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Original scientific paper

DIFFERENCES IN STRENGTH PERFORMANCES BETWEEN GROUPS OF 7-YEAR-OLD MALE MACEDONIAN STUDENTS WITH DIFFERENT LEVELS OF EXPLOSIVE STRENGTH ABILITIES

INTRODUCTION

One of the physical education (PE) curriculum aims, in early school stages is to contribute to improvement of students' motor abilities, as it is emphasized in Macedonian PE curriculum, as well as in many national curriculums for PE around the world (Klincarov, 2007). Strength performances represent a fundamental motor base closely related with other motor abilities that define the total motor space for children at this age. (Bala, 1981, 2002, 2003; Rausavljević, 1992; Rajtmajer, 1993, 1997; Pejćić & Malacko, 2005; Pisot & Planinsec, 2005). Defining the interrelations and interdependence in subspaces among strength abilities that exist at seven years old male students is the subject of the research in this paper. The aim of this research is to determine the differences in manifested explosive, repetitive and static strength performances in a group of students with different level of manifestation of explosive strength qualities.

Estimated dependences of student's subspaces of strength qualities, as well as the relations with other anthropological subspaces of children at this age should be used as a base for designing new and improved PE curricula and academic standards in the Republic of Macedonia.

The use of the results obtained in these and other similar researches, as well as a proper selection of educational contents, could be a strong base in order to ensure the most effective way for the improvement of students' motor status from the point of PE teaching process.

METHODS

A total number of 120 second grade 7-year-old students, from 5 primary schools in Skopje, Macedonian capital city, were measured on 11 motor tests hypothetically used for estimation of strength performances. The explosive strength qualities were fortified using the following tests: standing broad jump (ESSDM), throwing medicine ball (1 kg) from standing position (ESFMST), throwing medicine ball (1 kg) from sitting position (ESFMG) and standing start 20m running (ES20VS). Repetitive strength qualities were measured using following four tests: modified push-ups (RSSKL), sit-ups (RSPTR), trunk lift (PSITR), hands pulling over the diagonal Swedish bench (RSVKK), while static qualities were estimated using following three tests: hanging with bent arms (SSVZG), keeping in position lying on the stomach (SSZLM), keeping in position lying on the back (SSZLG),

A component factor analysis with Kaiser Gutman criteria for determination of principal components higher than 1, was used with the aim to determine the factor structure of analyzed motor space for estimation of explosive strength qualities among 7-year-old children.

Extracted significant principal components were transformed in orthogonal varimax factors. Factor scores were calculated for every participant. In the further procedure, based on the factor scores for defined varimax factors, using taxonomic K-means clustering analysis, three groups of participants were defined. Groups were defined on the basis of different explosive strength qualities, selected as: group 1 with low achievements, group 2 with medium achievements and group 3 with above average high achievements on tests for estimation of explosive strength qualities. Finally, using univariant analysis of the variance ANOVA, differences among groups with different levels of explosive strength abilities were estimated for all 11 tests used for evaluation of strength performances among 7-year-old students.

RESULTS AND DISCUSSION

Results obtained with factor analysis in the analyzed space for estimation of explosive strength are shown in Table 1. According to these results, two significant main components with eigenvalues above 1 were obtained, which explains 75% of the analyzed system total variability. According to the projections of analyzed variables on the defined varimax factors (V1 and V2), it could be concluded that for the analyzed sample of examinees, two different abilities for manifestation of explosive strength qualities exist.

The first varimax factor is defined as absolute explosive strength on upper body parts determined according to significant high projections on variables ESFMST and ESFMG (ESFMST=0.864; ESFMG=0.865), while variables ESSDM and ES20VS

have significant high projections (ESSDM=0.816; ES20VS =-0.876) at second varimax factor defined as relative explosive strength on lower body parts.

Table 1. *Communalities (h2), factor loadings (unrotated F1 & F2; varimax normalized V1 & V2), explored variance (Expl. Var), proportion of total variance (Prp. Totl); Extraction: Principal components*

	F1	F2	V1	V2	h^2
ESSDM	0.699	-0.479	0.229	0.816*	0.719
ESFMST	0.727	0.478	0.864*	0.099	0.757
ESFMG	0.704	0.507	0.865*	0.062	0.753
ES20VS	-0.525	0.703	0.047	-0.876*	0.770
Expl.Var	1.789	1.210	1.551	1.448	
Prp.Totl	0.447	0.302	0.388	0.362	

On both defined varimax factors V1 and V2, factor scores for every participant were calculated. Using K-means clustering procedure, examiners were grouped in three maximum distinct groups (clusters) with low (1), medium (2) and high (3) scores in defined varimax factors. Results from this analysis are presented in Table 2.

Table 2. *Means, Standard Deviations (SD) & Valid N (N); Factor scores K-means clustering of factor scores in factors V1 & V2*

Cluster	Clustering factor scores V1			Clustering factor scores V2		
	Means	SD	N	Means	SD	N
1	-0.804	0.400	58	-1.729	0.638	17
2	0.325	0.310	43	-0.294	0.355	55
3	1.720	0.651	19	0.949	0.384	48
All Groups	0.000	1.000	120	0.000	1.000	120

Results from the obtained univariant differences between defined groups with different explosive strength qualities on all of the analyzed tests used for estimation of different types of strength performance in children are presented in Table 3.

Table 3. *ANOVA results*

	Factor V1 (absolute exp. Strength)				Factor V2 (relative exp. Strength)			
	Groups	Means	F(df1,2) 2,117	p-level	Groups	Means	F(df1,2) 2,117	p-level
ESSDM	1	108.362	4.419	0.014*	1	89.941	68.723	0.000*
	2	117.000			2	107.109		
	3	120.526			3	128.875		
ESFMST	1	2.882	94.552	0.000*	1	3.156	1.984	0.142
	2	3.788			2	3.669		
	3	4.945			3	3.511		
ESFMG	1	1.428	97.132	0.000*	1	1.744	0.179	0.837
	2	1.923			2	1.761		
	3	2.524			3	1.812		
ES20VS	1	4.975	0.019	0.981	1	6.068	115.362	0.000*
	2	4.970			2	5.087		
	3	5.004			3	4.467		
RSSKL	1	13.845	0.285	0.753	1	11.765	2.568	0.081
	2	13.140			2	12.909		
	3	14.421			3	15.250		
RSPTR	1	15.414	0.162	0.851	1	11.529	4.818	0.010*
	2	14.488			2	13.255		
	3	14.316			3	18.000		
RSITR	1	16.000	0.566	0.569	1	11.471	6.412	0.002*
	2	14.907			2	13.855		
	3	13.842			3	18.229		
RSVKK	1	13.984	1.144	0.322	1	17.453	9.201	0.000*
	2	12.348			2	13.663		
	3	12.513			3	11.075		
SSVZG	1	6.689	0.883	0.416	1	5.785	3.661	0.029*
	2	7.628			2	6.396		
	3	8.457			3	8.886		
SSZLS	1	20.035	2.455	0.090	1	16.815	1.282	0.281
	2	23.802			2	24.098		
	3	29.707			3	23.723		
SSZLG	1	15.353	0.998	0.372	1	12.839	1.167	0.315
	2	17.879			2	18.070		
	3	19.471			3	17.023		

It is established that significant differences, between groups of examines with different level of absolute explosive strength of upper body parts, except in the manifest variables that define the first varimax factor (ESFMST and ESFMG), also exist in the variable ESSDM (F=4.419; p-level=0.014).

The obtained results also show that significant differences, between groups of examines with different level of relative explosive strength of lower body parts, beside in the manifest variables that define the second varimax factor (ESSDM and ES20VS), also exist in the following variables: RSPTR (F=4.818; p-level=0.010); RSITR (F=6.412; p-level=0.002); RSVKK (F=9.201; p-level=0.000); SSVZG (F=3.661; p-level=0.029).

Ability for manifestation of absolute explosive qualities on upper body parts, estimated using throwing medicine ball (1 kg weight) from standing and sitting position is not related with the manifestation of any other analyzed strength performances of repetitive and static strength character (Rajtmajer, 1993; Popeska, 2009a). We assume that the ability for manifestation of larger explosive strength through pitch out medicine ball in this age period depends on some biomechanical parameters in relation with morphologic structure of the body, as well as some other motor qualities such as absolute manifestation of maximal strength qualities that were not researched nor presented in this work.

The simultaneous manifestation of better explosive strength of lower body parts estimated through standing long jump and better absolute manifestation of explosive strength of upper body parts of children at this age still points out to a certain degree to the integration of explosive strength qualities. (Rausavljevic, 1992; Pejcic & Malacko, 2005; Pisot & Planinsec, 2005; Popeska, 2009b)

On the other hand, success in manifestation of relative explosive strength qualities on lower body parts estimated through standing broad jump and standing start 20m running is positively related with success in manifestation of some of the analyzed repetitive and static strength qualities. These points out the fact that a greater ability for explosive body translocation in space generates an increased ability for manifestation of greater repetitive strength of the trunk and upper body parts as well as a greater muscle endurance of arms and shoulders as it is confirmed in many other researches (Rajtmajer & Proje,1990; Rausavljevic, 1992; ; Lasan et al., 2005; Pejcic & Malacko, 2005; Popeska, 2009).

CONCLUSION

Analyzing the relations in the manifestation of explosive strength qualities with other types of strength performances among seven-year-old students in the Republic of Macedonia points out that:

1. Children who manifest a different level of absolute explosive strength qualities in upper body parts are not distinguished in repetitive and static strength performances.
2. Children who manifests greater absolute explosive strength qualities in the upper body parts, also have a better explosive strength in the lower body parts estimated through the test standing broad jump.
3. Children who manifest different level of relative explosive strength qualities of lower body parts are distinguished in repetitive and static strength performances.
4. Children who manifest higher relative explosive strength qualities on lower body parts also have better repetitive strength of the trunk and upper body parts estimated using following tests: sit-ups, trunk lift, hands pulling over the diagonal Swedish bench, as well as greater static strength estimated using the test hanging with bent arms.

Specific relations in motor success in a certain age period should be considered in practice, in the process of designing and enriching PE curricula as well as in the determination of PE content standards.

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ABSTRACT

This paper analyzes the differences in the manifestation of strength performance between groups of seven-year-old male Macedonian students with different level of explosive strength abilities. A total number of 120 children were measured in 11 motor tests used for estimation of explosive, repetitive and static strength qualities. Tests hypothetically used for estimation of explosive strength were factorized with component factor analysis. Orthogonal varimax factors were defined and factor scores of participants were calculated using K-means clustering procedure in order to determine groups of students with under average (low), average (medium) and above (high) average explosive strength qualities. Group univariant differences among all analyzed variables were also assessed using ANOVA analysis. It was concluded that both: defined latent dimensions of relative manifestation of explosive strength of upper part of the body and the absolute strength of lower body parts have a significant and specific influence on the success of manifestation of strength performance in students at this age. This type of findings should be used as a base for determining the qualitative physical education teaching programmes and academic standards.

Key words: *explosive, strength, abilities, physical education, students*