the KTK subtests than their older counterparts. As for the boys, median values show that 11-year-old boys achieved higher scores than their older counterparts. This shows that the 11-year-olds showed higher levels of motor coordination than 12-year-olds. The median values presented in Table 1 also show that 11-year-old girls achieved higher scores than 11- and 12-year-old boys. However, 11- and 12-year-old boys showed higher levels of motor coordination than 12-year-old girls.

Table 2 shows significant differences in somatometric and motor coordination parameters between 11- and 12-year-old students from Slovakia. There were statistically significant differences ($p<0.05$) between 12-year-old boys and 12-year-old girls in body weight and BMI. The differences between 11-year-old girls and 12-year-old girls were statistically significant ($p<0.05$) in HH – hopping for height, which assesses kinesthetic-differentiation ability and the ability to couple movements. Also, there were statistically significant differences between 11-year-old boys and 12-year-old boys in body height, body weight and BMI.

The comparisons of motor coordination levels between the Slovak and Portuguese populations are presented in Tables 3 and 4. There were statistically significant differences in the parameters studied between the Slovak students aged 11 and 12 from our pilot study and the Portuguese population of 11- and 12-year-old students from the Autonomous Region in Madeira tested in 2005 and 2006 [15]. The differences were statistically significant ($p<0.01$) between 11- and 12-year-old boys and their age-matched counterparts from Portugal. There were significant differences in balancing backwards, which assesses balance. The differences in raw scores recorded were significantly different ($p<0.01$) between 11-year-old Slovak students and their age-matched counterparts from Portugal for hopping for height (the ability to couple movements and kinesthetic-differentiation ability), jumping sideways (lower-body frequency ability and rhythm ability). As for the jumping sideways tests, the differences were statistically different between 12-year-olds from both countries as well. The significant differences in hopping for height were found both between 12-year-olds from Slovakia and 12-year-olds from Portugal. For girls, there were statistically significant differences between 12-year-old girls from Slovakia and their counterparts from Portugal in moving sideways. The results demonstrate that the Slovak population of 11- and 12-year-old boys and girls showed higher levels of motor coordination than children from Portugal.

Table 1. Complex levels of motor coordination in school-aged student population

GROUP	n	M	Mdn	SD	min	max
B 11	29	400	407.78	48.24	281.27	487.97
G 11	22	400	413.26	41.94	309.02	456.24
B 12	24	400	400.52	52.28	263.44	479.78
G 12	22	400	395.89	41.35	334.28	472.93

n - sample size; M - arithmetic mean; Mdn - median; SD - standard deviation; min - minimal score; max - maximal score; B - boys; G - girls

Table 2. Somatic and motor coordination parameters in 11- and 12-year-old Slovak children

T	G 11	B 11	p	G 12	B 12	p	G 11	G 12	p	B 11	B 12	p
BH	147.45	143.81	0.0589	149.77	153.13	0.0999	147.40	149.77	0.1963	143.79	153.13	0.033
BW	38.20	39.17	0.7140	42.31	50.52	0.0200	38.20	42.31	0.1220	39.17	50.52	0.017
BMI	17.46	18.73	0.0170	18.76	21.23	0.0229	17.46	18.76	0.1798	18.73	21.23	0.015
WB	51.46	45.89	0.1654	51.63	46.17	0.1549	51.45	51.63	0.9592	45.89	46.17	0.946
HH	56.40	63.20	0.0641	64.09	63.21	0.8268	56.40	64.09	0.0246	63.20	63.21	0.998
JS	64.68	63.65	0.7341	65.09	68.21	0.3394	64.48	65.09	0.8942	63.65	68.21	0.151
MS	46.00	47.65	0.3982	46.81	49.73	0.1825	46.00	46.81	0.6581	47.65	49.73	0.340

T - test, p - statistical significance at $p<0.05$, BH - body height; TH - body weight; BMI - body mass index; WB - walking backwards; HH - hopping for height; JS - jumping sideways; MS - moving sideways; B - boys; G - girls

Table 3. Differences in motor coordination between Slovak and Portuguese populations: 11-year-olds

	Slovak Republic				Portugal				Slovak Republic				Portugal			
	B 11				B 11				G 11				G 11			
TEST	n	M	SD	p	n	M	SD	p	n	M	s	p	n	M	SD	p
WB	29	45.89	14.32	<0.01	92	53.70	11.90	<0.01	22	51.45	13.46		103	54.50	12.70	
HH	29	63.20	13.55	<0.01	92	47.20	14.20	<0.01	22	56.40	11.44	<0.01	103	43.30	14.70	<0.01
JS	29	63.65	10.34	<0.01	92	54.30	12.10	<0.01	22	64.68	11.00	<0.01	103	55.30	10.70	<0.01
MS	29	47.65	6.62		92	43.80	5.80		22	46.00	6.87		103	42.30	5.20	

B - boys; G - girls; n - sample size; M - arithmetic mean; SD - standard deviation; WB - walking backwards; HH - hopping for height; JS - jumping sideways; MS - moving sideways; p - significance level

Table 4. Differences in motor coordination between Slovak and Portuguese populations: 12-year-olds

	Slovak Republic				Portugal				Slovak Republic				Portugal			
	B 12				B 12				G 12				D 12			
TEST	n	M	SD	p	n	M	SD	p	n	M	s	p	n	M	SD	p
WB	24	46.17	14.93	<0.01	87	56.80	10.60	<0.01	22	51.63	9.70		97	55.80	11.20	
HH	24	63.21	15.59	<0.01	87	53.30	13.70	<0.01	22	64.09	10.38	<0.01	97	47.90	14.00	<0.01
JS	24	68.21	12.21	<0.01	87	59.20	13.10	<0.01	22	65.09	9.21	<0.01	97	60.20	11.70	
MS	24	49.73	8.67		87	46.50	6.00		22	46.81	4.84		97	36.20	5.90	<0.01

B - boys; G - girls; n - sample size; M - arithmetic mean; SD - standard deviation; WB - walking backwards; HH - hopping for height; JS - jumping sideways; MS - moving sideways; p - significance level

DISCUSSION

Antunes et al. [15] found a significant main effect for age was found in walking backwards: balance and moving sideways: the ability to couple movements. Boys performed significantly better than girls on moving sideways. At the upper limit of the distributions, inter-individual variability was higher in hopping on one leg (girls) and jumping and moving sideways (boys and girls).

Smits-Engelsman et al. [16] also reported girls scoring better than boys in a sample from the Netherlands. These findings are in contrast with the absence of gender differences in the original KTK sample [6], who consequently did not develop separate reference values for boys and girls for this item. In this respect, Beunen et al. [17] found that girls at elementary school age performed better on

a static balance test (the flamingo balance test of the Eurofit test battery), which provides support for the notion that girls are slightly ahead of boys on general balance control between 6 and 12 years of age. At least for the Flemish 2008 population, it is advised that separate reference values for boys and girls should be used for the dynamic balance item of the KTK.

These differences might be explained by gender-specific leisure activities. The development of specific skills before puberty is influenced by the environment. As a rule, girls are found to be better than boys in flexibility, balance and (rope) jumping activities, considering the typical games of girls in social surroundings [18]. Chaves et al. [12] found pervasive inter-individual differences were noted in all coordination tests as well as decreasing of the coordinative gains per year. Mean values of Vouzela children's motor coordination were lower than German and Belgian samples suggested a marked specificity to each test and sex.

In the study by Valdivia et al. [14], motor coordination levels were assessed using the KTK on a sample of 4,007 children (*n*=1889 females; *n*=2118 males) between 6 and 11 years of age (young=8.99; children=9.07) from several schools of the metropolitan area of Lima, Peru. The authors found that the development of coordination is highly gender specific. There is a clear trend, in boys and girls, to show a coordination profile that is lower than expected for their chronological age.

As reported by Vidal et al. [13], motor coordination performance percentile values may be used to portray individual profiles and to interpret their meaning according to what is expected for a given age and scholar level. The results of the study showed that both sexes showed visible increase in performance not only in mean values but also in extreme performance.

The differences between the populations studied may be attributed to the variability of the curricula and the content of physical education, which may particularly affect children's motor skills. The curricula are based on the combination of traditions, region, school, teachers, and parents. As reported by Antala [19], physical education is a compulsory subject in all European countries. An interesting fact is that the subject of physical education is not compulsory in some private schools in Portugal. The number of physical education classes taught at the primary education level is one only, which differs from Slovakia where students can attend 2 to 3 physical education classes per week.

CONCLUSION

The results have shown that:

- eleven-year-old students showed higher levels of motor coordination than 12-year-old students,
- eleven-year-old and twelve-year-old Slovak students showed higher levels of motor coordination than their age-matched counterparts,
- data from this pilot study will be beneficial for future monitoring of motor coordination.

Based on the results, we recommend that:

- physical and sports educators should place more emphasis on the development of motor coordination, which is a limiting factor in the human motor behavior,
- the levels of motor coordination be monitored using the KTK test battery because motor coordination levels may be efficiently tested by administering the KTK test battery.
- the study has shown that students found the test battery attractive and the subtests kept them motivated, showing rivalry and attempting to do their best.

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REFERENCES

1. Bendikova E. Curricular transformation of education in the field of physical and sport education in Slovakia. Eur J Contemp Educ 2016; 4: 410-417.

2. Kacur P, Cech P, Kandrac R, Dzugas D, Jesensky M, Jancosek M, Elias T, Ruzbarska B. The assessment of somatic parameters and physical fitness levels in prepubertal children. Scientific review of physical culture 2016; 4: 27-32.
3. Bendikova E, Dobay B. Physical and sport education as a tool for development of a positive attitude toward health and physical activity in adulthood. Eur J Contemp Educ 2017; 6: 14 -21.
4. Dzugas D, Kandrac R, Peric T, Turek M, Tomkova P, Jesensky M. Scientific review of physical culture 2017; 22: 31-35.
5. Wąsik J, Ortenburger D, Góra T, Shan G, Mosler D, Wodarski P, Michnik R. The influence of gender, dominant lower limb and type of target on the velocity of taekwon-do kick. Acta Bioeng Biomech 2018; 20(2): 133-138 doi: 10.5277/ABB-01085-2018-02
6. Wasik J, Ortenburger D, Gora T. The kinematic effects of taekwondo strokes in various conditions the outside environment. Interpretation in the psychological aspect and perspective of application in sport, health-related training and survival abilities. Arch Budo 2016; 12: 287-292.
7. Iivonen S, Saakslahti AK, Laukkanen A. A review of studies using the Körperkoordinationstest für Kinder (KTK). EUJAPA 2015; 8:18-36.
8. Kiphard EJ, Schilling F. Körperkoordinationstest für Kinder. Weinheim: Beltz Test; 1974.
9. Kiphard, EJ, Schilling F. Körperkoordinationstest für Kinder 2, überarbeitete und ergänzte Aufgabe. Göttingen: Beltz Test; 2007.
10. Vandorpe B, Vandendriessche J, Lefevre J, Pion J, Vaeyens R, Matthys S, Philippaerts R, Lenoir M. The KörperkoordinationsTest für Kinder: reference values and suitability for 6-12-year-old children in Flanders. Scand J Med Sci Sports 2011; 21: 378-88.
11. Vandorpe B, Vandendriessche J, Vaeyens R, Pion J, Matthys S, Lefevre J, Philippaerts R, Lenoir M. Relationship between sports participation and the level of motor coordination in childhood: A longitudinal approach. J Sci Med Sport; 15: 220-225.
12. Chaves RN, Tani G, Souza MC, Baxter-Jones A, Maia J. Desempenho coordenativo de crianças: construção de cartas percentílicas baseadas no método LMS de Cole e Green. Rev Bras Educ Fís Esporte 2013; 27: 25-41.
13. Vidal SM, Bustamante A, Lopes VP, Seabra A, Silva RG, Maia JA. Construçao de cartas centílicas da coordenaçao motora de crianças dos 6 aos 11 anos da Região Autónoma dos Açores, Portugal. Rev Port Cien Desp 2009; 9: 24-35.
14. Valdivia AB, Lara RF, Espinoza CB, Pomahuacre SQ, Ramos GR, Seabra A, Garganta R, Maia J. Prontitud coordinativa: perfiles multivariados en función de la edad, sexo y estatus socio-económico. Rev Port Cien Desp 2009; 8: 34-46.
15. Antunes AM, Maia JA, Stasinopoulos MD, Gouveia ER, Thomis MA, Lefevre JA, Teixeira AQ, Freitas DL. Gross motor coordination and weight status of Portuguese children aged 6-14 years. Am J Hum Biol 2015; 27: 681-689.
16. Smits-Engelsman BCM, Henderson SE, Michels CGJ. The assessment of children with developmental coordination disorders in the Netherlands: the relationship between the movement assessment battery for children and the KörperkoordinationsTest für Kinder. Hum Mov Sci 1998; 17: 699-709.
17. Beunen G, Borms J, Vrijens J, Lefevre J, Claessens AL, Pion J. Fysieke fitheid van de Vlaamse jeugd van 6 tot 18 jaar. Brussel: BLOSO; 1991.
18. Jurimae J, Jurimae T. Growth, physical activity and motor development in prepubertal children. Boca Raton: CRC Press; 2001.
19. Antala B. et al. Telesná a športová výchova a súčasná škola. Bratislava: Národné športové centrum a FTVŠ UK Bratislava; 2014.