ADAPTIVE PHYSICAL ACTIVITY AND SPORT IN 15-YEARS OLD STUDENTS WITH THORACIC DEFORMATION

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INTRODUCTION: In the conditions of modern life, the problems of improvement of the health of pupils by means of physical education are extremely important. The low motor activity together with bad body position and gait are among the most important etiological factors for the appearance of abnormal spinal curvatures. For many decades, different authors have tried to uncover the secrets of spinal abnormalities and to find the best methods and tools for their early and secondary prevention. A unified set of methods for treatment of abnormal spinal curvatures in its conservative, orthopedic or surgical modalities is still nonexistent at the world scale. Many authors admit that asymmetrical load, weakness and easy fatigue of the neuromuscular system are the reason for the formation of flawed posture, which can serve as an unlocking mechanism for structural scoliosis [5,6]. Others consider heredity to be an etiological factor [8,9]. According to them, the predisposition to the disease is congenital, but the deformations appear as a result of excessive load. Good prevention of abnormal spinal curvatures requires a whole set of measures, applied in both home and school environments [3].

One of the main tasks of adapted physical activity and sports (APAS) is achieving a more intense regime of children and adolescents with special needs in order to improve their functional and physical status. According to W. Bunnel (1979), an indication for conservative treatment is a deformity up to 20˚ [4]. A lot of authors [7,2] communicate their experience in applying regulated swimming in the complex therapy of children with scoliosis and flawed posture (kyphosis).

The purpose of the study is to develop and test a specialized motor program for treatment of spine deformations in the frontal plane, which will be applied in the work with 15-years-old pupils beyond school hours.

METHODS: The study sample consisted of sixteen 15-years-old pupils having C-shape thoracal scoliosis, evenly distributed according to gender (TG – test group). The control group (CG) included 12 pupils (6 girls and 6 boys), who took part only in physical education and sports classes 3 times a week at Secondary School.

The monitoring included observation, body height in erect position (cm), length of lower extremities (cm), Hirtz II (difference in the rib cage circumference at the level of the mamilla at maximal inspiration and expiration in cm), Ott test for mobility of the thoracic spine in cm, body weight (kg), tests for dynamic strength endurance of back, abdominal, and pelvic muscles until failure [1], ischiocrural muscles tone and shortening (score) and X-rays examination to determine the top of the deformity curve and the degree of back deformation – Cobb method.
Pupils in the both groups took classes of physical education and sports at school 3 times a week. For experimental group APAS program completed with a selective therapeutic massage of the back, gluteal and abdominal muscles, correction exercise program (active exercises from different initial positions; stretching and postisometric relaxation for shortened muscles; exercises using specialized gymnastic tools and equipment; isometric exercises; breathing and relaxation exercises – Table 1) – three times per week and swimiing – two times per week.

RESULTS: The final study of Hirtz II (difference in chest circumference at maximal inspiration and expiration in cm) shows an average increase 1,46 cm for control group and of 1,95 cm for test group. The better results of the test group show that APAS practice three times a week improves the functional capacity of chest muscles, which also has favorable influence on lungs volume.
The mobility of the thoracic part of the vertebral column is indicative of the functional state of the spine. The increase for this indicator is 0,93 cm for the test group and 0,50 cm for the others. APAS practice improves spine mobility to a greater extent than the routine workload in physical education classes. Data from this test show the advantages of regular and targeted correction exercieses.
The balance between their tone of static and dynamic muscles ensures good stabilization of the pelvis, providing the support for the spine and being a precondition of good body position. The test positions for measurement of dynamic power endurance are also initial positions in the performance of exercises improving the tone of the respective muscle group. This test measures the capacity of performing a certain number of repetitions of movements done by different muscles. The movements are performed at a rate of 1 second for the movement and 1 second – return to initial position. The results for dynamic power endurance of abdominal, back, pelvic and hip muscles are presented in Table 2.
The better power endurance of abdominal muscles of pupils in the test group contributes to a higher degree to decreasing the dorsal rotation of pelvis. This results in lower hypertone of muscles in the lumbar spine and better body position of pupils.
The application of manual soft-tissue mobilisation techniques in combination with isometric and general exercises improve dynamic power endurance to a greater extent than exercises during physical education classes. The progress for the test group is 13,79 repetitions more at the end of the monitored period, and for the children of the same age in the control group – an increase by 10,71 repeated movements. Stronger back and abdominal muscles improve the static position of the vertebral column, regulate the load during motion and rest, and contribute to the decrease of deformations in the frontal plane.
Testing pelvic and hip muscles uncovered the same trend as for abdominal and back muscles. The initial tests exhibit similar values for both groups. On both the homolateral and the contralateral side of the convexity, the increase is lower in the control group. On the deformation side, the difference is 4,36 repetitions in favor of the test group, and on the opposite side – 10,52 repetitions more.

DISCUSSION: The control group started with an average deformation of 13,17° in the frontal plane, while test group had 13,51° scoliosis. After the performed APAS practice in the

test group, the deformation was reduced by 8,87° reaching the value of 4,64°. There is also a reduction in scoliosis for the control group, but it is 3,50° and the reached value is 9,67°. Participation in physical education classes results in overcoming hypodynamy and increases the functional capacities of pupils, influencing favourably the degree of spine deformation. The better results of the test group (the difference in spine deformation reduction between the two groups is 5,03° in favour of test group) prove the necessity of involving pupils with spine deformations in specialized APAS session out of school.

CONCLUSION: The APAS program resulted in more significant growth in the values of the main anthropometric indicators characterizing physical development as body height and weight.

The improvement of the locomotor system function and the restored vertebrae joint play increase the possibilities for correction of the spine deformation, which was higher by 5,03° on average for the test group during the 7-months period monitored by us.

The application of static and pelvic/back stabilization exercises increases the strength of the weakened muscles and their dynamic power endurance.

The correct performance of exercises, the improved muscle balance and the education of patients for proper body position resulted in corrective action on the static and dynamic position of the body.

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Table 1

Procedure structure

Parts	Content	Timing	Instructions	Tasks
Intro-ductory part	Selective therapeutic massage of the back, pelvic and abdominal regions, combined with manual mobilisation of the thoracic segment.	10 – 15 min	For parts with high muscle tone, the massage is relaxing and for regions with low muscle tone - stimulating.	To regulate the muscle tone and to prepare the body for the upcoming effort.
Main part	Exercises for the vertebral column and adjacent joints – with, without specialized equipment and on such equipment; isometric exercises; PIR and stretching of the shortened muscles; general strengthening exercises, breathing and relaxation exercises.	35-40 min	The exercises are performed from different initial positions (mainly supine, knees bent, feet placed on the floor; kneeling; sitting, etc.). They are performed at maximum range of motion and are combined with breathing.	To improve blood circulation, trophism and mobility of the vertebral column in its thoracic section. Relaxing static and strengthening dynamic muscles, increasing vital capacity.
Conclu-ding part	Exercises for correct body position, good walking posture and autorelaxation.	5 - 6 min	Exercises are performed slowly. Participants are advised to make pauses and to stay in horizontal position after the procedure.	Recovery and calming children emotionally.

Table 2

Dynamic power endurance (numbers)

Group	Muscles / Score	Abdominal muscles	Back muscles	Pelvic and hip muscles	
				Homolateral	Contralateral
Control Group n=12	$\overline{X}_1$	12,69	7,55	16,88	17,79
	$\overline{X}_2$	27,02	18,26	26,59	28,09
	$d = \overline{X}_2 - \overline{X}_1$	14,33	10,71	9,71	10,30
Test Group n=16	$\overline{X}_1$	12,81	8,91	14,49	18,59
	$\overline{X}_2$	31,04	22,70	28,56	39,41
	$d = \overline{X}_2 - \overline{X}_1$	18,23	13,79	14,07	20,82