CHILDREN'S ACHIEVEMENTS IN COMPOSITE MEASUREMENT INSTRUMENTS FOR EXPLOSIVE STRENGTH

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Abstract
A battery of the five composite motor tests for explosive strength suitable for preschool children aged five has been applied to a group of 180 participants in extracurricular sports program in four kindergartens in the city of Rijeka in Croatia. This experimental research has contributed to the results of previous research regarding the following; 1. The results in applied composite tests in the research have determined that the third performance of the task has achieved better results which lead to the conclusion that children learn how to perform the task during the first and second performance 2. Conducted analysis has confirmed good metric characteristics of examined motor tests for explosive strength in children aged 5 and 3. The applied battery of five composite motor tests concerning its metric characteristics could be implemented in the standardized battery of motor tests suitable for preschool children for monitoring children motor development as well as their achievements in motor abilities.

Key words*; children, explosive strength, composite motor test.*

Introduction

Children show considerable increase in performance in skills between 5 and 8 years of age (running speed and shuttle run) and a steady, more gradual increase in performance in others from 5 years of age through childhood (e.g. jumping, throwing and strength). Controlling of learning effects is a significant logistic problem in longitudinal studies of motor performance; How much of the observed improvement reflects growth-related changes and how much reflects learning to perform the task? (Malina et al. 2004). Motor performance depends on muscular strength and according to the longitudinal studies strength improves linearly with age from early childhood. According to the analysis of the results from different research (Rajtmajer, 1990; Živčić and Hraski, 1995; Bala, 1999; 2003; Mišigoj-Duraković, 1999; Malina, 2004; Trajkovski-Višić, 2004;, Živčić et al. 2008; De Privitellio, 2006 and 2009) we can conclude the following; 1. Muscular strength increases gradually during early childhood and 2. Gender differences in average strength are small but consistently favour boys for running, jumping and throwing. According to Malina, 2004. gender differences in motor performance probably reflect the types of activities available to preschool children and motor skills of boys and girls at this young age as well as societal expectations for physical activity.

The purpose of this research is to analyse one part of strength; the achievements in explosive strength motor tests, suitable for preschool children aged 5. The paper has been prepared as a pilot experimental research of the Master thesis on the Faculty of Kinesiology, University of Zagreb. The development of explosive strength has great influence on children's health, especially on child's skeleton. Furthermore, bone density structure during the youth period can determine the bone density in adulthood. Some of the main objectives for preschool aged children in process of developing of explosive strength are harmonious child's growth and development as well as child's well being and health. (Mišigoj – Duraković, 1999). According to Milanović (2008), the most appropriate physical activities for developing explosive strength are the basic motor movements such as walking, running, throwing as well as different elementary and sport games with low intensity and without extra weight. Concerning all the important scientific knowledge written above, the intention of this experimental research was to examine the battery of composite motor test for explosive strength which is characterized as high reliability and simplicity of movement, suitable for children considering their age, abilities and motor knowledge, safety and feasibility in all kindergartens on national level regarding necessary equipment.

Problem and aim

This study is a contribution to several previous studies which have been conducted in Croatia with the aim to design the battery of motor tests for motor abilities (motor behaviour) suitable for preschool children. (Živčić and Hraski, 1995; Trajkovski-Višić 2004; De Privitellio, 2009). The lack of such kind of research can be justified by the following reasons; 1. Lack of the PE teachers in kindergarten as well as multidisciplinary approach between the kindergarten teacher and PE teacher, 2. Infrastructure (gym) limitations for providing different kinds of regular physical activity programs, 3. Difficulties associated with applying a larger number of motor assessments on small children, and 4. Lack of quality cooperation between the institution responsible for health and physical activity (motor behaviour, physical literacy) of preschool aged children. According to Bala (1999) in kinesiology theories on motor space it is methodologically almost impossible to prove the existence of a single dimension within a child's motor space. Some of the reasons can be explained by child's short attention, impatience and lack of motivation or by the cooperation during the testing. With regard to these mentioned problems, this analysis was based on observation of children's achievements in composite motor tests and relations among the items (internal data consistency) as well as its metrical characteristics.

Methods

The sample of subjects included 180 preschool children, 74 girls and 106 boys, aged 5, participants in extracurricular sports program. The extracurricular sports program has been organized several years in 4 kindergartens in Rijeka (Maestral, Galeb, Zamet and Krnjevo). According to the aims of the study, all participants fulfilled the following conditions; 1) health condition (without any physical problems), 2) participants in the group of the above mentioned kindergartens and 3) aged 5 years in November 2007, when we started with the measurement procedure. Estimation of the explosive strength achievements was performed based on the following motor tests (Table 1). All applied tests have been designed as three-item tests. The sample of motor tests is selected based on the battery which is used in school sports clubs. For the purpose of this research we have modified motor tests with the balls before they can be applied to children (MFEBLD, MFEBMD and MFEBML) in Table 1.

Table 1. A battery of five motor composite tests for explosive strength

variable	Description	Number of repetition
MFEBLD*	Throwing the tennis ball; throwing forward as much as possible the tennis ball from the standing position	3
MFEBMD*	Seated medicine ball throwing from the chest; child sits on the bench, keeping the feet flat on the ground, thrown vigorously out as far as posible	3
MFEBML*	Throwing 1 kg medicinal ball from lying on back; lying on back, holding arms raised upward with medicinal ball, thrown vigorously out as far as possible	3
MFESVM	Standing jump up (Sargent test); stands side on to a wall and reaches up with hand to the wall, keeping the feet flat on the ground, fingertips is marked, leaps vertically as high as possible using both arms and legs	3
MFESDM	Standing long jump; stands at a line marked on the ground with the feet slightly apart, takes off and lands using both feet, swinging arms and bending knees to provide forward drive as far as possible	3

*these tests haven't been used in previous studies on the sample of preschool aged children

When we received the permission from the heads of the kindergartens as well as from children's parents we introduced all above mentioned subjects involved in the study with the main aim and schedule of measuring procedure which was organized during the extracurricular sports programmes in kindergarten gyms.

The measurement schedule for each day of the measurement process was made with the special criteria; to activate different muscle groups related to previous motor test.

It is important to emphasize that the whole measurement procedure and collecting data are the results of the quality cooperation between the professor of kinesiology and kindergarten teacher who participated in the study. In the case of the composite test (consisting of three items) the following procedure was applied; mean (Mean) and standard deviation (SD), range of the results (minimum- MIN and maximum - MAX) as well as symmetry (Skewness - SKEW) and homogeneity (Kurtosis – KURT) were calculated for each item (repetition).

Correlation coefficients between the items have been calculated. Metric characteristics of the motor tests for explosive strength were determined by the RTT7stb. (Dizdar, 1999) which was based of the RTT7 program (Momirović, 1983), statistical programme for determining the metric characteristics of composite measurement instruments).

Results

Table 2 shows the descriptive parameters of the motor tests which measure explosive strength.

According to the data we can define the conclusion regarding its suitability and sensitivity for preschool children aged 5. The statistical indicator of the sensitivity of the motor test is variance, as standard deviation.

According to the analysis of the standard deviation and range of the results, we determined good sensitivity for all applied motor tests for explosive strength. The descriptive parameters as well as the distribution of the results are shown in Table 2.

Table 2; Descriptive parameters and values of the K-S test

Variables	ITEMS	MEAN	SD	MIN	MAX	SKEW	KURT	MAX D
MFEBLD (cm)	1	748.26	348.56	160	2300	1.19	2.32	0.093
	2	749.42	336.22	141	2360	1.24	2.79	0.094
	3	736.17	337.01	100	2190	1.13	1.94	0.129
MFEBMD (cm)	1	188.17	48.09	80	320	0.30	-0.25	0.079
	2	191.25	46.40	80	310	0.21	-0.24	0.082
	3	195.03	44.48	70	320	0.11	-0.17	0.068
MFEBML (cm)	1	91.77	40.13	30	200	0.62	-0.42	0.132
	2	94.66	43.90	20	250	1.14	1.68	0.120
	3	99.70	43.72	10	260	0.74	0.72	0.107
MFESVM (cm)	1	15.32	4.78	3	30	0.46	0.37	0.116
	2	15.46	4.47	5	30	0.41	0.54	0.096
	3	15.70	4.74	5	29	0.41	0.02	0.086
MFESDM (cm)	1	99.47	18.70	50	140	-0.14	-0.46	0.061
	2	99.97	18.60	55	136	-0.12	-0.59	0.054
	3	101.26	18.73	50	148	-0.12	-0.32	0.069

The analysis of the means and standard deviation of all items in each motor test (Table 2) shows that the third performance of the task gave better results which refer to conclusion from the some of the previous research (Bala, 1999) that the children were learning how to perform the task during the first performance and actually performed it during the second and third performance. The results of distribution of the results of each performance showed slightly asymmetric (Skewness) and not so homogenous (Kurtosis) distribution.

Table 3; Correlations between the items for each composite test

variable	R items	R
MFEBLD	1-2	.89
	1-3	.85
	2-3	**.89**
MFEBMD	1-2	.84
	1-3	.79
	2-3	**.85**
MFEBML	1-2	.78
	1-3	.73
	2-3	**.78**
MFESVM	1-2	.83
	1-3	.81
	2-3	**.89**
MFESDM	1-2	.83
	1-3	.81
	2-3	**.86**

Table 4: Realibility, homogeneity and representative quality coefficients

	MFEBLD	MFEBMD	MFEBML	MFESVM	MFESDM
RTT	.95	.93	.90	.94	.93
Alpha	.95	.93	.90	.94	.93
Alpha1	.40	.38	.36	.39	.39
Alpha2	.86	.85	.84	.86	.85
Lamda6	.93	.90	.86	.92	.91
Rho1	.87	.82	.75	.85	.83
Rho2	.99	.99	.98	.99	.99
Tau	.87	.82	.75	.85	.83
MSA	.99	.98	.96	.98	.98
Hom1	.97	.96	.95	.97	.97

Abbreviations; RTT – reliability standard (Spearman-Brown-Kuder-Richardson-Cronbach), Alpha – reliability standard, Alpha 1 – bottom reliability limit, Aplha 2 – top reliability limit, Lambda 6 – Guttman-Nicewander's reliability standard, Rho1 – bottom reliability limit, Rho2 – top reliability limit, Tau-Momirović's bottom reliabilty limit, MSA – Kaiser-Rice's particles representative quality standard, and Hom1 – Momirović's homogeneity coefficient.

By using Kolmogorov-Smirnov's test normal distribution (maxD) was confirmed in all motor variables, critical values of K-S test was determined regarding the number of samples with errors 0.01. Correlation values between single measuring items of multi-item tests had satisfying values (0.79 – 0.89) except in the case of the test MFEBML - throwing 1 kg medicinal ball from lying on one's back position which correlation values was in lower range (0.73-0.78). The intercorrelation between the items is positive and high value, especially between the second and third items. (Table 3).

Discussion and conclusions

The analysis of motor test metric characteristics (Table 4) showed the following; 1. Keiser-Rice's coefficients of representativity of all tests are high with the amount from .96 to .96. Spearman- Brown's measure of reliability (RTT reliability standard) is high for all test (.90 to .95). Reliability of the measurement result of all tests, evaluated by Crombach's index of generalizability (Alpha) is high with the range from .90 to .95. Momirović's homogeneity coefficient showed high values for all applied motor tests in range from .95 to .98.

Conducted analysis has confirmed good metric characteristics of examined motor tests for explosive strength in preschool children aged 5 as well as acceptability of the composite tests for explosive strength in the battery for motor abilities or motor behaviour. The applied composite motor tests for explosive strength had very good metric characteristics. This research has contributed to previous researches with the purpose to design the battery of motor tests which is suitable for preschool children.

The results of the analysis confirmed the conclusions from the previous study regarding difficulties in measuring motor behaviour of preschool children. It is well known that changes in the motor abilities of preschool children who attended the extracurricular sports program showed significant differences in all tests used to estimate motor behaviour. It would be useful if we had taken into consideration all these results and practical experience in measuring procedure for the purpose to define the national standardized measuring procedure for longitudinal and systematic evaluation of the motor achievements (motor behaviour) of the preschool children. Over the period of five years, we can notice some improvements and more researches on the sample of preschool children. Unfortunately, in mentioned researches the authors have used different designing measuring procedures which directly influenced on difficulties in comparison with the results form different researches. The applied battery of five composite motor tests and its metric characteristics could be implemented in the standardized motor tests battery for motor abilities suitable for preschool children.

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MOTORIČKA POSTIGNUĆA DJECE PREDŠKOLSKE DOBI U KOMPOZITNIM TESTOVIMA NAMIJENJENIM PROCJENI EKSPLOZIVNE SNAGE

Sažetak

Provedeno je istraživanje motoričkih postignuća u kompozitnim testovima eksplozivne snage na uzorku od 180 polaznika izvankurikularnog sportskog programa u dobi od 5 godina u četiri vrtića u gradu Rijeka. Na temelju primjenjenih analiza na podacima ovog eksperimentalnog istraživanja, može se zaključiti slijedeće: 1. Djeca predškolske dobi postižu najbolje rezultate u primjenjenim motoričkim testovima u trećem ponavljanju te se može zaključiti da djeca tijekom prvog i drugog izvođenja motoričkog zadatka uče, odnosno usvajaju strukturu gibanja u cilju postizanja što boljeg rezultata što je sukladno dosadašnjim spoznajama, 2. Primjenjenim analizama utvrđene su dobre metrijske karakteristike primjenjenih kompozitnih motoričkih testova namijenjenih procjeni eksplozivne snage, primjerenih djeci u dobi od 5 godina, 3. Primjenjena baterija kompozitnih motoričkih testova namijenjenih procjeni eksplozivne snage, s obzirom na metrijske karakteristike i rezultate ovog eksperimentalnog istraživanja, može se uvrstiti u bateriju motoričkih testova namijenjenih procjeni motoričkih sposobnosti djece predškolske dobi.

Ključne riječi*; djeca, eksplozivna snaga, kompozitni motorički testovi.*

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