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PALACKY UNIVERSITY IN OLOMOUC,
FACULTY OF PHYSICAL CULTURE[1]
CHARLES UNIVERSITY IN PRAGUE,
FACULTY OF PHYSICAL EDUCATION AND SPORT[2]
FACULTY OF EDUCATION[3]

DEVELOPMENT OF THE MOTOR FUNCTIONS IN 7–15-YEAR-OLD CHILDREN: THE CZECH NATIONAL STUDY

RUDOLF PSOTTA[1], JAN HENDL[2], JAKUB KOKŠTEJN[2],
GABRIELA JAHODOVÁ[3], MILAN ELFMARK[1]

ABSTRACT

The aim of the national study was to assess the development of motor functions in the population of the Czech children. A Czech representative sample of 7–15-year-old children (n = 1076) was assessed on fine manual coordination, gross motor coordination and balance using the Movement Assessment Battery for Children-2 (MABC-2). Concurrently, the cross-cultural validity of the MABC-2 was examined on a basis of the comparison of results of the testing to the test performance reported for the United Kingdom sample.

Unimanual and bimanual coordination, and visuomotor coordination associated the aiming and timing interceptive tasks improved up to 12–15-year-old children. The Czech girls demonstrated the mature static balance at the age of 7 years, while the Czech boys by two years later. The study showed that the MABC-2 can be a valid method for assessment of gross motor coordination in the Czech children. Before use of this test battery in research and educational and clinical practice in the Czech Republic, an adjustment of the norms of the manual dexterity and balance tests is needed.

Keywords: coordination; manual dexterity; aiming; catching; balance; test

INTRODUCTION

The national surveys of physical competency of the Czech children done during the last three decades were focused primarily on physical performance while motor development assessment with larger cohorts were not carry out in the Czech Republic (CR). The physical fitness test systems as the Eurofit (Council of Europe, 1993) and Unifittest (Měkota & Blahuš, 1995) can provide information on some health-related components, however performance demonstrated in these tests is usually affected by anthropometric measures of a child (Milanese et al., 2010). Besides the physical fitness testing, assessment of child's motor development by the movement coordination tests can serve as the useful indirect indicator of a level of the motor functions.

In a current population of the children increased prevalence of the specific developmental disorders including motor difficulties was reported (Boyle et al., 2011). Then the knowledge on typical patterns of development of motor functions seems to be very useful for the diagnostical puposes. Therefore the first aim of the study was to describe the level of motor coordination in the Czech children of different age.

Motor coordination assessment in children is carried out by professionals in physical education and sport, child psychology, special education and pediatrics. However, in the CR no broadly used diagnostic tool for motor coordination assessment of children exists. On the basis of considerable structural and content changes of the Movement Assessment Battery for Children (Henderson & Sugden, 1992), the new version of this battery was developed – the MABC-2 (Henderson, Sugden, & Barnett, 2007). This battery enables assessment of overall motor coordination and separately fine motor coordination (manual dexterity), gross motor coordination (aiming and catching) and balance.

To use the MABC-2 in the population of Czech children, the cross-cultural validity of the battery should be examined. The previous studies focused on examination of the MABC in some European countries concluded that the battery can be a useful tool for assessment of motor development, however after relevant adjustment of the norms (e.g. Ellinoudis, Kourtessis, & Kiparissis, 2008; Ruiz, Graupera, Gutiérrez, & Miyahara, 2003). Therefore the second aim of the study was to examine the cross-cultural validity of the MABC-2 for the Czech children.

METHODS

Design and subjects

The MABC-2 was used in the Czech sample of 7–15-year-old children (n = 1076) formed by a random selection of 20 primary public schools from all the geographical regions of the CR (a sample size of each age and gender group – see tab. 1–4). Children with physical and other neurological disabilities were not tested. Raw scores were used to analyse the significance of the age factor on motor test performance. The assessment of cross-cultural validity of the MABC-2 was based on comparison of the motor tasks performance in the Czech sample and the United Kingdom (UK) standardisation sample of the same age (n = 741) reported in the MABC-2 Examiner's Manual by Henderson et al. (2007).

Procedures

Before testing, pilot verification of the tests in the 7–15-year-old children (n = 32) was completed. On the basis of the verification, the formulation of verbal instructions to children was specified. Fifteen trained testers with a university master's or Ph.D. degree in physical education, adapted physical education or kinanthropology, performed the testing with the children.

The children were tested in the classrooms and gyms during morning hours. Testing was always running with a group of the 5–8 children going from one station to another one. The study had been approved by the Ethical committee of the faculty and by the

Czech Science Foundation. The study was conducted in accordance with the Declaration of Helsinki. Testing was completed in the schools after receiving the informed consent of parents of the children and the school principals.

Motor asssessment

Two age-adjusted test sets of the MABC-2 – for the age band of 7–10 years (AB2) and 11–16 years (AB3) used contained:

1) three tests of manual dexterity – placing pegs (MD 1), threading lace (MD 2), drawing trail (MD 3) in the AB2; turning pegs (MD 1), triangle with nuts and bolts (MD 2) and drawing trail (MD 3) in the AB3;

2) two tests aiming & catching – catching with two hands (AC 1) and throwing beanbag onto mat (AC 2) in the AB2; catching with one hand (AC 1) and throwing at wall target (AC 2) in the AB3; 3);

3) three balance tests – one-board balance (Bal 1), walking heel-to toe forward (Bal 2) and hopping on mats (Bal 3) in the AB2; two-board balance (Bal 1), walking toe-to-heel backwards (Bal 2) and zig-zag hopping (Bal 3) in the AB3.

Scoring of test performance and convertion of raw scores to the standard scores (SS) was completed according to the MABC-2 Examiner's Manual (Henderson et al., 2007). Reliability and objectivity of the MABC-2 AB3 was reported as intraclass correlation 0.62–0.92, and 0.92–1.00. The stability of SS of three motor components and total test score (TTS) was assessed with SEM = 1.20–1.56 SS (on the scale 1–19 SS, with M ± SD 10 ± 3 SS) (Henderson et al., 2007).

Data analysis

The significance of age on the test performance was analysed using the Kruskal-Wallis test followed by post-hoc multiple comparison test ($\alpha = 0.05$). The differences of test performance between the Czech and UK samples were analysed by the Cohen's effect size coefficient d with pooled SD. The values $d < 0.50$, $d = 0.50–0.80$ and $d > 0.80$ were interpreted as a small, medium and large effect of age, respectively (Cohen, 1988). The difference was finally interpreted as significant if the practical difference $d \geq 0.50$ was confirmed by the two-tailed z-test as statistically significant ($\alpha = 0.05$). For the analyses the NCSS Statistical Software version 2007 (Kaysville, Utah, USA) was used.

RESULTS

Age variations of the motor performance

Manual dexterity performance in the MD 1 and MD 2 tests improved during the prepubescence (7–10 yrs.) and pubescence (11–15 yrs.) in both genders, with statistical significance of the age factor ($\alpha = 0.05$). On the other hand, age wasn't found as a significant factor of a number of errors in drawing trail (MD 3) in both boys and girls (tab. 1–4).

Table 1. Performance in the MABC-2 tests in the 7–10 years old boys (n = 251)

MD 1 pref. hand (s)				MD 1 non-pref. hand (s)				MD 2 (s)				MD 3 (n. of errors)			
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**
7	32	23	39	**7**	36	29	47	**7**	32	23	50	**7**	0	0	2
8	29	19	41	**8**	32	0	42	**8**	28	18	41	**8**	0	0	2
9	26	20	38	**9**	30	20	36	**9**	22	15	36	**9**	0	0	4
10	25	16	46	**10**	**29**	**18**	**58**	**10**	22	15	56	**10**	0	0	3
p = 0.0000				**p = 0.0000**				**p = 0.0000**				**p = 0.8211**			
7 vs 9, 10; 8 vs 9, 10				7 vs 9, 10; 8 vs 10				7, 8 vs 9, 10							
AC 1 (n. of catches)				**AC 2 (n. of hits)**				**Bal 1 better leg (s)**				**Bal 1 other leg (s)**			
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**
7	6	0	10	**7**	6	2	9	**7**	23	4	30	**7**	22	3	30
8	8	1	10	**8**	7	1	10	**8**	20	2	30	**8**	20	2	30
9	7	0	10	**9**	8	0	10	**9**	30	3	30	**9**	21	3	30
10	9	0	10	**10**	8	1	10	**10**	30	5	30	**10**	30	3	30
p = 0.0023				**p = 0.0008**				**p = 0.0000**				**p = 0.3648**			
7 vs 10				7, 8 vs 10				8 vs 10							
Bal 2 (n. of steps)				**Bal 3 better leg (n. of jumps)**				**Bal 3 other leg (n. of jumps)**							
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**				
7	15	8	15	**7**	5	1	5	**7**	5	0	5				
8	15	3	15	**8**	5	1	5	**8**	5	1	5				
9	15	3	15	**9**	5	2	5	**9**	5	1	5				
10	15	4	15	**10**	5	4	5	**10**	5	1	5				
p = 0.0241				**p = 0.0102**				**p = 0.0910**							

Legend: Mdn – median; Min, Max – minimum and maximum value; p = a significance level in the Kruskal-Wallis test; 7 vs 9 – significant difference between two age groups in the post hoc comparison test (α = 0.05)

Age was found the significant factor of performance in the aiming and catching tests (AC 1, AC 2) in the prepubescent and pubescent children of both genders (tab. 1–4), with exception no significant effect of the age on the number of hits in throwing at wall target (AC 2) in the 11–15-year-old girls (tab. 4).

Table 2. Performance in the MABC-2 tests in the 11–15 years old boys (n = 310)

MD 1 pref. hand (s)				MD 1 non-pref. hand (s)				MD 2 (s)				MD 3 (n. of errors)			
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**
11	21	16	34	**11**	23	16	36	**11**	41	21	70	**11**	0	0	4
12	19	15	70	**12**	22	16	50	**12**	38	24	79	**12**	0	0	3
13	19	14	25	**13**	21	15	27	**13**	35	24	68	**13**	0	0	4
14	19	13	27	**14**	22	13	30	**14**	39	23	48	**14**	0	0	3
15	19	16	23	**15**	22	16	27	**15**	35	25	48	**15**	0	0	1
p = 0.0310				**p = 0.0192**				**p = 0.0205**				**p = 0.1479**			
11 vs 12, 13				11 vs 13				11 vs 13							
AC 1 pref. hand (n. of catches)				**AC 1 non-pref. hand (n. of catches)**				**AC 2 (n. of hits)**							
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**				
11	8	0	10	**11**	7	0	10	**11**	6	2	10				
12	9	0	10	**12**	7	0	10	**12**	6	1	10				
13	9	2	10	**13**	9	0	10	**13**	6	1	10				
14	9	0	10	**14**	8	0	10	**14**	7	4	10				
15	10	4	10	**15**	9	2	10	**15**	7	3	10				
p = 0.0003				**p = 0.0000**				**p = 0.0034**							
11, 12 vs 15				11 vs 13, 15; 12 vs 14, 15				11 vs 14							
Bal 1 (s)				**Bal 2 (n. of steps)**				**Bal 3 better leg (n. of jumps)**				**Bal 3 other leg (n. of jumps)**			
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**
11	30	2	30	**11**	15	2	15	**11**	5	1	5	**11**	5	1	5
12	30	2	101	**12**	15	0	15	**12**	5	0	5	**12**	5	1	5
13	30	3	30	**13**	15	1	15	**13**	5	4	5	**13**	5	1	5
14	30	4	30	**14**	15	2	15	**14**	5	3	5	**14**	5	5	5
15	30	2	30	**15**	15	3	15	**15**	5	5	5	**15**	5	5	5
p = 0.7103				**p = 0.1122**				**p = 0.8294**				**p = 0.0565**			

Legend: Mdn – median; Min, Max – minimum and maximum value; p = a significance level in the Kruskal-Wallis test; 11 vs 12 – significant difference between two age groups in the post hoc comparison test (α = 0.05)

Significant improvement of balance performance of boys was found only during the prepubescent (7–10 yrs.) stage, but static and dynamic balance performance in the Bal 1 and Bal 3 test, respectively, was not significantly affected by age (tab. 1).

In the prepubescent girls, age was the significant factor of one-board balance with both better and other leg (Bal 1), and hopping on mats with better leg (Bal 3) (tab. 3). In the pubescent girls, age-improved performance in walking toe-to-heel backwards (Bal 2) and zig-zag hopping with a better leg (Bal 3) was confirmed statistically as the age factor was found as significant (tab. 4).

Comparison of the AB2 (7–10 yrs.) motor test performance of the Czech a UK samples

Of the all manual dexterity tests, only mean performance in the MD 3 test was significantly higher in Czech children (in five Czech age/gender groups) in comparison to the UK sample (tab. 5). Results of the aiming and catching tests achieved in the Czech sample were not significantly different across the age and gender groups in comparison to performance of the UK children. The majority of the age/gender groups of the Czech children showed significantly higher performance in the balance tests than the UK sample (tab. 5).

Table 3. Performance in the MABC-2 tests in the 7–10 years old girls (n = 236)

MD 1 pref. hand (s)				MD 1 non-pref. hand (s)				MD 2 (s)				MD 3 (n. of errors)			
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**
7	31	22	42	**7**	35	21	50	**7**	30	17	42	**7**	0	0	2
8	27	21	41	**8**	30	22	41	**8**	26	16	39	**8**	0	0	3
9	27	19	38	**9**	30	37	30	**9**	22	15	31	**9**	0	0	2
10	25	16	46	**10**	28	21	48	**10**	21	14	78	**10**	0	0	2
p = 0.0000				**p = 0.0000**				**p = 0.0000**				**p = 0.4147**			
7 vs 8, 9, 10				7 vs 8, 9, 10				7 vs 8, 9, 10; 8 vs 9, 10							
AC 1 (n. of catches)				**AC 2 (n. of hits)**				**BAL 1 best leg (s)**				**BAL 1 other leg (s)**			
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**
7	6	0	10	**7**	6	3	10	**7**	30	3	30	**7**	18	3	30
8	7	0	10	**8**	6	3	10	**8**	30	3	30	**8**	28	4	30
9	6	0	10	**9**	7	0	10	**9**	30	3	30	**9**	30	3	30
10	8	0	10	**10**	7	1	10	**10**	30	6	30	**10**	30	3	30
p = 0.0011				**p = 0.0093**				**p = 0.0178**				**p = 0.0006**			
7, 9 vs 10				8 vs 10								7 vs 9, 10			
Bal 2 (n. of steps)				**Bal 3 best leg (n. of jumps)**				**Bal 3 other leg (n. of jumps)**							
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**				
7	15	12	15	**7**	5	1	5	**7**	5	0	5				
8	15	3	15	**8**	5	5	5	**8**	5	0	5				
9	15	4	15	**9**	5	4	5	**9**	5	4	5				
10	15	13	15	**10**	5	4	5	**10**	5	0	5				
p = 0.3279				**p = 0.0751**				**p = 0.0140**							

Legend: Mdn – median; Min, Max – minimum and maximum value; p = a significance level in the Kruskal-Wallis test; 7 vs 8 – significant difference between two age groups in the post hoc comparison test (α = 0.05)

Table 4. Performance in the MABC-2 tests in the 11–15 years old girls (n = 279)

MD 1 pref. hand (s)				MD 1 non-pref. hand (s)				MD 2 (s)				MD 3 (n. of errors)			
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**
11	20	14	27	**11**	22	15	31	**11**	43	25	93	**11**	0	0	2
12	19	14	28	**12**	23	14	32	**12**	38	14	58	**12**	0	0	3
13	18	13	27	**13**	21	16	33	**13**	39	26	66	**13**	0	0	5
14	19	14	25	**14**	20	15	28	**14**	36	24	69	**14**	0	0	1
15	16	7	23	**15**	18	7	26	**15**	36	22	58	**15**	0	0	1
p = 0.0000				**p = 0.0000**				**p = 0.0000**				**p = 0.1363**			
11, 12, 13, 14 vs 15				11, 12, 13 vs 15				11 vs 12, 13, 14, 15							

AC 1 pref. hand (n. of catches)				AC 1 non-pref. hand (n. of catches)				AC 2 (n. of hits)			
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**
11	7	0	10	**11**	6	0	10	**11**	5	1	9
12	8	0	10	**12**	6	0	10	**12**	6	1	10
13	8	0	10	**13**	7	0	10	**13**	5	1	9
14	9	1	10	**14**	8	0	10	**14**	6	1	9
15	9	1	13	**15**	9	1	10	**15**	6	1	10
p = 0.0191				**p = 0.0000**				**p = 0.4934**			
11 vs 15				11, 12, 13 vs 15; 11 vs 14							

Bal 1 (s)				Bal 2 (n. of steps)				Bal 3 best leg (n. of jumps)				Bal 3 other leg (n. of jumps)			
age	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**	**age**	**Mdn**	**Min**	**Max**
11	30	3	30	**11**	15	1	15	**11**	5	5	5	**11**	5	4	5
12	30	3	30	**12**	15	2	15	**12**	5	4	5	**12**	5	1	5
13	30	9	30	**13**	15	2	15	**13**	5	5	5	**13**	5	1	5
14	30	2	30	**14**	15	2	15	**14**	5	0	5	**14**	5	0	5
15	30	5	30	**15**	15	5	15	**15**	5	5	5	**15**	5	4	5
p = 0.3374				**p = 0.0590**				**p = 0.0451**				**p = 0.3924**			

Legend: Mdn – median; Min, Max – minimum and maximum value; p = a significance level in the Kruskal-Wallis test; 11 vs 15 – significant difference between two age groups in the post hoc comparison test (α = 0.05)

Table 5. The MABC-2 tests which showed significantly different performance of the 7–10-year-old Czech boys (B, n = 251) and girls (G, n = 236) in comparison to performance of the United Kingdom standardisation sample

test	gender	age	d	z-value	test	gender	age	d	z-value
MD 3	B	7	0.72	2.870*	**Bal 2**	B	10	0.57	5.835**
	G	7	1.89	11.794**		G	10	1.00	9.164**
	B	8	0.50	4.202**	**Bal 3**	G	8	1.23	9.734**
	G	8	0.65	5.025**		B	9	0.70	5.969**
	G	10	0.57	5.395**		G	9	2.00	14.945**
Bal 1	B	7	0.70	2.658*		B	10	1.14	10.772**
	G	7	1.04	5.983**		G	10	0.94	8.293**
	B	8	0.54	4.487**					
	G	8	1.10	8.567**					
	B	9	0.52	4.316**					
	G	9	1.12	8.551**					
	B	10	0.77	7.552**					
	G	10	1.17	10.512**					

Legend: d – Cohen's effect size coefficient; * – $p < 0.05$; ** – $p < 0.001$

Comparison of the AB3 (11–15 yrs.) motor test performance of the Czech a UK samples

Mean performance of all the Czech age/gender groups in the MD 3 test was significantly higher than the MD 3 performance in the age-relevant UK groups (tab. 6). In a case of the MD 2 test, significantly lower performance was found only in the 14-year-old Czech boys and 15-year-old girls as compared to the UK sample (tab. 6).

The Czech sample demonstrated no significant differences in performance in the aiming and catching tests in comparison to the UK sample (tab. 6). Among 15 age/tender comparisons of the balance test performance in the girls, 6 Czech groups achieved signficantly higher performance than the UK girls of the relevant age (tab. 6).

Table 6. The MABC-2 tests which showed significantly different performance of the 11–15 years old Czech boys (B, n = 310) and girls (G, n = 279) in comparison to the performance of the United Kingdom standardisation sample

test	gender	age	d	z-value	test	gender	age	d	z-value
MD 1	B	15	0.67	3.496*	**AC 1**	B	15	0.60	2.778*
MD 2	B	14	0.55	4.756**	**Bal 1**	G	11	0.52	4.636**
	B	15	0.57	2.498		G	12	0.54	4.851**
	G	15	0.64	3.561*		G	13	0.58	7.814
MD 3	B	11	1.00	11.611**		G	15	0.70	3.922**
	G	11	1.32	17.600**	**Bal 2**	G	15	0.78	9.000**
	B	12	0.87	10.151**	**Bal 3**	G	13	0.50	8.058**
	G	12	1.20	13.233**		B	14	0.60	9.200**
	B	13	0.88	8.925**		B	15	0.67	NC
	G	13	1.30	16.273**		B	15	0.67	NC
	B	14	0.68	5.781**					
	G	14	0.90	12.014**					
	B	15	0.77	5.400**					
	G	15	0.78	7.000**					

Legend: d – Cohen's effect size coefficient; * – $p < 0.05$; ** – $p < 0.001$, NC – no calculation due to SD = 0

DISCUSSION

Age variations of the motor functions

The tasks of placing and turning pegs (MD 1 tests) represent unimanual coordination, while threading lace and constructing of a triangle by connecting strips with bolts and nuts in MD 2 tests require bimanual coordination. Found significance of the age factor on performance in these tasks within the both age bands suggested improving in uni- and bi-manual coordination during both the prepubescent and pubescent stage. These findings are relevant to the general meaning that between age of 6–12 years children typically master basic fine motor coordination (Forssberg, 1998).

Although the drawing trail task (MD 3 test) requires unimanual (hand-eye) coordination as the MD 1 test task, no age-related improvement in drawing was observed. The median of number of errors in the drawing task was zero in all age groups of both genders. These results suggested mature graphomotor skills already in the 7-year-old children. However, these findings suggested a methodological problem of the ceiling effect and thus poor sensitivity of the MD 3 test for identification of the developmental improvement of visuomotor functions connected with precise movements with a hand and fingers.

The aiming and catching tasks in the MABC-2 have been considered the indicators of gross motor coordination (Henderson et al., 2007). Performance in the both tasks significantly improved with age of the Czech children within the prepubescent and pubescent stage. There is opinion that fine and gross motor coordination develop together (Hendesron et al., 2007). Concurrent improvement of performance in manual dexterity tasks and aiming & catching tasks of the MABC-2 observed in the Czech children could result from improved visuomotor coordination of the hand-eye system which underlies performing both small and gross movements (Forssberg, 1998).

Development of static balance is considered a basic characteristic of motor development (Geuze, 2003). The Czech prepubescent boys and girls demonstrated improvement of static one-leg balance (Bal 1), even though significant improvement of balance on a worse leg was observed in boys till at age of 10 years. The maximal score of maintaining static balance position 30 s with better leg was observed as early as at the age of 7 years in girls and 9 years in boys. Maturation of the static balance on a non-dominant leg in this task was delayed by 1–2 years in comparison to the balance on a dominant leg. The dynamic balance demonstrated in the tasks of walking and jumping in the Bal 2 and Bal 3 tests seemed to be mature as early as at the age of 7 years in both genders. However, the problem of the ceiling effect of these tests has to be again considered when 15 steps and 5 jumps, respectively, are the maximal raw scores fot these tests.

Comparison of motor performance in the MABC-2 between the Czech and UK sample

The unequivocal significant tendency of higher performance in the Czech children in the drawing trail test (MD 3) was found in comparison to performance of the UK sample, with exception of the 9-year-old Czech children. The assessment of gross motor coordination with the aiming and catching test of the MABC-2 showed to be valid for the both prepubescent and pubescent Czech children.

Besides the manual dexterity test MD 3, performance in the static balance test Bal 1 showed the largest differences (higher scores) in comparison to the mean performance of the UK standardisation sample. The similar problem with cross-cultural validity of the norms was also found in the case of the dynamic test Bal 3 (jumping), with exception for the 7 and 12-year-old subjects.

Prevalence of developmental motor difficulties in the Czech children

Total test score TTS ≤ 5th percentile denoting having a significant motor difficulties was found in the 0.6% of the prepubescents and 1.4% of pubescents. The prevalence of developmental coordination disorder among the European and north-american populations of children was estimated as 2–4% (Barnhart, 2003). A little lower incidence of motor difficulties found in the study could be partly explained by using various diagnostical tools in the studies, but also by the fact that the Czech sample originated from the public schools and do not included the subjects from schools providing educational programs for the children with severe developmental disorders.

CONCLUSION

Unimanual and bimanual coordination in the tasks requiring both speed and accuracy, and visuomotor coordination used in the aiming tasks and timing interceptive tasks can improve up to 12–15 years-old children. The Czech girls demonstrated the mature static balance at the age of 7 years, while the Czech boys by two years later. The study showed that the MABC-2 can be a valid method for assessment of gross motor coordination in the Czech prepubescent and pubescent children. Before use of this test battery in research and educational, psychological and clinical practice in Czech Republic, an adjustment of the norms of the manual dexterity and balance tests for the relevant age groups are needed.

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Rudolf Psotta
rudolf.psotta@upol.cz