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COMPARATIVE ANALYSIS OF THE SPECIALLY PROGRAMMED KINESIOLOGICAL ACTIVITY ON MOTOR AREA STRUCTURAL CHANGES OF MALE PUPILS AGED 6 TO 8

Babin, Josip,[1] Bavčević, Tonči[1] and Prskalo, Ivan[2]

Faculty of Kinesiology, University of Split, Croatia[1]
Faculty of Teacher Education, University of Zagreb, Croatia[2]

jbabin@kifst.hr
ivan.prskalo@ufzg.hr

Summary *- The effects of two different kinesiological treatments were analysed during one academic year on a sample of 325 pupils from the first grade of elementary schools. For the purposes of this research, the pupils were divided into a control (N=140) and experimental group (n=185). The control group attended regular physical education lessons, while the experimental group was subjected to an experimental kinesiological programme based on elements from track-and-field, sport gymnastics, games and global preparatory exercises.*

Between two points of measurements, both groups showed significant quantitative progress in the area of motor abilities. The positive effects of the experimental treatment were reflected in the comprehensive quantitative progress of all motor variables, simultaneously maintaining the structural coexistence of the motor system, in other words, the structural changes were expressed to a lesser degree.

Since the area of motor abilities represents one of the vital areas of the anthropological status and its development, which is an important task of kinesiological education, the need arises for constant quality improvement in the modality of physical exercise. Therefore, it is important to establish criteria for the validation of kinesiological treatment and, in determining its success in the transformation of the aimed anthropological features, to evaluate both quantitative and qualitative, i.e. structural changes, in the relations of the single partial dimensions of the anthropological status.

Key words: *specially programmed physical education lessons, first grade pupils of elementary school, motor abilities, quantitative and qualitative changes.*

1. Introduction

The period of primary education represents, from the point of view of growth and development, one of the most important periods in a child's phylogenesis. In this stage of life, the anthropological status is still not structurally determined, so the possibilities for affecting its development are great.

Environmental changes, such as an increase in urbanisation, traffic, access to media, staying indoors, unawareness of education and the dissolution of traditional social structures, have been described as having a negative effect on the motor development of children (Dollman, Olds, Norton, & Stuart, 1999). These changes affect children's capabilities, described as involving a decrease in sensory, motor, playing and social experience, and the capacity for concentration and endurance (Kretschmer, 2001), thus emphasising the need for organised kinesiological activity (Nagyová & Ramacsay, 1999). Research shows that well programmed and conducted kinesiological treatment compensates for the number of unfavourable environmental effects on the morphological and motor status through the development of muscle tissue and the skeleton in the form of enhanced bone mineralisation and adipose tissue reduction (Helge & Kanstrup, 2002).

Motor abilities, as one of the principal components of the anthropological status in the period of the younger school age, also show distinctive features of the system at the developmental stage. So, the structure of children's motor abilities is significantly different from that defined in adult subjects, which has been confirmed by a series of studies conducted so far (Katić, Zagorac, Živičnjak, & Hraski, 1994; Katić, Babin, & Blažević, 1999; Rausavljević, Katić, Žvan, & Viskić-Štalec, 1998; Katić, 2003; Vlahović, Bavčević, & Katić, 2007). For the previously mentioned reasons, it is important to create optimal conditions for the development and structuring of the motor area at this age, primarily by applying programmed and controlled kinesiological treatment (Findak, 1999). However, it is of great importance to take care not only of quantitative developmental shifts, but also to form the internal structure of the motor area, i.e. the qualitative changes which occur inside the system under the influence of the process of physical exercise. So, to define specific kinesiological treatment as valid and therefore recommendable for the development of, for example, the motor area, it has to fulfil two general conditions, i.e. it has to achieve the following effects: 1) the development of single motor area dimensions – *quantitative transformation*; and 2) the formation of the desired internal structure of the motor area by creating optimal mutual relationships of single motor dimensions – *qualitative transformation*.

Accordingly, the aim of this research was to define the influence of specially programmed physical education lessons from the aspect of quantitative and qualitative changes achieved in the domain of some motor abilities in pupils from the first grades of elementary school.

The intention was to establish the differences between the experimental and the control group of subjects at the beginning and at the end of the experiment. In addition, the quantitative shifts in the development of motor abilities between the two points of measurement in both groups were to be determined. The latent structure of the motor area for the control and the experimental group in both the initial and final measurement were also to be established with the aim of comparing them. The structural changes in motor dimensions with regard to the applied kinesiological treatment would then be determined.

2. Methods

The sample of subjects for this research consisted of 325 pupils from the first grades of elementary schools from the City of Split. To answer the proposed scientific questions, the general sample was divided into two sub samples. *The control group* of subjects (n=140) attended regular physical education classes (according to the elementary school teaching programme), and *the experimental group* (N=185) attended specially programmed classes based on elements from track-and-field, sport gymnastics, games and global preparatory exercises, for one academic year (Table 1).

Table 1. Year plan of the physical education experimental programme.

		Months										
Contents		IX	X	XI	XII	I	II	III	IV	V	VI	Total
	Measurements	4									4	8
Track-and-field	Walking and running	1	2	1	1	1	1	1	2	1		11
	Jumping	1	2	1	1	1	1	1	1	1		10
	Throwing		2	1	1	1	1	1	1	1		9
Sport gymnastics	Floor exercises	1	2	2	1	1	1	1	2	1		12
	Apparatus exercises		1	2	1	1	1	1	1	1		9
	Jumps		1	2	1	1	1	1	1			8
Games	Basic sp. games tech.s		1	1	1	1	1	1	1	1		8
	Elementary games	1	1	1			1		1		1	6
	Relay games	1		1	1	1		1	1	1		7
	Team games				1	1	1	2	1	2	1	9
Competitions	Sp. gymnastics						1			1		2
	"Between two fires"						1			1		2
	Track-and-field							2			2	4
	General preparatory exercises – in every lesson											
	Total	9	12	12	9	9	11	12	12	11	8	105

The subjects involved in the programme did not have any expressed physical or psychological aberration. All the subjects were voluntarily involved in the experiment and written confirmation was obtained from their parents. The research was conducted under project number 5-10-219, approved by the Ministry of Science, Education and Sports. The experimental programme as well as the measurements were all conducted by the physical education teachers.

The assessment of motor abilities was performed by using 11 motor tests suggested on the basis of research by Kurelić et al. (1975), as follows:

Body coordination:	- *side steps* (MKUS) / sec
	- *polygon backwards* (MPOL) / sec
Balance:	- *standing on an equilibrium bench transversely on both feet with open eyes* (MP2O) / sec
Flexibility:	- *forward bow* (MPRR) / cm
Motor velocity:	- *hand tapping* (MTAP) / no. of repetitions
	- *foot tapping* (MTAN) / no. of repetitions
Explosive strength:	- *standing jump* (MSDM) / cm
	- *distance ball throwing* (MBLD) / m
	- *20m high start run* (M20V) / sec
Repetitive strength:	- *sit ups* (MDTS) / no. of repetitions
Static strength:	- *bent arm hang* (MVIS) / sec

The mentioned measurements of motor abilities were performed on two separate occasions - at the beginning and at the end of the academic year.

As part of the data analysis, the following principal descriptive parameters were calculated: mean ($\overline{X}$), standard deviation (SD), minimum result (MIN), maximum result (MAX), skewness ($\alpha3$), kurtosis ($\alpha4$).

Quantitative differences among single groups and points of measurements were determined with the use of multivariate and univariate analysis of variance with the calculated parameters of Wilks' lambda, F-test value and significance threshold (p).

Factor analysis was applied in order to establish the latent structure of the motor area based on the model of principal components with the application of varimax rotation. As part of the conducted analysis, the parameters of eigenvalue (λ) and of the percentage of the interpreted variance (σ^2) were calculated.

Changes in the relationships in the internal structure of the motor area among two points of measurements were determined with the application of the algorithm LQDIFF. The matrices of the manifest variable correlations of the initial measurement, the final measurement and the cross-correlations of the initial and final testing, especially for the control and experimental group of subjects, were calculated. The following parameters were also calculated: the trace of the matrix of the squared correlation difference of the initial and final measurement (TraceR^2), the degrees of freedom for the number of variables (df1), the degrees of freedom for the number of subjects (df2), the chi-square test for testing the significance (χ^2), and the significance threshold (p). By using the above-mentioned algorithm, the measurements of the local and global qualitative changes of each group of subjects among two points of measurements were determined.

3. Results

The parameters of the descriptive statistics imply a positive quantitative shift of results of all motor variables from the initial to the final measurement in the control and experimental group of subjects (Table 2).

The coefficients of the data skewness and kurtosis in the control group are within the normal value range, except for the variables *polygon backwards* (MPOL; α4=4.83) and *standing on the equilibrium bench transversely on both feet with open eyes* (MP2O; α4=7.00) in the initial measurement, and the variable *bent arm hang* (MVIS; α4-inicijalno=15.03, α4-finalno=6.28) in the initial and final measurement. In the experimental group, the cited coefficients significantly deviate from normal values for the variables *side steps* (MKUS; α4=4.63) and *bent arm hang* (MVIS; α4=6.23) and only in the initial measurement (Table 2). Analysis carried out in an earlier study showed a satisfactory metric characteristic of all the variables included in the model (Vlahović, Babin & Bavčević, 2008).

The results of multivariate analysis of variance, shown in Table 3, indicate statistically significant differences among the two groups of subjects in the initial measurement (F=4.062, p=0.000). The mentioned differences are recorded for the variables *hand tapping* (MTAP), *foot tapping* (MTAN) and *bent arm hang* (MVIS), and they were all in favour of the control group of subjects.

Analysing the variance in the final measurements, there is a statistically significant difference among the groups of subjects (F=9.803, p=0.000) for the variables *polygon backwards* (MPOL), *standing on the equilibrium bench transversely on both feet with open eyes* (MP2O), *the forward bow* (MPRR), *hand tapping* (MTAP), *foot tapping* (MTAN), *20m high start run* (M20V), *sit ups* (MDTS) and *bent arm hang* (MVIS) (Table 3). All the mentioned variables define the diversity in favour of the experimental group.

Between the two points of measurements, both groups of subjects achieved a positive quantitative resultant shift (Table 3; control group: F = 10.452, p = 0.000; experimental group: F = 34.041, p = 0.000).

In the control group, this is achieved in the area of the variables *side steps* (MKUS), *polygon backwards* (MPOL), *foot tapping* (MTAN), *standing jump* (MSDM), *distance ball throwing* (MBLD), *20m high start run* (M20V) and *sit ups* (MDTS). The regular physical education classes showed statistically

Table 2. Descriptive statistics.

Varia-bles	Initial measurement						Final measurement					
	Control group (N=140)											
	$\bar{x}$	SD	min	max	α3	α4	$\bar{x}$	SD	min	max	α3	α4
MKUS	16.11	2.03	11.23	24.70	0.93	1.87	14.29	1.75	10.13	20.07	1.03	1.46
MPOL	23.25	7.12	11.70	57.87	1.60	4.83	17.46	4.39	10.27	34.00	1.27	2.05
MP2O	18.45	8.03	2.67	64.33	1.73	7.00	20.03	7.76	8.67	45.67	1.01	0.96
MPRR	36.38	8.12	21.33	60.00	0.37	-0.28	37.33	7.00	20.83	56.67	0.41	-0.25
MTAP	19.81	3.00	12.00	30.67	0.32	1.12	20.82	2.33	13.67	25.67	-0.30	0.22
MTAN	15.94	1.87	11.33	20.67	-0.09	-0.21	17.09	1.79	12.33	22.33	-0.13	-0.02
MSDM	111.50	18.68	56.67	155.00	-0.11	-0.10	127.63	18.87	81.67	181.33	-0.01	-0.09
MBLD	10.78	3.23	3.17	22.00	0.64	0.42	11.96	3.57	4.83	23.33	0.53	0.35
M20V	4.98	0.44	4.07	6.27	0.25	0.10	4.72	0.38	3.97	5.87	0.74	0.41
MDTS	21.96	7.03	5.00	39.00	-0.27	-0.14	25.11	6.58	3.00	45.00	-0.53	1.40
MVIS	12.59	11.77	0.00	92.00	2.97	15.03	14.00	9.97	0.00	63.00	1.85	6.28
	Experimental group (N=185)											
	$\bar{x}$	SD	min	max	α3	α4	$\bar{x}$	SD	min	max	α3	α4
MKUS	16.41	2.14	12.20	27.50	1.31	4.63	14.15	1.58	10.70	21.00	0.83	1.99
MPOL	22.75	5.48	11.73	40.30	0.75	0.56	16.47	3.67	9.33	26.67	0.56	-0.12
MP2O	16.87	6.96	1.67	50.00	1.16	2.68	22.21	7.37	2.67	55.33	0.83	1.88
MPRR	37.22	8.78	19.00	59.33	0.12	-0.32	42.39	8.44	20.83	62.67	0.05	-0.52
MTAP	18.70	2.50	13.00	28.33	0.43	0.86	21.68	2.67	13.00	32.00	0.33	1.80
MTAN	15.47	1.98	9.00	22.67	-0.14	1.49	17.59	1.92	12.00	23.33	0.08	0.32
MSDM	114.30	16.29	75.00	163.33	0.16	0.38	130.70	15.57	91.67	166.00	-0.23	-0.55
MBLD	10.40	2.95	3.27	19.17	0.45	0.07	12.65	3.16	6.03	24.33	0.36	0.42
M20V	4.91	0.43	4.10	6.30	0.30	-0.15	4.48	0.34	3.80	5.50	0.32	-0.11
MDTS	21.44	5.84	0.00	34.00	-0.48	0.37	28.22	5.45	13.00	40.00	-0.43	-0.07
MVIS	9.57	7.21	0.00	47.00	2.08	6.23	22.45	13.03	2.20	74.80	1.38	2.25

Legend: $\bar{x}$ – mean, SD – standard deviation, min – minimum result, max – maximum result, α3 – skewness coefficient, α4 – kurtosis coefficient.

Table 3. Multivariate and univariate analysis of variance

Variables	K1:E1		K2:E2		K1:K2		E1:E2	
	F	p	F	p	F	p	F	p
MKUS	1.691	0.194	0.557	0.456	64.358	0.000	134.138	0.000
MPOL	0.532	0.466	4.950	0.027	66.858	0.000	167.917	0.000
MP2O	3.724	0.055	6.676	0.010	2.670	0.103	51.353	0.000
MPRR	0.796	0.373	33.056	0.000	1.132	0.288	33.344	0.000
MTAP	12.798	0.000	9.263	0.003	9.946	0.002	122.234	0.000
MTAN	5.006	0.026	5.711	0.017	26.739	0.000	109.145	0.000
MSDM	1.824	0.178	2.584	0.109	50.520	0.000	98.050	0.000
MBLD	1.060	0.304	3.352	0.068	8.758	0.003	49.956	0.000
M20V	2.181	0.141	37.035	0.000	28.519	0.000	114.927	0.000
MDTS	0.526	0.469	21.542	0.000	15.004	0.000	133.052	0.000
MVIS	8.620	0.004	40.774	0.000	1.026	0.312	138.414	0.000
	Wilks' λ = 0.875 F = 4.062 p = 0.000		Wilks' λ = 0.744 F = 9.803 p = 0.000		Wilks' λ = 0.699 F = 10.452 p = 0.000		Wilks' λ = 0.489 F = 34.041 p = 0.000	

Legend: K1 – control group - initial measurement, E1 – experimental group - initial measurement, K2 – control group - final measurement, E2 – experimental group - final measurement, Wilks' λ – Wilks' lambda, F – value of the F-test p – significance threshold.

significant quantitative changes in the area of motor abilities over the period of one academic year.

The experimental group achieved statistically significant progress in the area of all the observed variables, which draws the conclusion that the specially programmed physical education lessons produced significant and comprehensive changes in the area of motor abilities.

The latent structure of the motor area was determined with the application of factor analysis according to the principal components model. To maximise the quantity of the interpreted variance, the extrapolated factors were subjected to varimax rotation (Table 4).

Four factors were isolated in the control group of subjects during the initial measurement. The first factor is defined by the variable projections *standing jump* (MSDM), *distance ball throwing* (MBLD) and *20m high start run* (M20V), so it is possible to define it as a mechanism for controlling explosive strength. The second factor is defined by the test *forward bow* (MPRR), i.e. by flexibility. The third factor unifies the projections of all the observed tests with some higher values of the variables *side steps* (MKUS), *hand tapping* (MTAP), *foot tapping* (MTAN) and *bent arm hang* (MVIS). The fourth factor is determined by the variable for the assessment of balance, i.e. *standing on the equilibrium bench transversely on both feet with open eyes* (MP2O).

Three factors were obtained by the factor analysis of the motor area of the control group in the final measurement. The first factor is defined by the variables *distance ball throwing* (MBLD) and *bent arm hang* (MVIS), which leads to the conclusion that the general mechanism for controlling strength is a basic part of this factor. The second factor is determined identically to the initial measurement by the variable projection *forward bow* (MPRR) which measures flexibility. The third factor is defined by the variables *hand tapping* (MTAP) and *foot tapping* (MTAN), so it is possible to define this as the motor velocity factor.

The above reasons show that the structure of the motor area for the control group of subjects is significantly different in two points of measurement.

Three factors were isolated during the initial and final measurement in the experimental group of subjects.

The first factor in the initial measurement is defined with the variables *polygon backwards* (MPOL) and *sit ups* (MDTS), and in the final measurement *polygon backwards* (MPOL) and *standing jump* (MSDM). It is clear that in both cases the basis of the isolated factors is still an undifferentiated mechanism for controlling strength and coordination. The second and third factors are defined by projections of identical variables on both measurements. The second factor is determined by the variables *hand tapping* (MTAP) and *foot tapping* (MTAN), so it is possible to conclude that we are dealing with the motor velocity factor. The third factor is predominantly defined by the variable *forward bow* (MPRR) intended for the evaluation of flexibility.

The obtained results of the factor analysis imply that the structure of the motor area in the experimental group of subjects is almost the same at two points of measurement.

Analysing the latent structure of the motor area of the control and experimental group of subjects in the initial and final measurement, significant structural differences were recorded (Table 4).

Particular differences in the structure were detected by comparing the latent structure of the motor area of both groups in the final testing. More precisely, two of the three isolated factors in the final measurement were identical in both groups of subjects (Table 4). The difference was noted in the first factor which is, in the control group, defined by the dimensions of explosive (*distance ball* throwing - MBLD) and static strength (*bent arm* hang - MVIS), and in the experimental group by coordination (*polygon backwards* - MPOL) and explosive strength (*standing* jump - MSDM).

By inspecting the correlation matrices for the variables of the motor area of the control group of subjects, more explicit Pearson's coefficients of linear correlation were generally noted in the final (from -0.003 to -0.557) rather than in the initial (from 0.014 to -0.529) measurement. The matrix correlation

Table 4. Factor analysis.

Variables	Initial measurement				Final measurement		
	Control group						
	F1	F2	F3	F4	F1	F2	F3
MKUS	-0.422	-0.323	0.407	0.029	-0.476	0.061	-0.472
MPOL	-0.435	-0.077	0.336	0.276	-0.414	0.009	-0.601
MP2O	-0.016	-0.030	0.001	-0.907	0.230	0.370	0.488
MPRR	-0.066	0.915	-0.021	0.022	-0.002	-0.856	0.089
MTAP	0.367	0.242	-0.582	-0.077	0.058	-0.191	0.736
MTAN	0.321	0.036	-0.438	-0.416	0.118	-0.116	0.775
MSDM	0.832	0.017	-0.074	0.048	0.611	0.139	0.506
MBLD	0.751	0.020	0.065	-0.086	0.762	0.057	0.119
M20V	-0.741	0.149	0.153	0.102	-0.645	0.016	-0.224
MDTS	0.431	0.349	0.177	-0.405	0.500	-0.464	0.293
MVIS	0.391	0.242	0.597	-0.183	0.725	-0.140	0.025
	λ=3.216 σ^2=29.239	λ=1.153 σ^2=10.479	λ=1.091 σ^2=9.921	λ=1.033 σ^2=9.391	λ=3.960 σ^2=36.000	λ=1.165 σ^2=10.590	λ=1.048 σ^2=9.527
	Experimental group						
	F1	F2	F3		F1	F2	F3
MKUS	-0.458	-0.421	0.191		-0.671	0.281	-0.016
MPOL	-0.742	-0.144	0.075		-0.702	0.203	0.186
MP2O	0.296	0.250	-0.314		0.098	-0.391	-0.559
MPRR	-0.081	-0.101	-0.781		0.057	0.091	-0.869
MTAP	0.109	0.821	-0.030		0.099	-0.836	0.068
MTAN	0.054	0.873	0.018		0.201	-0.843	-0.053
MSDM	0.587	0.286	-0.318		0.730	-0.289	-0.092
MBLD	0.629	0.115	0.167		0.542	-0.219	-0.007
M20V	-0.340	-0.255	0.604		-0.641	0.144	0.343
MDTS	0.711	-0.005	-0.028		0.638	-0.137	0.033
MVIS	0.440	-0.035	-0.330		0.675	0.118	0.045
	λ=3.269 σ^2=29.721	λ=1.323 σ^2=12.031	λ=1.055 σ^2=9.590		λ=3.811 σ^2=34.648	λ=1.281 σ^2=11.644	λ=1.129 σ^2=10.260

Legend: λ – eigenvalue, σ2 – percentage of the interpreted variance.

difference of two points of measurement is statistically significant, with the value of the chi-square test χ^2=111.767 and the significance threshold p=0.000 (Table 5).

The values of the cross-correlations of both the initial and final measurement of appropriate variables of the control group of subjects are of medium intensity and operate within boundaries from 0.299 to 0.854.

The analysis of the quantitative structure changes of the motor area between two points of measurement in the control group of subjects, as shown

Table 5. Correlation matrix of manifest variables of the initial measurement (above the diagonal), of the final measurement (below the diagonal) and cross-correlations of initial and final measurement (diagonal of the matrix) for the control group of subjects.

	Control group (N=140)										
Var.	MKUS	MPOL	MP2O	MPRR	MTAP	MTAN	MSDM	MBLD	M20V	MDTS	MVIS
MKUS	0.488	0.297	-0.103	-0.141	-0.281	-0.192	-0.325	-0.305	0.262	-0.198	-0.037
MPOL	0.385	0.573	-0.169	-0.035	-0.282	-0.271	-0.369	-0.250	0.256	-0.166	-0.141
MP2O	-0.303	-0.229	0.299	0.015	0.059	0.176	0.014	0.112	-0.149	0.207	0.103
MPRR	-0.102	-0.062	-0.042	0.854	0.124	0.031	0.019	0.022	0.059	0.166	0.086
MTAP	-0.296	-0.386	0.188	0.097	0.596	0.306	0.263	0.203	-0.355	0.174	0.044
MTAN	-0.387	-0.441	0.248	0.120	0.413	0.537	0.313	0.221	-0.253	0.240	0.061
MSDM	-0.431	-0.557	0.362	0.009	0.313	0.422	0.647	0.479	-0.529	0.283	0.230
MBLD	-0.328	-0.370	0.237	-0.003	0.210	0.195	0.464	0.764	-0.453	0.349	0.164
M20V	0.352	0.317	-0.208	-0.035	-0.274	-0.234	-0.459	-0.400	0.716	-0.262	-0.127
MDTS	-0.320	-0.315	0.170	0.234	0.351	0.289	0.333	0.366	-0.350	0.492	0.195
MVIS	-0.360	-0.321	0.137	0.076	0.119	0.232	0.385	0.365	-0.295	0.316	0.533

$TraceR^2 = 1.597$ $df1 = 11$ $df2 = 140$ $\chi^2 = 111.767$ $p = 0.000$

Legend: $TraceR^2$ – trace of matrix of squared correlation difference of initial and final measurement, df1 – degrees of freedom (number of variables), df2 – degrees of freedom (number of subjects), $\chi2$ – chi-square test for testing the significance, p – significance threshold.

Table 6. Measurements of the local and global qualitative changes – control group.

Var.	Control group
	L.P.
MKUS	0.424
MPOL	0.276
MP2O	0.463
MPRR	0.133
MTAP	0.305
MTAN	0.373
MSDM	0.228
MBLD	0.198
M20V	0.255
MDTS	0.370
MVIS	0.311
G.P.	0.508

Legend: L.P. – local change measure, G.P. – global change measure

in Table 6, indicates the explicit value of the global change measurement (G.P.=0.508). The biggest contribution to the detected structural change came from the local change in the area of the variables *side steps* (MKUS, L.P.=0.424) and *standing on the equilibrium bench transversely on both feet with open eyes* (MP2O, L.P.=0.463) and slightly less for the variables *hand tapping* (MTAP, L.P.=0.305), *foot tapping* (MTAN, MTAN, L.P.=0.373), *sit ups* (MDTS, L.P.=0.370) and *bent arm hang* (MVIS, L.P.=0.311).

Slightly more expressed Pearson's coefficients of linear correlation in the final (from 0.002 to 0.571) rather than in the initial testing (from 0.020 to 0.565) were recorded with an insight into the correlation matrix of motor variables of the experimental group of subjects. The findings are statistically significant with the values of the chi-square test χ^2=75.111 and a significance boundary p=0.000 (Table 7).

The trans-correlations of the initial and final measurement of appropriate motor variables of the experimental group of subjects assume medium to high values from 0.404 to 0.879.

The recorded qualitative changes in the structure of the motor area between two points of measurement in the experimental group of subjects are defined by the extent of the global change at the level G.P.=0.484 (Table 8). The local changes in the area of the variables *standing on the equilibrium bench transversely on both feet with open eyes* (MP2O, L.P.=0.488) and *side steps* (MKUS, L.P.=0.312) and less so for the variables *polygon backwards* (MPOL, L.P.=0.299), *hand tapping* (MTAP, L.P.=0.284), *foot tapping* (MTAN,

Table 7. Correlation matrix of manifest variables of the initial measurement (above the diagonal), final measurement (below the diagonal) and cross-correlations of initial and of final measurement (diagonal of the matrix) for the experimental group of subjects.

Var.	Experimental group (N=185)										
	MKUS	MPOL	MP2O	MPRR	MTAP	MTAN	MSDM	MBLD	M20V	MDTS	MVIS
MKUS	0.596	0.352	-0.207	-0.054	-0.268	-0.308	-0.412	-0.216	0.319	-0.276	-0.167
MPOL	0.424	0.614	-0.239	-0.055	-0.235	-0.176	-0.408	-0.321	0.281	-0.427	-0.276
MP2O	-0.200	-0.234	0.404	0.040	0.125	0.194	0.290	0.154	-0.294	0.162	0.115
MPRR	-0.010	-0.131	0.172	0.879	0.020	-0.040	0.079	0.021	-0.185	0.069	0.096
MTAP	-0.252	-0.209	0.107	0.021	0.661	0.565	0.257	0.172	-0.212	0.153	0.114
MTAN	-0.322	-0.330	0.321	-0.011	0.571	0.665	0.225	0.148	-0.182	0.105	0.070
MSDM	-0.548	-0.521	0.195	0.132	0.318	0.323	0.666	0.306	-0.417	0.280	0.293
MBLD	-0.261	-0.355	0.132	0.065	0.233	0.219	0.468	0.855	-0.161	0.276	0.111
M20V	0.445	0.465	-0.186	-0.245	-0.183	-0.304	-0.439	-0.280	0.744	-0.239	-0.224
MDTS	-0.407	-0.389	0.185	0.002	0.150	0.227	0.381	0.298	-0.365	0.777	0.229
MVIS	-0.307	-0.378	0.062	0.039	0.054	0.149	0.365	0.227	-0.325	0.257	0.734

$TraceR^2 = 0.812$ df1 = 11 df2 = 185 $\chi^2 = 75.111$ p = 0.000

Legend: $TraceR^2$ – trace of matrix of squared correlation difference of initial and final measurement, df1 – degrees of freedom (number of variables), df2 – degrees of freedom (number of subjects), $\chi2$ – chi-square test for testing the significance, p – significance threshold.

Table 8. Measurements of the local and global qualitative changes – experimental group.

Var.	Experimental group
	L.P.
MKUS	0.312
MPOL	0.299
MP2O	0.488
MPRR	0.105
MTAP	0.284
MTAN	0.247
MSDM	0.281
MBLD	0.126
M20V	0.213
MDTS	0.199
MVIS	0.236
G.P.	0.484

Legend: L.P. – local change measure, G.P. – global change measure

L.P.=0.247), *standing jump* (MSDM, L.P.=0.281), *20m high start run* (M20V, L.P.=0.213), *bent arm hang* (MVIS, L.P.=0.236) mostly contributed to the mentioned structural changes.

4. Discussion and conclusion

The principal aim of the conducted research was to establish quantitative and qualitative differences in the effects of regular and specially programmed physical education lessons in the area of the motor abilities of first grade pupils in elementary schools.

Even by inspection of the descriptive indicators alone, a positive resultant shift between the initial and final measurement in all of the observed variables, both in the control and experimental group of subjects, was recorded. Therefore, it is clear that both treatments generate positive transformational effects in the manifest motor area.

In order to define the difference among the single groups of subjects and the points of measurement, multivariate and univariate analyses of variance were used. Based on the conducted analyses, a statistically significant difference was found between the groups of subjects in the initial testing. The difference was recorded in favour of the control group in the area of motor velocity (MTAP, MTAN) and static strength.

However, after the conducted treatment lasting one academic year, an analysis of variance confirmed a statistically significant difference in favour of the experimental group of subjects. This was achieved primarily by differences in the area of coordination (MPOL), balance (MP2O), flexibility (MPRR), motor velocity (MTAP, MTAN), explosive strength (M20V), repetitive strength (MDTS) and static strength (MVIS). These findings could be attributed to the differences in the treatment to which the groups were subjected. The experimental programme lasting one academic year achieved not only a compensatory effect in relation to the initially better control group, but it ultimately enabled significant transformational changes in the majority of observed components of the motor area. The obtained findings are in accordance with the conclusions of Malina & Bouchard (1991) and Shepard & Zavallee (1994). They particularly indicate that specifically programmed kinesiological treatment provides greater effects in the area of motor abilities, including all factors of strength, flexibility and aerobic endurance, followed by adipose tissue reduction, muscle mass increase and moderate skeleton development. It is clear that at this age more significant and more complex transformational effects of relevant basic motor abilities are achieved through the application of more different kinesiological content (Babin, Katić, Ropac, & Bonacin, 2001).

Analysing the differences in the initial and the final state of both groups, it can be concluded that both kinesiological treatments brought about statistically significant changes. Progress in the experimental group was achieved in the area of coordination (MKUS), motor velocity (MTAN), explosive strength (MSDM, MBLD, M20V) and repetitive strength (MDTS). On the other hand, the experimental treatment led in the experimental group of subjects to a positive and statistically significant resultant shift in all of the observed motor variables. The suggested programme, therefore, comprehensively and evenly treats the motor domain, enabling the uniform development of all motor abilities.

A factor analysis was conducted in order to gain insight into the latent structure of the motor area. The task was to establish the existence of a structural difference in the observed motor area in relation to the applied kinesiological treatment.

In the control group, during the initial testing, four factors were isolated: *explosive strength, flexibility, general motor*, and *balance*. After a year of regular physical education lessons, the mentioned motor area was transformed into the space defined by the three following factors: *general strength, flexibility* and *motor velocity*. So, the regular programme resulted in significant structural changes in the area of motor abilities.

Almost three identical factors were isolated by a factor analysis of the motor area in the experimental group of subjects in the initial and in the final testing, as follows: *general strength and coordination, motor velocity,* and *flex-*

ibility. Comparing the findings of the discriminative analysis and the presented factor analysis, it can be concluded that the experimental programme of physical education caused significant quantitative shifts in the area of observed variables without an interruption of the present latent structure of the motor area.

If the effects of the two applied treatments on the structure of the motor area of the control and experimental groups are compared, it can be noted that an initial and significantly different structure was recorded in both groups in the initial measurement, while after the conducted treatment it was almost completely equalised. This leads to the conclusion that regularly programmed and conducted kinesiological treatments favour, with the significant effect of growth and development, an optimal structuring of the motor area in children at the developmental age (Babin, 1996).

With the aim of gaining insight into the extent of the structural changes in the area of motor abilities between two points of measurement, a qualitative analysis was conducted based on the definition between the correlation matrix differences and the final testing.

Slightly higher regression coefficients were recorded in the final testing in relation to the initial testing for both groups of subjects. The above-mentioned difference is more expressed in the control group, which implies significant structural changes in the motor area as a consequence of the different work modalities. It is possible to conclude that both kinesiological treatments, regular as well as experimental, were favourable for the internal connection of the motor area.

The differences in the correlation matrices of the initial and final measurement are statistically significant for both groups of subjects, but with a higher magnitude of change in the control group. This is also confirmed by the cross-correlation coefficients of appropriate variables for both points of measurements, which are prominently higher in the experimental group.

Both treatments, therefore, resulted in an increase in the connection of the motor dimension, that is, in the specific homogenisation of the motor area. The above-mentioned findings are more expressed in the control group of subjects as confirmed by the factor analysis results which imply a clear reduction in the latent motor area dimensions in the cited group. The obtained results are in keeping with the research by Rausaljević et al. (1998) who also recorded an integration process of the latent motor dimensions by evaluating the different modalities of physical education lessons.

The extent of the global structure change is prominently greater in the control group of subjects. The recorded qualitative changes in both groups were caused primarily by the changes in the area of coordination and balance, and to a lesser degree in the area of motor velocity and strength. Therefore, the experimental physical education lessons created the pre-conditions for significant shifts in the domain of the observed dimensions, without a significant interruption of the internal motor area consistency. It can be concluded that the level and the quantity of adequate motor manifestations depend on the latent structure of the motor area.

It is clear that one of the results of the physical education process, irrespective of its type, is the change in the structure of the system. This is particularly expressed in the developmental age, when the specific dimensions and sub dimensions of the anthropological status still do not exist (Katić, Bonacin, & Blažević, 2001). Therefore, it is precisely in this life period that it is important to offer support and to create optimal conditions for the regular growth and development of the organism, and this certainly includes the processes of the development and structuring of the motor area where kinesiological activity cannot be omitted.

It can be concluded that experimental kinesiological treatment generally produces more expressed and more comprehensive developmental effects on the motor area of pupils aged 7 to 8. Educational units, based on more complex and more intense motor elements, obviously influence more deeply the development of the observed motor abilities. The stated facts demand the constant control and improvement of kinesiological programmes, since the quality of the developmental processes depends on them. On the basis of the obtained results, the implementation of more complex kinesiological operators in teaching practice is recommended, aiming at optimising the development of the overall anthropological status. It is especially important to ensure the preconditions and criteria for the objective and valid assessment of single treatments, taking into account the transformational effects on the quantitative manifestations of single parameters as well as on the qualitative changes which a specific treatment generates in the structure of the system.

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KOMPARATIVNA ANLIZA SPECIJALNO PROGRAMIRANE KINEZIOLOŠKE AKTIVNOSTI NA STRUKTURALNE PROMJENE MOTORIČKIH SPOSOBNOSTI KOD UČENIKA U DOBI OD 6 DO 8 GODINA

Babin, Josip, Bavčević, Tonči i Prskalo Ivan

Sažetak *- Na uzorku od 325 učenika prvih razreda osnovnih škola podijeljenih za potrebe istraživanja na kontrolnu (N=140) i eksperimentalnu skupinu (n=185), analizirani su učinci dvaju različitih kinezioloških tretmana u trajanju jedne školske godine. Kontrolna skupina pohađala je redovitu nastavu tjelesne i zdravstvene kulture dok je eksperimentalna skupina podvrgnuta eksperimentalnom kineziološkom programu baziranom na elementima atletike, sportske gimnastike, igara te opće pripremnih vježbi.*

Obje skupine polučile su između dvije točke mjerenja značajan kvantitativni napredak u području motoričkih sposobnosti. Pozitivni učinci eksperimentalnog tretmana odrazili su kroz sveobuhvatniji kvantitativni napredak svih motoričkih varijabli uz istovremeno zadržavanje konzistencije latentnog motoričkog prostora odnosno manje izražene strukturalne promjene.

Budući da područje motoričkih sposobnosti predstavlja jednu od vitalnih sfera antropološkog statusa, a njegov razvoj važnu zadaću kineziološke edukacije, nameće se potreba za stalnim unapređenjem kvalitete modaliteta tjelesnog vježbanja. Pri tome je važno ustanoviti kriterije validacije kinezioloških tretmana te u određivanju njihove uspješnosti u transformaciji ciljanih antropoloških obilježja vrednovati kako kvantitativne tako i kvalitativne odnosno strukturalne promjene u odnosima pojedinih parcijalnih dimenzija antropološkog statusa.

Ključne riječi: *posebno programirana nastava tjelesne i zdravstvene kulture, učenici prvog razreda osnovne škole, motoričke sposobnosti, kvantitativne i kvalitativne promjene.*