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ADAPTIVE CHANGES IN MOTOR ABILITIES INFLUENCED BY THE PROGRAM FOR THE CORRECTION OF KYPHOTIC BAD BODY POSTURE

ABSTRACT

The main objective of this study was to evaluate the changes of motor skills at the end of the experimental period in the experimental group of subjects who were encompassed by the correction and rehabilitation of the kyphotic bad body posture program. The sample consisted of 100 primary school pupils, male, aged 10 years (± 6 months) in Nis. The sample was divided into two groups: The first group had 50 subjects included in the correction and rehabilitation of the kyphotic bad body posture (experimental group). The second group had 50 subjects included in the teaching of physical education within the regular school obligations envisaged by the physical education curriculum (control group). A sample of measuring instruments represented motor skills within which following dimensions have been observed: Repetitive strength : trunk lifting for 30 seconds, mixed chin-ups, squats, Segmentary speed: foot tapping, hand tapping, tapping feet on the wall; Coordination: agility in the air, coordination with bat, agility on the ground. Raw data were analyzed by Student's t -test, canonical discriminant analysis and analysis of variance. The results showed that the application of correction and rehabilitation of the kyphotic bad body posture had a positive effect on motor skills of the researched subjects.
Key words: *kyphotic bad body posture, motor skills, students, canonical discriminant analysis, analysis of variance.*

1. INTRODUCTION

Some studies of the leisure time of the primary school pupils show an unsatisfactory level of engagement in any sports activities in their free time, which is especially notable in schoolgirls. Research mentioned in the list of domestic and foreign literature emphasizes a lack of education about the effects of the regular physical exercise on the health of pupils. The authors highlighted high percentage of parents who in their spare time, do not take up any sports activities and thus cannot be role model to their children, in order for them to encourage creation of a habit to exercise.

From many professional analyses it can be concluded that the volume and quality of physical exercising influences health status. Lack of movement causes poor

condition of the locomotor and nervous systems, which brings about the growing number of young people with disorders of locomotion, especially the joints and spine.
Kyphotic bad body posture or kyphosis, is a postural disorder or a physical deformity, located on active and passive elements of the spinal column, expressed in the sagittal plane. The main characteristics of the kyphotic bad body posture is reflected in the specified curvature, which is usually partial (local) type, and is located in the chest (thoracic) part.
Convexity of that curvature is oriented backwards, so that in pronounced and severe kyphotic bad body postures, form of the spinal column, together with the active forces portrays a picture similar to a hump , so that this body deformity is often called the stoop or hunchback.
Kyphosis mostly occurs as a partial deformity, and is located in the region of the chest (thoracic part of the spinal column), involving 12 thoracic vertebrae.
Depending on the fact whether only the active system power (muscles) is affected or the passive system (ligaments), is affected as well, the following can be distinguished:

- easier functional kyphosis (functional kyphosis of the I degree),
- harder or severe functional kyphosis (functional kyphosis of the II degree).

Generally, it may be noted that the functional kyphosis are reducible, they can be fully restored, and a program that can be used for this purpose is a program of corrective gymnastics.
By its origin, kyphosis can be congenital or acquired. For the study of postural disorders from the perspective of the corrective gymnastics, most significant are acquired kyphosis. The most common cause of acquired kyphosis is rickets, then the bad habits of body posture. In addition, a very common cause of kyphosis is flammable kyphosis, as a cause of inflammatory processes in the thoracic region of the spinal column (tuberculosis, rheumatic processes). Possible acquired causes include possible mechanical injuries in the region of the thorax.

Juvenile kyphosis, as one of the highest acquired scoliosis, was observed in schoolchildren in special vocational schools, with practical training, in which specific physical engagement of pupils can be considered as indicative for the occurrence of some postural disorders and physical deformities.

Regular physical education classes three times a week for 45 minutes, according to the results of numerous studies, are insufficient for the optimal individual development of the anthropological characteristics of pupils. This is confirmed by the increasing number of research results that highlight the problem of the decline in individual abilities. A particular problem entails the motor skills whose decline is a worrying fact, especially when you need to implement simple everyday motor tasks that are associated with the functional abilities (Visnjic, Jovanovic and Miletic, 2004; Visnjic, 2002, Jankovic, 2008).

Therefore, except for hypokinesia that is present in a number of children, obesity is next in a series of disorders which occur as a consequence of the lack of physical activity. Greater height and body mass, due to the lack of movement and relatively weak muscles, directly affect the bones and joints, which is statistically substantiated by the results of systematic medical examinations in primary schools and the problems of poor body posture as well as deformities of the spine and feet.

Results of systematic medical examinations for the enrollment in the first grade of two primary schools in 2011 in Nis show that 23 % of pupils display incorrect posture, and deviations from the normal foot was found in 33 % of boys and 30 % of girls. Structural deformations of the spine are more frequent in girls. This is

supported by the data relating to the occurrence of scoliosis in primary schools, which is registered in 3.5 % of boys and 4.5 % of girls.

There is justified concern that in children and adolescents hypokinesia marked the new names of the population of young people who are prone to sedentary lifestyle and who are in our area labeled with terms like " homo - sedentary population " and / or " young elderly population ".

The main objective of this study was to evaluate the changes of motor skills at the end of the experimental period in the experimental group subjects involved in correction and rehabilitation kyphotic bad body posture.

2. METHODS

2.1 Subject sample

Subject sample consisted of 100 primary school pupils, male, aged 10 years (± 6 months) in Nis. The sample was divided into two groups: The first group had 50 subjects included in the correction and rehabilitation of the kyphotic bad body posture (experimental group). The second group also had 50 subjects included in the teaching of physical education within the regular school obligations envisaged by the physical education curriculum (control group).

2.2 Sample of the measuring instruments

Statement of the kyphotic bad body posture was done on a systematic medical examination of subjects by clinical somatoscopy method.

Motor skills consisted of the following dimensions: *Repetitive strength*: trunk lifting for 30 seconds (MD30), mixed chin-ups (MMZG), squats (MČUČ), *Segmentary speed:* foot tapping (MTAN), hand tapping (MTAP), tapping feet on the wall (MTAZ); *Coordination*: agility in the air (MOKV), coordination with bat (MKOP), agility on the ground. Applied set of motor variables was taken from the research of Kurelić et al. 1975. Raw data were analyzed by Student's t-test, canonical discriminant analysis and the analysis of variance.

2.3 Experimental program

Experimental exercise program for the correction and rehabilitation of the kyphotic bad body posture during corrective gymnastics classes was implemented in the Health Center in Nis. The experimental program lasted for two months, with three classes of exercise a week, totaling 24 hours of corrective gymnastics.

The training work for the realization of the experimental program of exercises for the correction and rehabilitation of the kyphotic bad body posture and exercise program coordination had a following structure:

The introductory part of the class (5 min) had a goal to warm up the body of subjects and "introduce" them into organized work for the realization of the tasks in the main part of the class.

The preparatory part of the class (10 minutes) had the aim of engaging the whole muscular system, preparing the muscles, tendons and ligaments in particular, for more complete preparation of the body for the realization of the tasks of corrective exercises in the main part of the class.

The main part of the class (35 min) contained motor exercises for correction and rehabilitation of the kyphotic bad body posture and coordination exercise program.
The final part of the class (10 minutes) had the objective to encourage the recovery processes, and gradually calm down all functions of the body and emotions of the students applying less dynamic and lower intensity activities (eg, relaxing jumps, loosening and stretching of the shoulder and pelvic girdles).
The scope and intensity of the work load in the classes was aligned with the individual abilities and characteristics of the experimental group subjects.

Exercises applied for the correction and rehabilitation of the kyphotic bad body posture

As an example of a set of exercises that was used for the correction and rehabilitation of kyphotic bad body posture, following exercises from the initial position, lying on the stomach, are described. In addition to this initial position, there were applied starting position standing, sitting, in the high jump and modified, the basic starting position, kneeling.

Exercise 1.From s.p. (arms beside the body) by raising shoulder close blades towards the spinal column. At the same time lift your head off the ground.
Exercise 2. From s.p. as in the first exercise. Raise your hands with your palms facing the floor and face to the ground.
Exercise 3. In s.p. hands are on the floor, bent at the elbows so that the forearms and upper arms form an angle of 90 °. Elbows are at the height of the shoulder belt. Lift the head, the chest part of the spine and arms up to the shoulder blades movement closer to the spinal column.
Exercise 4. In s.p. arms are bent at the elbows, fingers intertwined on the back of the neck. Try to raise as much as possible from the ground, head and chest part of the spine.
Exercise 5.From s.p. lift your head up as much as possible. Face facing the ground. Intertwined fingers at the back of the neck to give a powerful resistance.
Exercise 6. From s.p. arms beside the body, palms to the ground. Lifting hand, hands outwards to hands upwards. The whole movement is taking place above the shoulder belt with lifting the chest part of the spine and head. The same route to be valid in s.p.
Exercise 7. In s.p. hands behind the body with twisted fingers . Thrust hands pulling them as far back and up with simultaneous turning the hands backwards and bring blades as close as possible to the spinal column.
Exercise 8. From s.p. arms bent, elbows and fingers at shoulder height. The upper arm and forearm over an angle of 90 °. Stretching the chest part of the spinal column (elongation) pull the forearm as far as possible backwards.
Exercise 9. In s.p. arms bent at the elbows, fingers clasped, hands behind the neck. Pull your elbows as much as possible back, not separating the palms from the neck, chest bulge and protrude forwards.
Exercise 10. From s.p. with the hands resting on the pelvis stretch backbone opposing with hands. In doing so, the head remains in the extension of the spinal column, shoulder belt pull downwards.
Exercise 11. In s.p. hands are outwards, palms thrusted forward. Pull hands back incorporating blades along the spinal column. When performing this

movement, ensure that your hands do not go below the level of the shoulders.

Exercise 12. The arms are bent, fingers intertwined with hands behind the neck. Thrust hands above the head, turning palms upwards. No unwinding of fingers pull hands backwards as much as possible.

3. RESEARCH RESULTS

3.1 Student's T-test

Table 1. Significance of differences between arithmetic means of the experimental group:

Tests	Mean(i)	Mean(f)	T-value	P
MDT30	11.01	15.87	7.48	**.000**
MMZG	1.47	3.71	7.55	**.000**
MČUČ	10.58	16.79	5.29	**.000**
MTAN	22.75	25.15	1.75	.346
MTAP	27.87	28.68	1.46	.165
MTAZ	15.48	16.87	1.15	.380
MOKV	19.54	17.28	2.79	**.007**
MKOP	13.85	12.63	6.84	**.000**
MONT	49.52	46.66	3.16	**.001**

*Legend***:** arithmetic means initial (Mean (i)), arithmetic means final (Mean (f)), T-test value (T-value) and level of significance (p)

Table 1 shows the results of T-test of motor abilities between the initial and final measurement of the experimental group. By analyzing the obtained results it can be concluded that there is statisticaly significant difference in trunk lifting for 30 seconds (MDT30 .000), mixed chin-ups, (MMZG .000), squats (MČUČ .000), agility in the air (MOKV .007), coordination with the bat (MKOP .000) and agility on the ground (MONT .001).

3.2 Discrimination analysis

Table 2. Significance of isolated discrimination function of the experimental group

Disc Func.	Eigenvalue	Canonical R	Wilks' Lambda	Chi-Sqr.	df	P-Level
1	3.102	.86	.158	148.83	9	**.000**

*Legend***:** squares of the discrimination coefficient (Eugenvalue), coefficients of the canonical correlation (Canonical R), values of the Bertlett's test (Wilks' Lambda), Chi- Square test (Chi-Sqr), degrees of freedom (df) and level of the determination coefficient (P-Level)

There was obtained a significant discrimination function of high intensity (CR=86%) which shows the correlation of data set used to perform discrimination analysis of the obtained results (Table 2). Results of the discriminative strength of the motor variables were obtained by Wilks-Lambda test (.158), which in turn shows that differences between the inital and final measurements in the area of motor abilities of the experimental group, are significant (p=.000). because Chi- Square test shows high values (Chi-Sqr = 148.83).

Table 3. Factor structure of isolated discrimination function of the experimental group

Variables	Root 1
MDT30	0.525
MMZGB	0.475
MČUČN	0.435
MOKV	-0.404
MKOP	-0.321
MONT	-0.300
MTAN	0.272
MTAP	0.242
MTAZ	0.200

Table 3 shows the structure of discrimination function of the participation of motor abilities variables in formation of significant discrimination functions. Displayed centroids of groups represent arithmetic means of the results of inital and final measurements. In order to check up the efficiency of the experimental treatment, there were measured nine motor tests, assumed to be good predictors of the researched area. The obtained results show that the biggest contribution to discrimination function is attributed to trunk lifting for 30 seconds (MDT30 0.525), mixed chin-ups, (MMZG 0.475) and squats (MČUČ 0.435).

Table 4. Centroids of the experimental group measurements

Measurements	Root 1
Initial	-3.258
Final	3.258

Results in Table 4 show discrimination function of the centroids on the basis of all motor tests which is 3.258 and -3.258. Significance of shown centroids of measurements which was tested through the significance of the discrimination function points out that their distance (discrimination) is significant.

Table 5. Classification matrix of the experimental group

MEASUREMENTS	Initial	Final	Total
Initial	47	3	50
Final	2	48	50
Initial	**94%**	6%	100%
Final	4%	**96%**	100%

Discrimination of groups shown in Table 5 as Percentils, points out that performed discrimination of the measurement results is explained by the precision of 95% (mean value of the percentages of the groups) from the coefficients of the canonical correlation whih is CR = 86%.

The obtained results of discrimination analysis of motor abilities in the final, in relation to the inital measurement of the experimental group show that, under the influence of the experimental treatment, there have occurred significant changes in motor abilities of the researched subjects.

3.3 Analysis of variance

Table 6. Multivariate analysis of variance between the exsperimental and control groups in the final measurement

Wilks' Lambda	Rao's R	Q
.175	12.22	**.000**

*Legend***:** value of Bertlett's test (Wilks' Lambda), Rao's F-approximation (Rao's R) and the level of significance (Q)

In Table 6 shown results of the multivariate analysis of variance between the subjects of the exsperimental and control groups in the final measurement, point out that there is statististically significant integroup difference in motor abilities since WILK'S LAMBDA is .175, which by means of Rao's F-approximation of 12.22 gives significance of differences at the level of Q= .000. Therefore, it can be concluded that in the applied system of motor abilities of the researched subjects there were determined statististically significant differences.

Table 7. Univariate analysis of variance between the exsperimental and control groups in the final measurement

Tests	Means (E)	Means (K)	F-odnos	Q
MDT30	15.87	11.22	9.46	**.000**
MMZGB	3.71	1.28	5.57	**.000**
MČUČN	16.79	11.34	6.87	**.000**
MTAN	25.15	26.10	1.35	.128
MTAP	28.68	30.68	1.38	.322
MTAZ	16.87	17.05	1.76	.255
MOKV	17.28	20.75	11.15	**.000**
MKOP	12.63	17.32	10.89	**.000**
MONT	46.66	49.24	6.47	**.000**

*Legend***:** arithmetic means exsperimental group (Mean (e)), arithmetic means control group (Mean (k)), values of F-test (F-relation) and level of significance (Q)

Table 7 shows univariate analysis of variance of the tests of motor abilities by comparison of the results of arithmetic means between the exsperimental and control groups in the final measurement. On the basis of the coefficient of F-relation and their significance
(P-Level) it can be conclued that there is statististically significant difference in the level of motor abilities between the exsperimental and control groups in the following motor tests: trunk lifting for 30 seconds (MDT30 .000), mixed chin-ups (MMZG .000), squats (MČUČ .000), agility in the air (MOKV .000), coordination with bat (MKOP .000) and agility on the ground (MONT .000).

4. CONCLUSION

Results of Student's T-test and cannonic discrimination analysis point out that in the final in relation to the initial measurements in the experimental group there have been observed statistically significant changes in motor abilities.

Results of the multivariate analysis of variance show that there are differences between the exsperimental and control groups in the final measurement in motor abilities.

In the line of all above said it can be concluded that the program for the correction and rehabilitation of the kyphotic bad body posture, during the classes of corrective gymnastics, which has lasted for two months, with the frequency of three classes of exercising a week, has indeed brought about positive changes in the level of motor abilities.

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