Original Article

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The Assessment of Movement Competence in Czech School Age Children Using BOT-2 Test

Iva Seflova[ABCDE], **Ludek Kalfirt**[B], **Jan Charousek**[C]

Technical University of Liberec, Faculty of Science, Humanities and Education, Department of Physical Education and Sport, Czech Republic

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Abstract

Introduction: A sufficient level of movement competence (MC) is a significant health and psychosocial factor. Overall, there is a strong consensus that movement competence is positively associated with all health-related variables. A lower level of movement competence in childhood is reflected in physical activity participation and engagement in physical activity later in life. The Bruininks-Oseretsky test of motor proficiency, 2nd version (BOT-2), is considered the most comprehensive diagnostic tool. There are no normative criteria of this test in the Czech Republic. The aim of this pilot study was to estimate a cross-cultural validity of the BOT-2 in a sample of Czech school children. *Methods*: The research sample was comprised of 83 school children (43 girls and 40 boys) of average age 10.15 ± 1.66 years. For the estimation of a MC we used the BOT-2, 2nd version - complete form. *Results*: The results of our tested group show that the group's MC is in the lower part of the average level in the area of total motor composite (standard score 46.4±11.8). On average, the weakest performance was recorded in the area of fine manual control. More in-depth analysis showed that the weakest subcomponent of the area of fine manual control was fine motor precision (scale score 10.1±5.5). The group's most successful area was the component concerning strength and agility. *Conclusion*: As a pilot study the project indicated that the BOT-2 can be valid for the Czech school children in 4 motor area composites regarding the manual coordination, coordination, strength and agility assessment only. It is not valid for the assessment of fine manual control. In a more detailed analysis of 8 subcategories we observe significantly worse results of Czech children in the area of fine motor precision.

Keywords: movement competence, BOT-2, developmental coordination disorder

Address for correspondence: Iva Šeflová - Department of Physical Education and Sport, Technical University of Liberec, Czech Republic; email: iva.seflova@tul.cz

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INTRODUCTION

Research has demonstrated a trend in recent years of children spending more time engaging in sedentary behaviors [1,2], and spending less time being physically active [3]. An increase of sedentary behavior and lack of physical activity (PA) is connected to several noncommunicable diseases worldwide [1,4]. Sedentary behavior is emerging as a novel risk factor for cardiovascular disease, diabetes, mental illness, and all-cause mortality active [5]. PA is thought to be a major influencing factor in the prevention and management of overweight and obesity in youth [6].

There is ample evidence that Czech children are insufficiently active, and the prevalence of physical inactivity and excessive screen-time has increased during the last two decades. Overall PA in Czech children and youth was observed to be insufficient to support fitness and health, with high rates of excessive screen-time and low numbers of children and youth spending time in unstructured/unorganized play [7]. An increasing percentage of obese or overweight children, increased sedentary time and a decline or stagnation of the proportion of children meeting recommendations for PA were found among Czech schoolchildren according to Health Behaviour in School-Aged Children (HBSC) study [8].

Nationally representative self-reported data show a significant increase in overweight (including obesity) prevalence among children from 1998 to 2014 in the Czech Republic. From 1998 to 2014 a significant increase in the prevalence of overweight and obesity was observed among boys in all age categories (11 years old 22.2%1998- 28.3%2014; 13 years old 17.9%1998- 26.7%2014; 15 years old 9.8%1998- 20.8%2014) and among 15-year-old girls (6.0%1998- 10.9%2014) [9].

The physical activity of a child is affected by many factors: individual, socio-demographic, interpersonal and environmental [10]. One of the factors related to the level of PA is movement competence (MC). MC is defined as the development of sufficient skill to assure successful performance in different physical activities [11]. A sufficient level of MC is a significant health and psychosocial factor. The degree of MC is a critically important, yet underestimated, causal mechanism partially responsible for the health-risk behavior of physical inactivity [12].

Overall, there is a strong consensus that MC is positively associated with all health-related variables [13]. A lower level of movement competence in childhood is reflected in PA participation and engagement in PA later in life [14]. Higher perceived MC is related with motor skill proficiency and increased levels of PA. The overestimation of children's capabilities may have a positive effect on engaging them in motor activities and sports [15].

The mastery of fundamental movement skills (FMS) is essential for the acquisition of more advanced, specific, and refined movement activities. In addition, a greater perceived MC in FMS has been related with the future adoption of active and healthier lifestyles [13]. FMS should persist for most part of the lifespan and are commonly categorized as fundamental locomotor skills (e.g., running, jumping, and hooping), fundamental manipulative skills (e.g., throwing, catching, and kicking), and fundamental stability skills (e.g., dynamic and static balance). Locomotor and manipulative movement skills engage an element of dynamic balance [12]. Prevalence of motor problems and developmental coordination disorders - dyspraxia (which is one of the specific learning disorders) is most often reported in 5-6% of the school children population [16]. Another approximately 10% have milder symptoms [17].

Monitoring children MC during maturation is fundamental to detect early minor delays and define effective intervention [18]. Several MC assessment batteries are available. Evaluation development of MC in the context of the assessment evaluation tools is very complicated issue.
The Bruininks-Oseretsky test of motor proficiency, 2nd version (BOT-2), is considered as the most comprehensive diagnostic tool. During the diagnostic quality analysis of diagnostic tools, BOT-2 has a wide age range for testing probands (4yrs -21yrs 11 months according to categories defined in the manual of BOT-2). The test allows evaluation of a much wider range of determinants such as fine motor skills, gross motor skills, coordination and strength than other tests such as Movement Assessment Battery for Children-2 (MABC-2) or Test of Gross Motor Development (TGMD-3) [19]. The main drawback of BOT-2 is the length of a time it takes to perform the test, administration and evaluation. This is compensated by the accuracy of this tool [20].

There are no normative criteria of BOT-2 test in the Czech Republic. The aim of this pilot study was to estimate a cross-cultural validity of the BOT-2 in a sample of Czech school children and to make a comparative analysis of performance in motor tasks of the BOT-2 measured in a Czech sample of 10-year-old children and the German norms [21].

MATERIAL AND METHODS

Subject

The research sample was comprised of 83 school children of average age 10.15 ± 1.66 years from the region of northern and central Bohemia. The sample included 40 boys and 43 girls. The children who participated in the study were from general population. They attended an ordinary primary school and did not play sports on a regular basis and were not members of sports clubs. Children with mild, moderate and severe physical disability were not included into the study because there are different diagnostic tools and criteria of assessment. The age category of prepubescence was selected purposely because during this period, the level of motoric displays naturally improves. Furthermore, a potential intervention in the case of MC insufficiency is more contributive and successful in this period than during the following phases of ontogenesis. If children of both gender devote themselves to the same activities, gender differences in the motoric development are only slight during this period [22]. Anthropometric data such as weight and height are not available because the children were ashamed during the collection of the data and wished them to remain anonymous.

Protocol

For the estimation of a MC we used the BOT-2, 2nd version (2015) - complete form with German normative criteria [21]. The level of MC corresponds with the result of total motor composite. For more detailed evaluation in the area of fine and gross motor skills development, we evaluated 4 motor area composites – fine manual control, manual coordination, body coordination, strength and agility with 8 subtests comprised of 53 items (Figure 1, Figure 2). Scoring of performance in the motor tests was completed according to the BOT-2 Examiner's Manual [23].

A raw score achieved in each test was converted to total point score in 8 subcategories: 1. fine motor precision, 2. fine motor integration, 3. manual dexterity, 4. bilateral coordination, 5. balance, 6. running speed and agility, 7. upper limb coordination, 8. strength. These total point scores are for comparison of subcategory results converted to age and gender related scale scores mean (M) = 15 and standard deviation (SD) = 5. The evaluated categories are: "well below average, below average, average, above average, well above average".

In these categories, 4 motor area composites of fine manual control, manual coordination, body coordination, strength and agility, we convert the results to standard scores with M = 50 and SD = 10. Total motor composite, as an indicator of the MC, was calculated as a sum of standard scores of all 4 motor area composites and converted to standard score and its confidence intervals, percentile ranks, age equivalents and descriptive categories.

Statistics

The level of studied parameters was expressed using mathematical and statistical characteristics of arithmetic M, and SD. For the estimation of effect size we used Cohen's d (Statistica v.12). The data are presented in tables and graphs.

Ethical Statement

This study procedure was approved by the ethical advisory committee at the Technical University of Liberec, Faculty of Science, Humanities and Education, Department of Physical Education and Sport. All parents were informed by the schools prior to the testing and were asked to communicate with the school in case they did not want their child(ren) to participate. All data were anonymously recorded in a secured dataset. Groups of children used two testing areas: one in the school gym and the other in their classroom. Testing took place on two different days with a maximum interval of one week. Data was collected in one session, and all testers were trained prior to data collection. Measurement of one test subject took 2 hours and evaluation of another hour. All examiners were trained for BOT-2 testing.

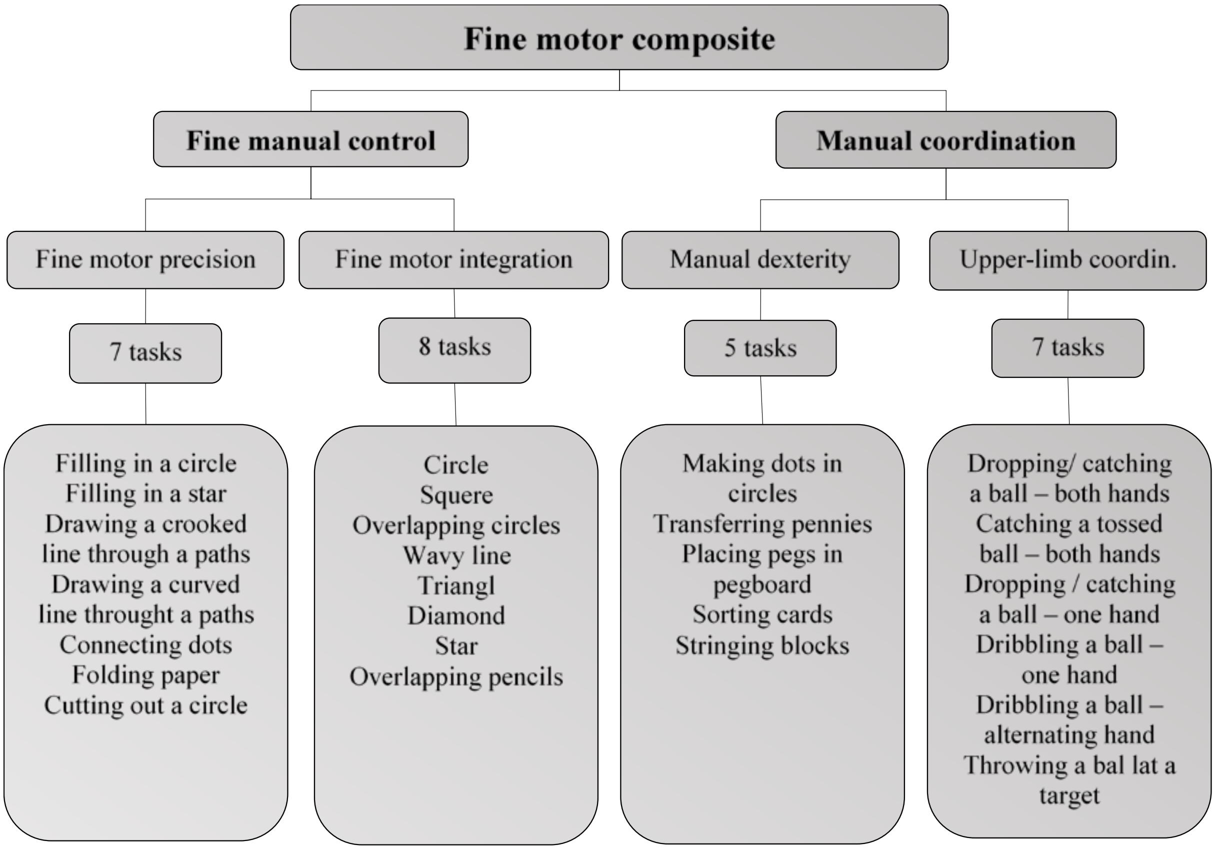

Figure 1. BOT-2 Fine motor composite.

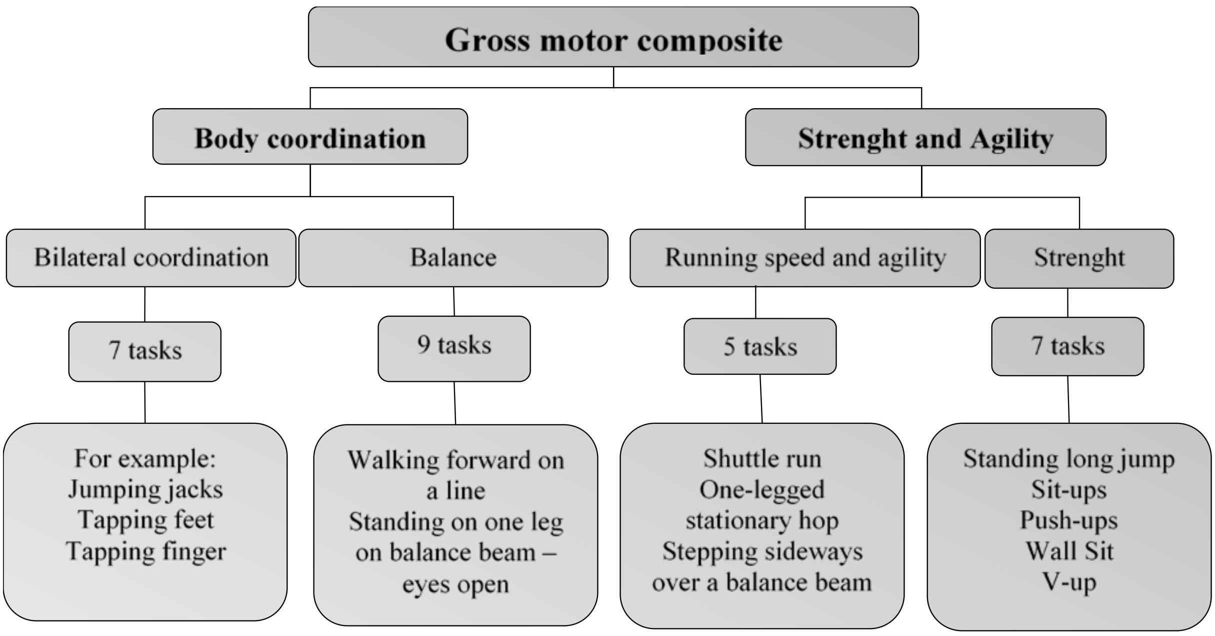

Figure 2. BOT-2 Gross motor composite.

RESULTS

Overall results of the total motor composite show that the group's MC is in the lower part of the average level in the area (Table 1). Of the total number of 83 children, 3 children were evaluated as well above average (3.6%), 6 children were above average (7.2%), 49 children were average (59.1%), 17 were below average (20.5%) and 8 well below average (9.6%).

For a more detailed analysis of the results we follow the subtest areas (Table 1): the weakest performance is in the area of fine manual control; results were below average in this area (standard score 42.1±12.1). Deeper analysis showed that the weakest subcomponent of the area of fine manual control was the fine motor precision (scale score 10.1±5.5) (Table 2). The second weakest result of the subcomponent area site was manual dexterity (standard score 45.3±11.4). The rest of components in composite score profile was analyzed and placed in the average level.

Table 1. Results of total motor composite a 4 motor area composites.

variable	Standard score (T-statistic)				
	fine manual control	manual coordination	body coordination	strength and agility	Total motor composite
M	42.10	45.30	50.21	51.15	46.40
SD	12.12	11.39	11.01	12.93	11.80
min	20	20	20	20	20
max	75	80	69	72	73

M - arithmetic mean, SD - standard deviation, min - minimal score, max - maximal score

Table 2. BOT-2 results of the subtest areas.

variable	Subtest - standard score							
	fine motor precision	fine motor integration	manual dexterity	upper-limb coordination	bilateral coordination	balance	running speed and agility	strength
M	10.14	13.48	12.31	14.12	15.20	14.68	15.27	15.99
SD	5.52	5.79	5.48	5.23	4.76	6.67	5.90	5.67
Min	1	1	1	1	2	1	1	3
Max	22	22	30	30	24	23	26	26

M - arithmetic mean, SD - standard deviation, min - minimal score, max - maximal score

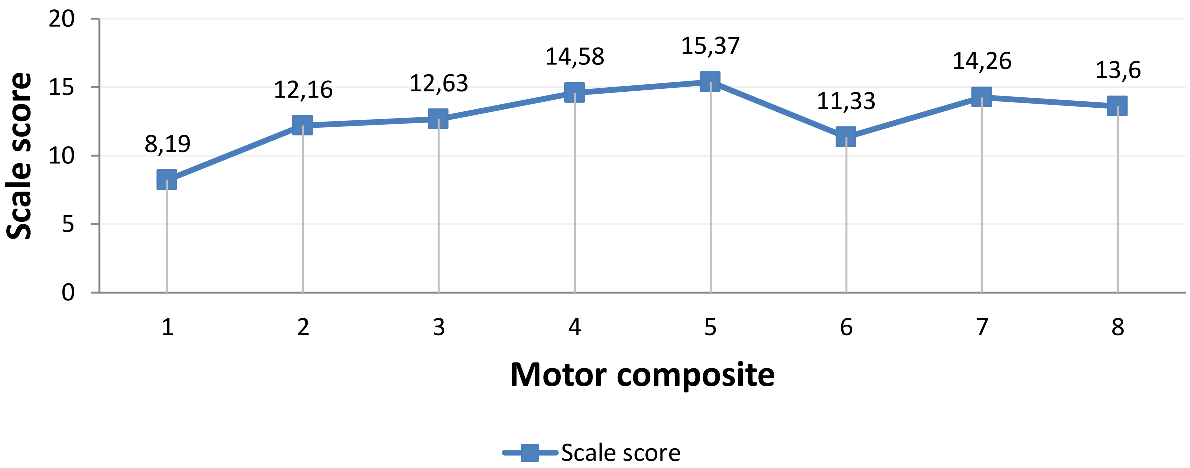

Figure 1. Results of the testing (BOT-2)–scale score in 1. – 8. motor composites: 1. fine motor precision, 2. fine motor integration, 3. manual dexterity, 4. upper-limb coordination, 5. bilateral coordination, 6. balance, 7. running speed and agility, 8. strength.

DISCUSSION

The composition and construction of BOT-2 was based on the assumption of the general motor ability of man and the manifestations of this general motor ability. It has been suggested that these motor components are closely interwoven [24, 25]. At the same time, each of these components is partially underlain by a specific functional aspect [26].

In addition to assessing general motor ability, BOT-2 allows detailed assessment of the level of specific motor skills: fine motor precision, fine motor integration, manual dexterity, bilateral coordination, balance, running speed and agility, upper limb coordination and strength, divided into 4 categories fine manual control, manual coordination, body coordination, strength and agility. This detailed evaluation is particularly important when weakening in one of the motor areas and defining an individual intervention strategy.

When evaluating the results of Czech children of a given age category, we monitor total motor composite. Overall results of the total composite show that the group's MC is in the lower part of the average level in the area. This difference, assessed by substantive significance according to effect size measures (Cohen's d), is small and non-significant (d = -0.33).

In 4 motor area composites, significant difference was observed in fine manual control (d = -0.71), which measures the motor skills involved in writing, drawing, and other tasks requiring a high degree of precision. In other categories there was non-significant difference: manual coordination (d = -0.43) (which measures coordination and control of the arms and hands, especially for manipulating small objects and catching, bouncing, and throwing a ball), coordination (d = 0.02) (which measures control of the large muscles that aide inmaintaining posture and balance,), strength and agility (d = 0.11) (which measures upper and lower body strength and control of the large muscles used in walking and running).

In a more detailed analysis of 8 subcategories we observe significantly worse results of Czech children in the area of fine motor precision (large effect size, d = -0.92) and manual dexterity (medium effect size, d = -0.92). In all other categories: fine motor integration, bilateral coordination, balance, running speed and agility, upper limb coordination, strength, differences in the results of Czech children compared to German standards were non-significant.

Of the total number of 83 children, 3 children were evaluated as well above average (3.6%), 6 children were above average (7.2%), 49 children were average (59.1%), 17 were below average (20.5%) and 8 well below average (9.6%). These children are at high risk of developing dyspraxia and can be diagnosed with developmental coordination disorder. There is a significantly higher incidence of these problems than in similar studies of European children and Czech children [27]. In 17 children we are talking about weakening in some motor area requiring intervention at specific area of motoric behavior. Without this intervention, ontogenetic development alone cannot improve the level of weakened areas. Even in the area of weakness, there are more problems. The limit of this study is the relatively lower number of children tested and the possibility of influencing the results mainly by lower socio-economic status in the monitored area.

CONCLUSION

As a pilot study the project indicated that the BOT-2 can be valid for the Czech school children in 4 motor area composites regarding the manual coordination, coordination, strength and agility assessment only. It is not valid for the assessment of fine manual control. In a more detailed analysis of 8 subcategories we observe significantly worse results of Czech children in the area of fine motor precision. 8 children from the overall number of 83 children (9.6%) were diagnosed with severe insufficiency in total motor composite, which requires necessary motoric intervention. These children are at high risk of developing dyspraxia and can be diagnosed with developmental coordination disorder. 17 children (20.5%) were diagnosed with mild insufficiency, which requires motoric intervention aimed at specific area of motoric behavior.

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