EFFECTS OF SPECIFIC PROGRAMMED TRAINING ON MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES IN CHILDREN SPORTS SCHOOL

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UČINKI SPECIFIČNEGA PROGRAMIRANEGA TRENINGA NA MORFOLOŠKE ZNAČILNOSTI IN MOTORIČNE SPOSOBNOSTI V OTROŠKI ŠPORTNI ŠOLI

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Abstract

The sample of 233 boys in the children sports school at the age of 9-10, divided into a control (117) and experimental groups (116), have been subjected to application of a system of 30 variables (12 anthropometric and 18 motor) with an aim to check the efficiency of the programmed training on the growth and motor abilities of boys in the experimental group (sports school) by means of determining differences between the groups.

The research has lasted for two years, while measurement was carried out in the initial (first measurement), transitive (second measurement) and final condition (third measurement). During data processing, canonical discriminant analysis and univariate analysis of covariance (ANCOVA) were applied.

The obtained results of the effects achieved in the experimental group under the influence of the experimental treatment in transitive and final conditions (applying univariate analysis of covariance), as well as calculation of differences (based on the canonical discriminant analysis) between the control and experimental group in the whole system (especially anthropometric and motor variables) in initial, transitive and final measurement, indicate that they are statistically different, primarily owing to better results of the experimental group. This confirms the hypothesis that the programmed training had a higher effect on the biological growth and motor development of the boys.

Key words: morphological characteristics, motor abilities, training, effects, boys, age 9-10

Izvleček

Sistem s 30 spremenljivkami (12 antropometričnih in 18 motoričnih) je bil uporabljen pri vzorcu 233 dečkov iz otroške športne šole, starih od 9 do 10 let, ki so bili razdeljeni v kontrolno (117) in eksperimentalno skupino (116). Namen raziskave je bil preveriti učinkovitost programiranega treninga na rast in motorične sposobnosti dečkov iz eksperimentalne skupine (športna šola) na podlagi ugotovljenih razlik med skupinama.

Raziskava je potekala dve leti, meritve pa so bile opravljene v začetnem (prvo merjenje), prehodnem (drugo merjenje) in končnem stanju (tretje merjenje). Pri obdelavi podatkov je bila uporabljena kanonična diskriminantna analiza in univariatna analiza kovariance (ANCOVA).

Dobljeni rezultati učinkov, ki so se pojavili v eksperimentalni skupini pod vplivom eksperimentalne obravnave v prehodnem in končnem stanju (s pomočjo univariatne analize kovariance), kot tudi izračun razlik (s pomočjo kanonične diskriminantne analize), ugotovljenih pri začetni, prehodni in končni meritvi v celotnem sistemu (predvsem antropometrične in motorične spremenljivke) kažejo na to, da sta kontrolna in eksperimentalna skupina statistično različni, zlasti zaradi boljših rezultatov v eksperimentalni skupini. S tem se je potrdila hipoteza, da ima programiran trening večji učinek na rast in razvoj motoričnih sposobnosti dečkov.

Ključne besede: morfološke značilnosti, motorične sposobnosti, trening, učinki, dečki, starost od 9 do 10 let

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INTRODUCTION

It is well known that programmed training can transform optimally the anthropological characteristics of humans. Numerous research works (Blašković, Matković, & Matković 1993; Milanović, Jukić, & Itoudis 1994; Pišot 1994; Verdenik 1981, Verdenik, Tancig, & Bravničar 1987) done so far as well as practical experience have shown that these transformations are highly efficient at the childhood age, which practically means that programmed training can affect development and orientate the personality structure in a desired direction. However, it has not been determined so far what kind of training contents and loadings are required in order to achieve optimal effects of the desired transformation.

Similarly, the desire to improve the anthropological status of children and youth is also well known, especially when there is a question of orientation and selection of children for particular sports activities (Elsner 1973; Gabrijelić 1975; Malacko, & Radosav 1985; Rajtmajer 1997). However, the field of research relevant to orientation and selection of children for sport as well as determining of the optimal effect of specially programmed training on the primary anthropological characteristics has not yet been sufficiently studied, resulting in a shortage of complete research works and solutions for this subject.

The purpose of this research was to determine, for a children's soccer school, the effect of programmed training on morphological characteristics and motor abilities of the selected boys at the age of 9–10.

METHODS

The system of 30 variables (12 morphological and 18 motor ones), as well as the experimental programmed training of the experimental group has been applied on a sample of 233 boys attending the children's soccer school, who were divided into a control (n=117) and an experimental group (n=116). The research lasted two academic years, whereas measurements were made at the (i) initial, (t) transitive, and (f) final stage.

Determination of morphological characteristics was based on the following system of variables: 1. body height, 2. leg length, 3. arm length, 4. pelvic width, 5. shoulder width, 6. knee width, 7. body mass, 8. medium girth of the chest, 9. girth of the forearm, 10. skin fold of the back, 11. skin fold of the stomach, and 12. skin fold of the upper arm (Stojanović, Momirović, Vukosavljević, & Solarić, 1975).

Evaluation of motor abilities was based on the following system of variables: 1. passing through and jumping, 2. overhead agility, 3. hand and leg drumming, 4. hand tapping, 6. leg tapping against the wall, 7. standing long jump, 8. medicine ball throw from supine position, 9. medicine ball throw with twist, 10. hang with elbows bent on parallel bars, 11. trunk twist in supine position, 12. sit-ups, 13. trunk bending on the bench, 14. forward split, 15. trunk bending astride, 16. crosswise standing on the balance bench with eyes open, 17. standing on one leg length-wise on the balance bench with eyes open, and 18. crosswise standing on one leg on balance bench with eyes closed (Kurelić, Momirović, Stojanović, Šturm, Radojević, & Viskić-Štalec, 1975).

The experimental programme was carried out during three classes daily of 60 minutes each per week. The classes were carried out on school sports facilities (gymnasium and outdoors) or in the fields of football clubs. In addition to regular P.E. Classes, there were extra classes of football for selected pupils of 3rd and 4th forms of elementary school with the aim to get the pupils attracted to this sport, so that they decide to train it, and continue training it after the 5th form in the football club with an organized form of work with this age. The total of 22 classes per month throughout the academic year included physical preparation, technical preparation and matches between schools or within sports club tournaments.

The programme of physical preparation included free exercises with/without movement, different types of runs with medicine ball carrying, jumping over hurdles with ball carrying, sprints from different starting positions up to 10 m, running with changing of direction and rhythm, carrying each other in pairs and trios, endurance running at different pace up to 300 m, combination of forward roll and cartwheel, forward roll over a barrier, jumps (one/both legs) over the rope, different polygons, pushing and pulling over in pairs.

The technical preparation included kicking the ball with inner foot, receiving the ball with inner foot, kicking the ball with front foot, receiving the ball with front foot, striking the ball with forehead, recei-

ving the ball with lower leg, straight-line dribbling, curved-line dribbling, feinting in place and in movement, simple form of ball takeover, goalkeeper's catching the ball - high and medium high, etc.

Canonical discriminative analysis has been applied in order to determine the significance of the structural differences between the control (C) and experimental group (E) within the whole system of the applied morphological variables, as well as individual determination of variables which have most contributed to differentiation between groups in the initial (*i*), transitive (*t*), and final (*f*) measurement, based on their correlation with the discriminative function. Concerning the multivariate parameters, the following have been calculated: Wilk's lambda, Hi-square and significance (p) for the whole system of variables, as well as the centroids of the groups (Malacko, & Popović, 2001; Momirović, 1984).

Efficiency of the effects of the programmed training on individual morphological and motor variables with experimental group in the transitive (*t*) and final (*f*) measurement, with neutralisation of arithmetic means in the initial measurement in both groups has been checked by means of univariate analysis of covariance (ANCOVA).

RESULTS

The obtained results are shown in the tables for the applied system of morphological variables and for the applied system of motor variables. Tables 1 and 2 show the results of the canonical discriminative analysis with an aim to see statistic significance (p) of the structural differences between the control (C) and experimental (E) groups in the initial (*i*), transitive (*t*) and final (*f*) measurements, as well as univariate analysis of covariance (ANCOVA) in the transitive (*t*) and final (*f*) measurements, in order to determine the effects of the applied specifically programmed training, with previously neutralised arithmetic means in the initial measurement. As the graphic presentation of the obtained results is more illustrative than the tables, especially for the system of morphological variables and the system of motor variables, expressed for each variable in the initial (*i*) and final measurement (*f*), structures of discriminative functions and position of centroids of the groups towards discriminative functions are also shown.

Table 1: Morphological variables

Variables	DISCRIMINANT ANALYSIS		
	DF (*i*)	DF (*t*)	DF (*f*)
1.	-.12	.14*	-.04
2.	-.13	-.14*	-.08
3.	-.15*	.10	.00
4.	-.21*	-.02	.03
5.	-.33*	-.10	-.13
6.	-.40*	-.01	-.13
7.	.11	.23*	.19*
8.	.15*	.23*	.09
9.	.05	.20*	.23*
10.	.42*	.48*	.59*
11.	.48*	.53*	.60*
12.	.59*	.62*	.63*
Wilk's λ=	.66	.89	.89
χ^2=	31.59	24.18	23.27
p=	.00*	.01*	.01*
Centroid **C**=	.38	.33	.34
Centroid **E**=	-.38	-.33	-.34

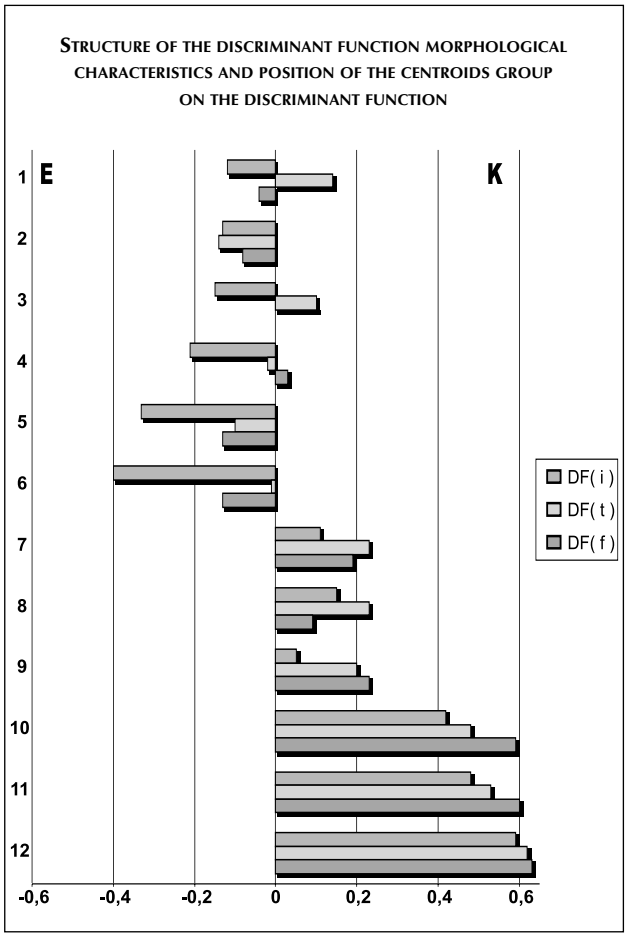

Figure 1: Structure of the discriminant function morphological characteristics and position of the centroids group on the discriminant function

Table 1 with the results that were processed by application of the canonical discriminative analysis demonstrates that the system of morphological variables between the control (C) and experimental group (E) differs statistically to a significant level in the initial (p=.00), transitive (p=.01) and final (p=.01) measurements.

In the initial measurement (*i*) this difference was accounted for by skin folds of forearm, stomach and back – in favour of the control group, which means that they had more adipose tissue compared to the experimental group, whose share of lean mass was higher. There were differences between variables: knee width, shoulder width and pelvic width. However, this time it was in favour of the experimental group, which means that the selected boys in the football school have had broader shoulders, pelvis and knees.

In transitional measurement (*t*) the subjects of the control group maintained the same amount of the adipose tissue, while their body mass increased, as well as the girth of forearm and the mean girth of the chest. In the final measurement (*f*), the control group has maintained the increased amount of the adipose tissue, girth of the forearm and body mass.

The results of the univariate analysis of the covariance (ANCOVA) also confirm that, following the neutralisation of arithmetic variable means in the initial measurement (Table 2), statistically significant differences in all variables (p=.00) have occurred in transitional (*t*) and final (*f*) measurements.

Table 3 with all the results processed by applying canonical discriminant analysis shows that in the whole system of the applied motor variables the

Table 3: Motor variables

Variables	DISCRIMINANT ANALYSIS		
	DF (*i*)	DF (*t*)	DF (*f*)
1.	-.34*	-.51*	-.32*
2.	.01	.08	-.21*
3.	-.08	-.08	.02
4.	.15*	.11	-.03
5.	.33*	.26*	.37*
6.	.44*	.42*	.40*
7.	.44*	.53*	.07
8.	-.37*	.08	.16*
9.	-.05	.02	-.03
10.	.20*	.42*	.14*
11.	.53*	.31*	.14*
12.	.43*	.22*	.38*
13.	.04	-.05	.12
14.	-.05	.08	.29*
15.	.01	-.18*	-.04
16.	-.03	.24*	.26*
17.	.27*	-.12	-.22*
18.	.18*	.11	.16*
Wilk's λ=	.69	.79	.78
χ^2=	81.69	51.43	52.87
p=	.00*	.00*	.00*
Centroid **C**=	-.66	-.51	-.51
Centroid **E**=	.66	.51	.51

Table 2: Morphological variables

Variables	VARIABLE ARITHMETIC MEANS						ANCOVA	
	E(*i*)	C(*i*)	E(*t*)	C(*t*)	E(*f*)	C(*f*)	p(*t*)	p(*f*)
1.	1402.0*	1395.5	1420.0	1426.8*	1477.6*	1475.2	.00	.00
2.	790.3*	785.5	810.6*	805.4	850.2*	846.9	.00	.00
3.	607.4*	601.9	618.3	621.1*	643.4	643.5*	.00	.00
4.	218.9*	216.2	222.2*	222.0	228.7	229.2*	.00	.00
5.	303.2*	298.9	307.8*	306.7	316.5*	314.4	.00	.00
6.	82.8*	80.3	85.6*	85.6	89.7*	89.2	.00	.00
7.	340.9	364.4*	348.2	358.6*	389.4	399.7*	.00	.00
8.	674.6	680.8*	677.8	685.8*	700.5	704.2*	.00	.00
9.	190.5	191.2*	190.1	192.4*	196.1	198.8*	.00	.00
10.	64.2	76.9*	61.6	73.3*	64.7	82.9*	.00	.00
11.	68.1	89.4*	67.2	86.3*	66.6	89.3*	.00	.00
12.	82.1	97.2*	80.2	93.2*	77.4	106.2*	.00	.00

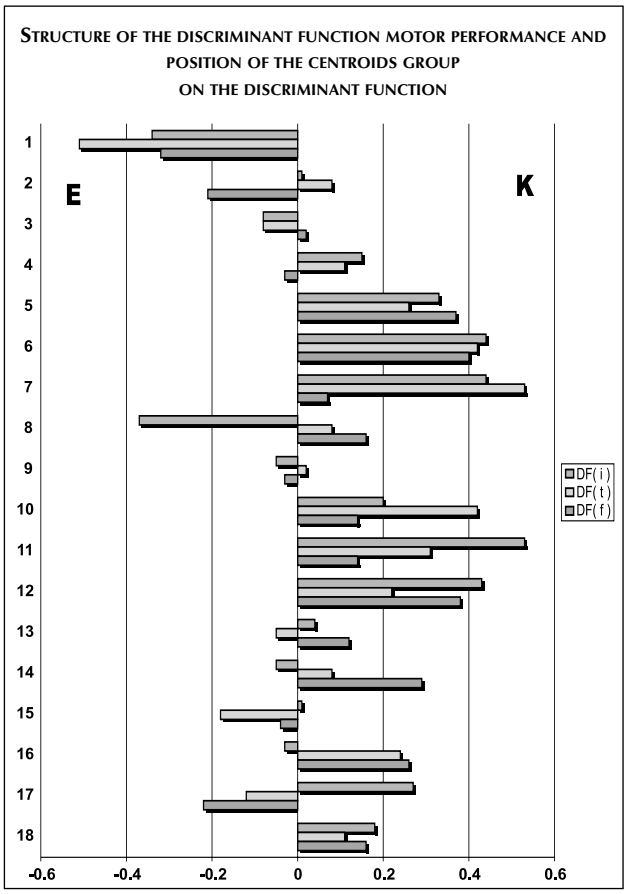

Figure 2: Structure of the discriminant function motor performance and position of the centroids group on the discriminant function

structural differences between the control (C) and experimental groups (E) are statistically significant (p=.00) in all three measurements – initial (*i*), transitional (*t*), and final (*f*).

In the initial measurement (*i*) it was observed that the boys of the experimental group proved better in repetitive strength, were more agile, faster in alternative movements of legs and that their lower extremities were stronger.

In the transitional measurement (*t*), the boys of the experimental group influenced by the programmed training (experimental treatment) retained satisfactory repetitive strength and considerably improved their explosive strength of lower extremities, agility and the speed of the alternative movements of legs.

Lastly, in the final measurement (*f*) relevant differences have been retained in favour of the experimental group with regard to the specific capabilities developed under the influence of the specifically programmed training, which affected the transformation of speed of leg movements, repetitive strength of the stomach muscles, coordination of the body, suppleness and balance.

Following the equalising of the results in arithmetic means of particular motor variables (see Table 4) and based on the applied univariate analysis of covariance (ANCOVA), the results obtained in the

Table 4: Motor variables

Variables	VARIABLE ARITHMETIC MEANS						ANCOVA	
	E(*i*)	C(*i*)	E(*t*)	C(*t*)	E(*f*)	C(*f*)	p(*t*)	p(*f*)
1.	148.9*	160.7	147.3*	162.2	157.8*	166.8	.00	.00
2.	52.9	52.6*	46.9	42.0*	50.2*	52.0	.00	.00
3.	2.8*	3.1	4.5*	4.8	5.5	5.4*	.00	.00
4.	26.1*	25.5	27.6*	27.2	28.7*	28.9	.00	.00
5.	17.8*	16.8	17.9*	17.1	18.7*	18.0	.00	.00
6.	18.7*	16.4	21.1*	19.3	49.9*	45.7	.00	.00
7.	159.8*	149.9	166.4*	155.4	167.6*	164.8	.00	.00
8.	360.8	398.1*	391.7*	385.3	482.1	503.7*	.00	.00
9.	570.6	578.9*	578.4*	575.2	678.2	683.0*	.00	.00
10.	2.9*	1.2	2.0*	1.1	1.8*	1.5	.00	.00
11.	34.0*	24.4	32.0*	27.5	24.1*	22.2	.00	.00
12.	7.2*	4.3	6.6*	5.4	7.5*	5.2	.00	.00
13.	41.8*	41.5	40.1	40.4*	40.4*	39.5	.00	.00
14.	137.8	138.6*	140.9*	140.1	147.5*	144.1	.00	.00
15.	43.5*	43.3	36.6	38.0*	34.9*	32.2	.00	.00
16.	5.9	6.1*	5.9	7.0*	23.2*	15.8	.00	.02
17.	18.4*	12.3	17.9*	14.2	35.9*	23.0	.00	.04
18.	1.8*	1.6	1.6	1.7*	2.6*	2.5	.11	.35

transitive (*t*) and final measurements (*f*) indicate that the differences are statistically significant (p=.00) with all variables applied except for the variable standing crosswise on the balance bench on one leg with eyes closed, both in the transitive (p=.11) and in the final measurement (p=.35).

DISCUSSION

The observed changes in morphology of the subjects in the control group in the transitional measurement were most probably due to increased adipose tissue in the organism caused by insufficient movement and exercises. Therefore, based on these structural differences a conclusion can be drawn that the starting selection and the applied programmed training had favourable effects which prevented the formation of increased adipose tissue in the organism and consequently the body mass (hindering factors). Skeleton dimensions are probably the result of the genotype, whereas reduction in body mass and subcutaneous adipose tissue was a result of the programmed training effect.

The differences in the motor status at the initial stage are probably the consequence of a good initial selection. The differences in the final measurement, however, prove the fact that this is a question of a well-conducted programmed training with boys in the experimental group which has significantly affected the achievement of the desired effects in the transformation process.

The results showing the effects recorded in the experimental group undergoing the programmed training (experimental treatment) in the transitive and final stages (applying the univariate analysis of covariance) and the calculated structural differences (based on the canonical discriminative analysis) between the control and experimental groups within the whole system, especially morphological and motor variables in initial, transitional and final measurements, indicate that they are statistically different, primarily owing to better results in the experimental group (sports school). Nevertheless, the hypothesis that the programmed training has more significant effect on biological growth and motor development of the boys has been confirmed.

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