Boris Maleš[1*]
Frane Žuvela[1]
Danijela Kuna[2]

INTEGRATION OF THROWING ABILITY INTO THE MORPHOLOGICAL-MOTOR SYSTEM OF SEVEN-YEAR-OLD ATHLETIC SCHOOL ATTENDANTS

INTEGRACIJA SPOSOBNOSTI META V MORFOLOŠKO-GIBALNI SISTEM SEDEMLETNIH UDELEŽENCEV ATLETSKE ŠOLE

ABSTRACT

A sample of 125 seven-year-olds was tested, using six morphological and eight motor-ability variables with purpose of analyzing the integration of explosive throwing strength. Sample was split in two groups: experimental (E; N=68) and control group (C; N=57). Boys of E group attended three hours of Physical Education class per week as well as three additional sixty-minute periods of athletic training over a period of nine months. C group only attended regularly-scheduled Physical Education classes. In concordance with the research goal, the relationships of morphological-motor variables with distance ball-throw result as a criterion were analyzed for both E and C groups. Data was processed using regression analysis. The results have clearly shown that values of the variable criterion grew and that predicting criteria using an applied group of variables gave improved results in the end as compared to the initial measurement. Growth and development, as well as secondary kinesiological engagement of children contributed to superior results. The resulting integration of ball throwing in E group was higher than that in C group, due to higher kinesiological engagement as well as application of the wide array of kinesiological operators used in athletic school.

Key words: athletic school, ball-throw, seven-year-olds, morphological-motor system, relations

POVZETEK

Vzorec 125 sedemletnikov smo testirali na podlagi šestih morfoloških in osmih gibalnih spremenljivk, da bi tako analizirali vključevanje eksplozivne moči pri metu žogice. Vzorec je bil razdeljen v dve skupini: eksperimentalno (E, N = 68) in kontrolno skupino (C, N = 57). Dečki iz skupine E so se devet mesecev udeleževali treh ur športne vzgoje tedensko, imeli pa so še tri dodatne šestdeset minutne atletske treninge na teden. Dečki iz skupine C so v tem obdobju obiskovali le redne ure športne vzgoje. V skladu z raziskovalnimi cilji smo raziskovali odnos morfološko-gibalnih spremenljivk z rezultati meta žogice v obeh skupinah dečkov. Podatki so bili obdelani z regresijsko analizo. Rezultati so jasno pokazali, da so vrednosti kriterijske spremenljivke rasle in da je prediktorski kriterij, ki je vključeval vrsto spremenljivk, pokazal na izboljšane končne dosežke v primerjavi z začetnim stanjem. Rast in razvoj sta skupaj s sekundarnim gibalnim udejstvovanjem otrok, prispevala k odličnim rezultatom. Vključevanje meta žogice v skupini E je bilo bolj uspešno kot v skupini C, predvsem zaradi obsežnejšega gibalnega udejstvovanja, kot tudi zaradi uporabe širokega spektra gibalnih dejavnosti, ki so bile vključene v program atletske šole.

Ključne besede: atletska šola, met žogice, sedemletniki, morfološko-gibalni sistem, odnosi

[1]***Faculty of Kinesiology, University of Split, Split, Croatia***
[2]***Kupres Secondary School, Kupres, Croatia***

****Corresponding author:***
Unversity of Split, Faculty of Kinesiology
Teslina 6, 21000 Split, Croatia
Tel.: +385 21 302 404
Fax.: +385 21 385 399
E-mail: boris.males@kifst.hr

INTRODUCTION

Athletics (Track and Field) is a branch of sport where the phylogenetical component is most expressed. The original forms of movement, described as fundamental, generic motor abilities (Burton, & Miller, 1998), have evolved from ancient utilitarian forms of surviving (running, throwing, aiming etc. which helped in hunting and fighting with enemies) into the modern sport, attracting millions of viewers across the world.

Because it requires different forms of bodily movement, athletics is a suitable activity for proper growth and development of a child.

Growth itself is not continuous; it obeys certain laws we need to be familiar with in order to provide targeted kinesiological activities that qualitatively support the integrated development of the anthropological characteristics of a child (Pejčić & Malacko, 2005; Lasan, Pažanin, Pejčić, & Katić, 2005). Additional training in athletic schools, as well as specially-programmed PE classes, produce development effects of almost every relevant motor ability, which are significantly higher when compared to kinesiological education at school which is done in the standard way (Katić, Maleš & Miletić, 2002; Babin, Katić, Ropac & Bonacin, 2001; Žuvela, Maleš & Jakeljić, 2006). They are followed by body fat tissue reduction as well as increase in muscle mass, with moderate skeletal development (Malina & Bouchard, 1991; Shephard & Zavallee, 1994).

Elementary school children primarily need to develop biotic-motor abilities such as their throwing ability. In order to integrate ball-throwing ability into the motor abilities group in the best possible way, coordination, balance and flexibility should be developed. Speed, strength and stamina should not be undermined (Bompa, 2000). However, in order to develop motor abilities and ball-throwing ability as well, one needs to have a minimum of persistent characteristics of a morphological system, such as development of skeleton, ligaments and musculature. The required minimum helps to achieve the integration of throwing ability into morphological system of the anthropologic structure. Two processes are practiced simultaneously and/or alternately: integration of throwing ability into motor abilities system and integration of ball-throwing ability into the morphological system.

The goal of this research is to assess effects of additional athletic training, standard kinesiological education as well as the growth and development of seven-year-olds by determining their explosive strength of ball-throwing ability with morphological characteristics and motor abilities. Structural changes of ball throwing will be analyzed through morphological-motor variables with respect to various kinesiological engagements of students.

METHODS OF WORK

Research was processed on a sample of 125 seven-year-old (± six months) first grade elementary school attendants in the city of Split, Croatia. The sample was divided in two groups: experimental (E;N = 68) and control (C;N = 57).

A standard fourteen-variable battery was applied to all sample units in order to evaluate morphological, motor and functional status. The following variables were applied from the morphological array: body height (cm), body weight (kg), forearm circumference (cm), subscapular skinfold (mm), abdomen skinfold (mm), and wrist diameter (cm). All measures were taken according to international biological standards. In order to evaluate motor status, the following variables were used: wide-stands bow (cm), polygon backwards (s), hand tapping (f), sit-ups (f), chin-up hold (s), 20 m run (s), three-minute run (m) and ball throwing (m).

After measuring, the collected data were analysed with the *Statistics for Windows Ver. 5.0* computer program.

Elemental statistical factors and standard linear regression analysis were covered using data processing methods by the model of smallest squares. Morphological-motor variables have predictor status, while distance ball-throwing variable represents a criterion variable and is omitted from motor variable group. Basic statistical variable parameters are represented in tables for both groups (X – arithmetic median and SD – standard deviation). Beta partial regression coefficients, correlation predictor coefficient with criterion (multiple correlations – RO), F – values (F), degrees of freedom (df) and significance of regression coefficients and multiple correlations are shown as well.

Experimental programme description

The C group was regularly engaged in the physical education curriculum (PE), three times a week, 45 min. each session (3x45). During the nine-month period, a total of 105 lessons were performed. In total there were nine teaching segments with 34 teaching themes, altogether comprised 200 frequencies (total repetition of all teaching themes). The C group participated in the regularly organized, planned and programmed PE (Findak, Metikoš, Mraković, Neljak, & Prot, 1998). Apart from the C, the E group performed and additional 3x60 minutes of exercise weekly. In comparison to the C group, the E group participated in the additional 131.25 school lessons in the course of the nine-month experiment. The overall volume of the E programme was realized throughout eight teaching segments, 27 teaching themes and 306 frequencies. Consequently, including the PE curriculum, the E group participated in the programme at total of 506 times.

It is well known that transformative effects, both qualitative and quantitative, are primarily achieved by properly distributing work volume using kinesiological forms that are optimally age-adapted. This fact was taken in consideration in our experiment. Basing their conclusions on recent research (Babin, Katić, Ropac, & Bonacin, 2001; Katić, Bonacin, & Blažević, 2001; Katić, Maleš, & Miletić, 2002; Maleš, Žuvela, & Jakeljić, 2006), the authors became aware that through additional the 131.25 school lessons over a period of nine months, it could come to such choice and distribution of volume of work pressure that would benefit anthropological status of children E group.

According to that theory, we tried to achieve satisfactory volume of work in each training unit by introducing a small amount of new material multiple times as well as by decreasing working pauses to minimum. Every subsequent training unit was constructed in a way that, after repeating information learned in previous class, boys learned material that continued logically from the previously learned information. After several hours of workout, a considerable volume of energy was expended with respect to pupils' improvement in technique. The global plan and programme of the athletic school was based on elements of running, walking, jumping and throwing. Those elements provide an essential base for athletic training and a firm foundation for successful training in any sport in the future.

RESULTS AND DISCUSSION

Basic morphological-motor parameters and tests are shown in Table 1. Final measurements of morphological variables such as longitudinal and transversal skeletal dimensions, volume and mass increased with respect to initial measurement at both experimental and control groups. However, boys in control group developed significant amount of body fat, while boys in experimental group suffered decrease of body fat tissue on their backs and increase of the same on their stomach area. Based on resulting values, it could be assumed that experimental group had larger positive changes in forearm circumference values rather than control group.

Table 1: Basic statistical parameters (X – arithmetic median and SD – standard deviation) of morphological-motor variables in experimental and control group

VARIABLES	EXPERIMENTAL GROUP (N = 68)				CONTROL GROUP (N = 57)			
	Initial measurement		Final measurement		Initial measurement		Final measurement	
	X	SD	X	SD	X	SD	X	SD
Body height (cm)	128.95	4.83	132.39	4.86	128.48	4.92	131.95	5.09
Body weight (kg)	27.29	3.71	29.04	3.64	26.89	3.62	29.28	3.99
Forearm circumference (cm)	18.02	1.29	18.76	1.23	18.00	1.51	18.65	1.54
Subscapular skinfold (mm)	6.34	2.03	6.20	1.73	6.82	2.28	7.25	2.39
Abdomen skinfold (mm)	5.49	1.88	5.61	2.11	6.16	2.56	6.59	2.25
Wrist diameter (cm)	4.20	0.21	4.32	0.21	4.22	0.27	4.33	0.27
Wide-stands bow (cm)	33.45	7.40	41.57	8.43	36.18	8.80	41.25	7.37
Polygon backwards (s)	18.45	3.91	16.65	3.20	18.02	2.86	16.11	3.14
Hand tapping (f)	18.18	1.70	20.71	1.99	18.80	2.08	21.10	1.72
Sit-ups (f)	24.65	7.79	29.29	5.74	22.63	7.69	27.07	6.02
Chin-up hold (s)	14.60	8.99	20.87	10.85	12.51	7.86	17.87	11.31
20 m run (s)	4.78	0.28	4.28	0.24	4.89	0.44	4.53	0.29
3 minute run (m)	504.34	72.65	545.06	73.99	495.96	65.81	513.40	70.39
Ball throwing (m)	9.96	2.88	14.06	3.79	10.35	3.36	12.68	3.56

Regression analysis values (Table 2) are statistically significant for both groups in initial and final measurements. This confirms that the applied group of variables was a good predictor of ball-throwing ability in seven-year-old boys. Due to that conclusion, throwing cannot be observed separately from other bio-motor abilities and characteristics.

Table 2: Regression coefficients (B) and multiple correlations (RO) in ball throw variable in morphological-motor part of experimental and control group

VARIABLES	EXPERIMENTAL GROUP (N = 68)				CONTROL GROUP (N = 57)			
	Initial measurement		Final measurement		Initial measurement		Final measurement	
	B	*p-level*	*B*	*p-level*	*B*	*p-level*	*B*	*p-level*
Body height (cm)	0.13	0.542	-0.07	0.688	-0,18	0,449	0,14	0,417
Body weight (kg)	0.21	0.468	0.16	0.502	0,27	0,493	0,25	0,352
Forearm circumference (cm)	0.48	**0.022**	0.09	0.614	0,15	0,604	0,04	0,851
Subscapular skinfold (mm)	-0.24	0.279	-0.13	0.486	-0,03	0,876	0,05	0,780
Abdomen skinfold (mm)	-0.03	0.882	0.15	0.408	0,05	0,841	-0,02	0,934
Wrist diameter (cm)	-0.15	0.328	0.14	0.295	-0,34	0,056	-0,26	0,198
Wide-stands bow (cm)	0.02	0.895	-0.11	0.321	-0,14	0,373	-0,08	0,554
Polygon backwards (s)	-0.07	0.598	-0.25	0.063	-0,16	0,306	-0,46	**0,002**
Hand tapping (f)	0.02	0.898	0.39	**0.006**	0,16	0,273	-0,28	0,056
Sit-ups (f)	0.18	0.235	-0.18	0.196	0,21	0,156	0,08	0,602
Chin-up hold (s)	0.00	0.993	0.07	0.615	-0,04	0,787	0,07	0,651
20 m run (s)	-0.05	0.728	-0.12	0.406	-0,35	**0,016**	-0,32	**0,021**
3 minute run (m)	0.06	0.684	0.05	0.732	0,10	0,445	0,18	0,190
F	2.23		4.12		2.08		3.49	
df	13.54		13.54		13.43		13.43	
p level	0.020		0.000		0.035		0.001	
RO	**0.59**		**0.71**		**0.62**		**0.72**	

The laws of bio-motor structure identification, as well as the mechanisms of morphological-motor functioning at children were already introduced (Katić, 2004; Katić, Pejčić, & Babin, 2004). Additionally, this means that procedures used in the kinesiological education of boys in terms of complicated motor manifestations should be represented even more. Complete and integrated action is assured for the development of relevant anthropological characteristics of children. Katić, Pejčić, and Viskić-Štalec (2004) came to similar conclusions by studying the integration of aerobic activity the into morphological-motor system of seven to eleven year-old children. Based on multiple correlation coefficients (RQ), and other parameters (F-values and p-level), we can assume that explosive throwing strength is integrated far better into the morphological-motor system in the final rather than initial measurement in both sample groups. That could be assumed due to growth, development and the secondary engagement of children. The integration process of anthropological sub-segments into harmonic form goes through certain phases of development. Combined with the development of individual morphological characteristics and motor abilities, that process changes the structural ability of distance ball throwing. If we accept the fact that any motor manifestation of elementary-school children depends on supra-summative effects of all dimensions of their anthropological status, it is completely obvious that possessing a higher level of total anthropological characteristics leads to higher integration factor of motor functioning. Looking at partial effect of each predictor variable on the criterion, forearm circumference variable has a statistically significant effect on distance ball throwing in the initial measurement of E group. Nonetheless, a positive influence of coordination during throwing action is significant. During initial measurements in C group, boys predominantly used speed in distance ball throwing action rather than other motor abilities. During the course of that action, average transversal wrist dimensionality benefits throwing ability. Differences in motor functioning between sample groups during ball throwing are evident. The results produced by C group are logical. The mechanics of throwing proved that length of a ball throw is primarily dependant on the speed of throwing. It can be concluded that boys in C group perform the throwing action based on their natural ability of speed of movement. The partial effect of forearm circumference on ball throwing could be defined as the effect of specific forearm muscular strength that is important in hand-gripped object throwing actions. The explanation of differences between these two groups is nevertheless interesting. Boys from E group function differently, probably due to usage of simple movements when solving motor assignments. They also have a need for a higher kinesiological engagement, which is why they chose athletics as supplemental activity. The final measurement in C group displayed significant parallel development of all motor abilities and morphological characteristics, which resulted in high mutual determination. The boys started to use dominant psychomotor speed and coordination in solving the complex motor assignment of distance ball throwing. The final measurement of both groups was higher in terms of better integrity of ball throwing ability into the morphological-motor system of seven-year-olds. Nonetheless, boys in C group used coordination based on psychomotor speed during the action of throwing in the final measurement, which is quite logical. If we define ball throwing as a complex motor task, then also depends on a complete motor functioning system. Developing this skill is extremely important in early school age. The schedule of turning certain predictor variables in criterion prediction on and off will dictate a choice of transformation procedures focused primarily on anthropological characteristics that significantly determine throwing ability development. Furthermore, the procedure choice will also maintain the achieved development level of anthropological characteristics that formed a base for the development of the same in the early phase. During that, it should not be forgotten that throwing ability is a part of the biotic-motor skill group that additionally requires a qualitative approach in developing this ability. When planning and programming the development of throwing ability, we should not forget that this moving structure is highly complex and requires entire kinetic chain engagement, similarly to the javelin throw, i.e. one of technically most demanding athletic events. Distance ball throwing is the first phase in adopting javelin throwing technique, which is the reason children compete in ball throwing until early adolescence when they transfer to javelin throwing. It is known that athletes need to possess a high level of explosive strength, speed, coordination and athletic morphological build in order to perform the javelin throw well (Čoh, 2001). The above-mentioned can be seen with seven-year-olds, as well as positive influence of athletic treatment on the development of relevant abilities needed to perform ball throw. However, individual curves of development limit the possible influence on boys' motor abilities.

CONCLUSION

After reviewing the final measurements, we can generally conclude that distance ball throwing ability of both groups was better integrated in morphological-motor system. Growth, development and secondary kinesiological engagement of children contributed to such results. Integrating sub-segments of anthropological status in a compact unit goes through certain phases of development. During that process, the distance ball throwing structure is changed as certain morphological-motor characteristics and abilities are developed. However, the resulting integration of ball throwing is more accentuated in E group, which is the result of application of wide array of kinesiological operators in athletic school.

In the end, if we were to develop seven-year-olds' ball throwing ability by increasing their non-adipose volume, joint strength and flexibility, coordination, psychomotor speed and explosive strength, we conclude that we should primarily influence the development of a minimum persistence of morphological characteristics using kinesiological operators. All these factors are necessary in order to realize this complex action, formally and energetically.

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