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DIAGNOSTIC POSSIBILITIES OF MOTOR FITNESS IN PRIMARY SCHOOL CHILDREN

INTRODUCTION

According to Gallahue and Donnelly (2003) perceptual-motor abilities are rapidly developing and refining fundamental movement skills during primary school period. Cross-lateral movements often present more difficulty than unilateral movements. Gross motor control is developing rapidly and occurs sooner than fine motor control. However, with an appropriate instruction and opportunity for physical activity in educational environment during this period, movements may become very efficient and coordinated.

Primary school children are active and energetic and would often rather run than walk. Many complex movements of older children and adults are little more than highly elaborated forms of these fundamental movements (Haywood and Getchel, 2005).

A variety of tasks can be used to document levels of motor performance. But emphasis is placed on standardized tasks that can be used in the field or school setting, in contrast to those limited to the laboratory. That is considered to be a very important point for the selection of motor tests in early school age (Malina, 2003).

It is critical, though, to understand developmental characteristics of children as well as their limitations or potentials. Only in this way can we structure movement experiences for young children that truly reflect their needs and interests and are within their level of ability. The aim of this study was to apply selected motor tests to assess and compare motor performance of children in a final period of early school age in a view of its structural aspects.

METHODS

A group of 195 girls and 175 boys aged 10, randomly selected from twelve elementary schools of the East Slovakia Region, participated in the study. The sample of subjects was drawn from the population of fourth-grade children. The children attended a regular educational programme and had no health related limitations. They did not participate in any special exercising programme.

The anthropometric data were assessed together with the tests for coordination abilities on the first day of the testing. Subsequently, the second day children underwent the condition motor tests while the endurance shuttle run test was performed at length. The testing procedure occurred in the school environment.

Children were subjected to 16 motor tests: Flamingo balance (FB) - *static balance*, Plate tapping (PLT) - *frequency speed of an arm*, Sit-and-reach (SAR) - *joint flexibility of a trunk*, Standing broad jump (SBJ) - *explosive strength of lower limbs*, Handgrip (HG) - *a static strength of the dominant hand*, Sit-ups (SU) - *dynamics and endurance strength of abdominal, coxal and thigh muscle*, Bent arm hang (BAH) - *static and endurance strength of upper limbs*, Shuttle run 10×5 m (SHR) - *running speed with the change of direction*, endurance shuttle run (ESR) - *running endurance*; the tests were applied and conducted according to EUROFIT instructions (Adam, Klissouras and Ravassolo, 1988). The following motor tests: Jump with accuracy (JWA) - *kinaesthetic differentiation*, Turns on a bench (TOB) - *dynamic body equilibrium*, Run for balls (RFB) - *orientation ability*, Ball tracing (BT) - *reaction speed*, Arrhythmical tapping (AT) - *rhythmical ability*, Jump without a swing (JWS) - *movement joining*, Jump back (JB) - *movement adaptation and transfer*, were applied according to Hirtz (1985) and Raczek, Mynarski, and Ljach (1998). According to the authors, the reliability of the motor tests (JWA, TOB, RFB, BT, RFT, JWS, JB) for range 6 – 18 years is 0.7 to 0.9. In addition, 3 somatic measurements were taken: body mass (BM), body height (BH) and sum of 5 skinfolds (5SF) – triceps, biceps, subscapular, anterior suprailiac and medial calf. Body weight was measured with a precision of 0.5 kg. Stature was measured using Martin's anthropometer with a precision of 0.1 cm. Skinfolds were measured using the Harpenden calliper with a precision of 0.1 mm. Then the sum of all 5 skinfolds was calculated.

Mean values and standard deviation were calculated for all variables. Independent *t*-test was used to assess gender differences. Statistical significance was set at $p < 0.05$; if there is a higher level of confidence, it is marked separately.

The hierarchy of motor and somatic indicators was established by applying cluster analysis. It enables dividing a group of objects (variables) into disjoint internally homogeneous subgroups but heterogeneous to each other (Blahuš, 1999). Since the number of clusters had not been preset, the agglomerative hierarchical clustering was selected from several techniques. As a clustering principle, the Ward's method based on minimization of the intra-cluster sum of squares was applied.

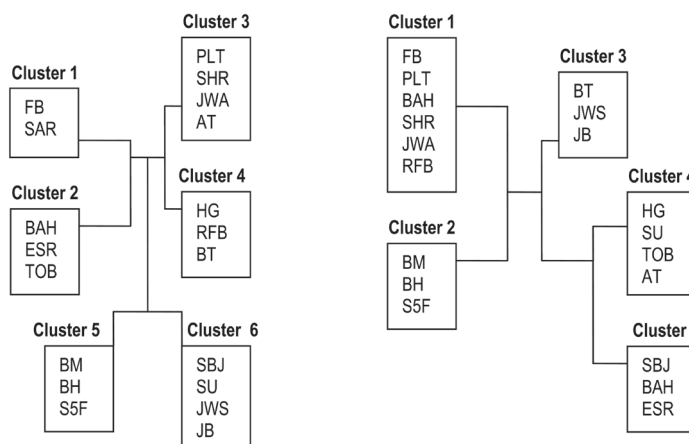
This hierarchical clustering process can be represented as a tree, or dendrogram (Hendl, 2004). Due to better „readability” the diagrams were transformed into box diagrams (Figure 1). Data were processed with statistical package SPSS 16.0 for Windows.

RESULTS AND DISCUSSION

Mean values and standard deviation together with *t-test* values indicate significant differences between group of boys and girls (Table 1). The results of *t-test* analysis pointed to a poorer level of majority of motor indicators in girls. It is evident that boys performed significantly better in speed, strength and endurance. This tendency was not absolutely repeated concerning coordination abilities. Girls performed significantly better only in rhythmical ability, boys in orientation and reaction speed. However, level of coordination abilities is similar in both examined groups. Coordination abilities can be regarded as important determinants in motor learning (Starosta, 2003) and their similar level in boys and girls indicate similar level of motor functions.

Comparison of physical development indicates similar level in both examined groups-boys are taller, but with lower level of adipose segment (Table 1).

On average, in early school age gender differences are relatively small but consistently favour boys for running, jumping, and throwing. Girls perform better, on average, in tasks that require balance, such as hopping. However, there is much overlap (Malina, Bouchard and Bar-Or, 2004; Ružbarská – Turek, 2010). The physical growth of girls and boys is very similar when viewed from a posterior position (Haywood and Getchel, 2005).



Legend: Flamingo balance (FB), Plate tapping (PLT), Sit-and-reach (SAR), Standing broad jump (SBJ), Handgrip (HG), Sit-ups (SU), Bent arm hang (BAH), Shuttle run 10×5 m (SHR), Endurance shuttle run (ESR), Jump with accuracy (JWA), Turns on a bench (TOB), Run for balls (RFB), Ball tracing (BT), Arrhythmical tapping (AT), Jump without a swing (JWS), Jump back (JB), Body mass (BM), Body height (BH), Sum of 5 skinfolds (5SF)

Figure 1. Cluster diagram of somatic and motor variables in girls (left) and boys (right) aged 10.

Table 1. Descriptive statistics of the anthropometric and motor characteristics, differences in the groups of girls and boys aged 10

Dimensions	Girls		Boys		t-test
	Mean	SD	Mean	SD	
Flamingo balance (n) / FB	8.8	4.7	7.8	4.7	
Plate tapping (sec) / PLT	17.1	2.3	17.2	2.2	
Sit-and-reach (cm) / SAR	23.2	6.1	22.1	5.7	
Standing broad jump (cm) / SBJ	133.5	15.5	145.9	19.0	*
Handgrip (kg) / HG	19.0	3.5	21.1	4.4	*
Sit-ups (n) / SU	18.1	4.5	19.2	4.4	
Bent-arm hang (sec) / BAH	11.4	7.1	17.4	11.9	*
Shuttle run 10x5 m (sec) / SHR	23.3	1.6	22.1	2.0	*
Endurance shuttle run (n) / ESR	22.6	6.5	29.0	9.2	*
Jump with accuracy (cm) / JWA	10.5	5.2	9.9	5.2	
Turns on a bench (n) / TOB	5.3	1.5	5.7	1.6	
Run for balls (sec) / RFB	20.4	1.8	18.9	2.1	*
Ball tracing (cm) / BT	130.2	18.4	116.9	18.3	*
Arrhythmical tapping (n) / AT	9.3	1.8	8.7	1.9	*
Jump without a swing (cm) / JWS	27.3	11.2	25.0	11.8	
Jump back (cm) / JB	64,51	15.5	61.2	19.1	
Body mass (kg) / BM	33.2	7,40	33.6	5.7	
Body height (cm) / BH	139.9	6.5	142.1	6.9	*
Sum of 5 skinfolds (mm) / S5F	45.2	10.4	42.9	10.0	

* p < 0.05

The tests that make up a particular cluster have the property of showing relatively close relations with each other. There were 19 variables, and the cluster analysis grouped them into 6 (girls) and 5 (boys) clusters.

The structure of motor and physical indicators in the examined groups differ in a sense that the group of boys had a more compact model. Coordination and speed abilities are in close relation and probably create the basis for motor performance at that age. Some relation between coordination and condition abilities grouped in clusters is difficult to explain. Physical development presents important factor of the hierarchical model. It is obvious that the hierarchy of somatic and motor variables is gender-dependent as early as primary school age. Differences between boys and girls probably reflect the types of activities available for children, availability of suitable role models, for motor skills, and societal expectations for physical activity and motor skill.

Although the correlation between physical development and coordinative performance of children indicate possible negative consequences, there are still no distinct research results concerned with correlations between coordination abilities and physical parameters. Results of body gross motor development test for children (KTK) unveiled significantly better level for boys in comparison with girls (Graf et al., 2003).

Information on the attained levels of motor performance is not as extensive for early childhood as it is for adolescence. There is much intraindividual and interindividual variability in the level of motor abilities among young children. Changes in mean levels of performance with age should be viewed with this variability in mind (Malina, Bouchard and Bar-Or, 2004).

It should be emphasized that during this specific period of motor development, movement outcomes for the children are the evidence of their undergoing biologically-driven growth and intersection of the underlying movement capacity of coordination with the learned performance of motor skills (Miller, 2006).

CONCLUSION

Motor performance is influenced, beside physical characteristics, by motivational factors, opportunity for practice, habitual physical activity, and other factors in the cultural environment. There is a need to consider all these factors while assessing motor performance differences. These variables may be especially relevant in the context of examining gender differences in performance.

In order to identify the actual status of motor dispositions in children, not only the information on specific elements is important but also on mutual relations between them and their structure. Condition abilities are in a straight continuity with coordination abilities and considering their control function, it is necessary to study abilities in a view of their complexity.

REFERENCES

1. Adam, C., Klissouras, V. & Ravassolo, M. (1988). *Eurofit. Handbook for the European test of physical fitness*. Rome: Council of Europe, Committee for Development of Sport.
2. Blahuš, P. (1999). Fuzzy - množiny jako formální metoda v diagnostice za neurčitosti: využití v kinantropologii. *Česká Kinantropologie*, Vol. 3, č. 2, 77-87.
3. Gallahue, D.L. & Donnelly, F.C. (2003). *Developmental physical education for all children*. Champaign, IL: Human Kinetics.
4. Graf, Ch., Koch, B., Kretschmann-Kandel, E., Falkowski, G., Christ, H., Coburger, S., ...Dordel, S. (2003). Correlation between BMI, leisure habits

- and motor abilities in childhood (CHILT- Project). *European Journal of Obesity*, 11, 4, 284-290. Retrieved from <http://www.nature.com/ijo/journal/v28/n1/full/0802428a.html>
5. Haywood, K. M. & Getchel, N. (2005). *Life span motor development*. Champaign, IL: Human Kinetics.
 6. Hendl, J. (2004). *Přehled statistických metod zpracování dat*. Praha: Portál.
 7. Hirtz, P. (1985). *Koordinative Fähigkeiten im Schulsport*. Berlin: Volk und Wissen Volkseigener Verlag.
 8. Malina, R. M. (2003). Motor Development during infancy and early childhood: overview and suggested directions for research. *Int. J. Sport. Health Sci.* 2, 50-66.
 9. Malina, R. M., Bouchard, C. & Bar-Or, O. (2004). *Growth, maturation, and physical activity*. Champaign, IL: Human Kinetics.
 10. Miller, J. (2006). *Primary school-aged children and fundamental motor skills – What is all fuss about?* Referred Paper for publication and presentation at the Australian Association for Research in Education (AARE), Adelaide, November 2006. Retrieved from <http://www.aare.edu.au/06pap/mil06230.pdf>
 11. Raczek, J., Mynarski W. & Ljach W. (1998). *Teoretyczno-empiryczne podstawy kształtowania i diagnozowania koordynacyjnych zdolności motorycznych*. Katowice: AWF.
 12. Ružbarská, I., Turek, M. (2010). *Vybrané kapitoly z elementárnej telesnej výchovy*. Prešov: Prešovská univerzita, Fakulta športu, 2010.
 13. Starosta, W. (2003). *Motoryczne zdolności koordynacyjne*. Warszawa: Instytut Sportu.

ABSTRACT

There is an ambiguity in approaches to application of individual test issues within the early childhood. It is necessary to start from the premise that a child is not a miniature adult. Due to these reasons, methodological approaches used with this age group are diametrically opposite and their results are difficult to compare. The aim of this study is to analyse and compare differences in the hierarchy of motor and physical indicators in primary school girls and boys. The hierarchy of somatic and motor variables is gender-dependent as early as the primary school age. Physical development affects condition as well as coordination performance independently of gender. This knowledge creates the base for the determination of more efficient diagnostic methods and retrospectively for successful development of motor competencies.

Key words: *primary school age, motor abilities, cluster analysis*