INFLUENCE OF THE EXERCISES WITH SPORTS HAMMOCK ON FUNCTIONAL DURABILITY OF THE POSTURAL STABILITY MUSCLES

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ABSTRACT

INTRODUCTION: “Good posture” is the position of the body that imposes minimal stress on muscles and negligible load on joints in order to maintain balance. This is achieved by keeping the muscle balance necessary for proper development and functioning of the locomotor system.

AIM: The aim of this study is to determine the influence of exercising with sports hammock on functional endurance of the postural stability muscles.

MATERIALS AND METHODS: The survey was conducted between February 2014 and December 2015 among 200 children aged between 5 and 7 years in the city of Varna. The test of Matthiass, the test of Kiel and the test of sustained balance were used for the assessment of the functional endurance at the beginning as well as at the end of the survey. For one half of the children (n=100), exercising with sports hammock was applied, while the rest of the children remained as a control group. Descriptive methods and hypothesis testing (Student's t-test) were used for data analysis.

RESULTS AND CONCLUSIONS: The differences between the initial and final means in all tests of endurance for the children of the intervened group are positive and statistically significant, i.e. all the tests demonstrate improvement ($p < 0.0001$). Upon completion of the test of Kiel on static and strength durability of the abdominal muscles the best improvement is observed in the experimental group (exercises with sports hammock): +0.94 seconds ($p < 0.0001$). The improvement is significant also in comparison with the results of the children from the control group.

Keywords: sports hammock exercising, functional endurance, postural stability muscles

INTRODUCTION

To maintain the body balance in the correct posture minimum stress of the muscles and slight load of the joints are required. This is achieved thanks to the muscle balance, which is needed for the proper development and functioning of the mus-

culoskeletal system. Body posture is formed from a very early age. It is determined by the position of the head, shoulder region, lower extremities, lean of the seat and most of all by the configuration of the vertebral column. Human posture is subject to change throughout the entire life. This is observed mainly through the periods of dynamic development (17,19) and is explained by the changes in the body dimensions and its proportions. In the opinion of many authors, the increasing trend toward hypodynamia also leads to distortions of the posture (8-12,16). The consequences thereof are expressed in the inharmonious development of the locomotor system, as a result of

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which orthostatic defects which are deemed to be a growing problem for the public health occur (14,21). If ignored and not treated, these defects can turn into spinal and chest deformities (10), which affect the psychological health of the children - they often refuse to accept their body image (14). In the course of time, complaints of pain, which often restrict the daily physical activity, occur (18).

This is the main reason to focus the attention on the development of correct posture and on the prevention of postural disorders in preschool children. For this purpose, remedial gymnastics is recommended to improve the muscle balance and to provide the best conditions for development of the locomotor system. The targeted physical exercises can strengthen the muscles of the shoulder region, back, abdomen and lower extremities and the muscles, which participate in the respiratory process (5-7). The programmes should include isotonic and isometric exercises to increase the strength and durability of these muscles and the balance durability as well. To motivate the children to perform the exercises correctly, it is preferable that the exercises be of a game nature. In compliance with these recommendations, we created and implemented author's methods - exercises with sports hammock. Being in the sports hammock, the child's body is unstable. The lack of controlled stability and the new and different postures and sensations of the body in space facilitate the improvement of the balance and stimulate the axial muscles (1,2). In addition, the rough movements are developed, while the fear of falling from heights is reduced. This facilitates the correction in the three planes (3D correction).

The literary sources do not contain information on any scientific research, which proves the effectiveness of the exercises with sports hammock, in particular for the prevention of spinal deformities. In his article, P. Raimondi mentions of a pilot project implemented in 2006 named Discipline Aeree per la Colonna Vertebrale on performance of acrobatic displays on trapeze and ropes as a therapy and preventive therapy of scoliosis in adolescents. However, the article describes neither the study design, nor the results of its conduct (13). Unlike trapeze exercises, the exercises with sports hammock are completely safe and can be applied to preschool children. We were provoked by the great interest of the children and by

the unique opportunities which the sports hammock provides through its unstable base and inverted postures, which are deemed to be suitable postures for decompression of the vertebra.

The purpose of this study is to establish the influence of the exercises with sports hammock on the functional durability of the muscles which stabilise the posture.

MATERIALS AND METHODS

The study was conducted in the period February 2014 - December 2015. It involved 200 children aged 5 - 7 from the city of Varna. The children were divided into two groups. The experimental group (EG; $n=100$) performed combination of exercises with sports hammock within four months, while the other half of the children were part of a control group (CG) of the intervention group. Since the children of the EG were beginners, we provided two sub-periods:

- ✧ preparatory period with duration of one month during which the children became familiar with the hammock and exercises;
- ✧ basic training period with duration of three months.

To evaluate the functional durability we conducted (3,4):

- ✧ the test of Matthiass,
- ✧ the test of Kiel,
- ✧ the balance durability test, both in the beginning and at the end of the study.

To analyse the data we used descriptive methods and methods of testing the hypotheses (Student's t-test).

RESULTS AND DISCUSSION

More than a half, 105 (52.5%), of the total number of children involved in the study were girls and 95 (47.5%) were boys (Table 1).

Upon completion of the descriptive analysis we did not find any significant difference in the initial results of the functional tests.

The results of the test of Matthiass showed reduced durability of the posture in the children from the two groups. In the children from the EG, the mean values at the beginning of the study were 19.91 seconds ($SD\pm 0.41$), while those observed at the end of the study were 20.59 seconds ($SD\pm 0.37$). Im-

Table 1. Distribution of the children in the two study groups broken down by sex

Girl		Sex		Total
		Girl	Boy	
Experimental group (with sports hammock)	Number	49	51	100
	% in the study group	49.0	51.0	100.0
	% by sex	46.7	53.7	50.0
Control group	Number	56	44	100
	% in the study group	56.0	44.0	100.0
	% by sex	53.3	46.3	50.0
Total	Number	105	95	200
	% in the study group	52.5	47.5	100.0
	% by sex	100.0	100.0	100.0

provement of 0.68 seconds was observed in the four-month period. The difference between the initial and final mean values for the same period reported in the children from the CG was 0.10 seconds (Table 2).

The preservation of the correct posture and control of the body in space are based on the good balance durability, which must be developed from early childhood. The balance durability test showed poor results at the beginning of the study in the two groups. The initial mean values measured in the children of the EG were 2.82 seconds (SD±0.15), while the final ones were 3.70 seconds (SD±0.11). After application of the methods, the results obtained upon completion of this test were improved – 0.88 seconds. For comparison, the values obtained in the children of the CG were 4.81 seconds (SD±3.58), at the beginning of the study and 5.22 seconds (SD±3.27) at the end of the study (Table 2).

We used the test of Kiel to objectivise the durability of the dorsal muscles. The test helped us to evaluate the dynamic and strength durability (DSD) and static and strength durability (SSD) of the abdominal and dorsal muscles. The improvement of DSD of the abdominal muscles per number of repetitions was 0.80 in the children of the EG, while the change in the children of the CG was 0.05 number of repetitions during the research period. The difference in the final and initial test mean values for the dorsal muscles in the children of the EG was considered to be an improvement of 0.67 number of repetitions, while in the children of the CG 0.14 number of repetitions were reported.

The results of the abdominal muscles SSD test in the children of the EG were improved at the end of the study - 0.94 seconds. Those reported in the children of the CG improved as well – 0.05 seconds. The

Table 2. Comparison of the initial and final results obtained upon completion of the tests of Matthiass and balance durability (Paired Samples T-Test).

Test result Mean		Experimental group (n=100)			Control group (n=100)			Δx ($x_1 - x_2$)		Between the study groups
		SD ($\pm$)	SE Mean	Mean	SD ($\pm$)	SE Mean	Exper- imen- tal group	Con- trol group		
Test of Matthiass	Final result - x_1	20.59	0.37	3.74	16.25	5.03	0.50	0.68*	0.10†	<0.005
	Initial result - x_2	19.91	0.41	4.12	16.15	5.20	0.52			
Balance durability	Final result - x_1	3.70	0.11	1.12	5.22	3.27	0.33	0.88*	0.41*	<0.0005
	Initial result - x_2	2.82	0.15	1.45	4.81	3.58	0.36			

P for ΔX final and initial result in each of the study groups: * $p < 0.0001$; † $p < 0.05$

following changes measured in seconds were reported in the dorsal muscles testing: EG - 0.71; CG - 0.12 (Table 3.).

The results of the functional tests of the initial examinations showed reduced muscle endurance in

The exercises with sports hammock influenced positively the functional durability of the muscles, which stabilise the posture in preschool children and are effective for prevention of postural disorders and spinal curvature.

Table 3. Comparison of the initial and final results of the test of Kiel on DSD and SSD of abdominal and spinal muscles (Paired Samples T-Test)

Result of the test of Kiel Mean		Experimental group (n=100)			Control group (n=100)			Δ x ($x_1 - x_2$)		Between the study groups
		SD ($\pm$)	SE Mean	Mean	SD ($\pm$)	SE Mean	Experi- mental group	Con- trol group		
DSD of the abdominal muscles	Final result - x1	17.51	0.24	2.46	17.26	7.42	0.74	0.80*	0.05‡	<0.0001
	H.P.- x2	16.71	0.32	3.17	17.21	7.50	0.75			
DSD of the spinal muscles	Final result - x1	17.26	0.32	3.19	14.41	7.63	0.76	0.67*	0.14†	<0.0005
	H.P.- x2	16.59	0.37	3.72	14.27	7.81	0.78			
SSD of the abdominal muscles	Final result - x1	14.38	0.47	4.25	15.07	6.80	0.68	0.94*	0.05‡	<0.0001
	H.P.- x2	13.44	0.53	5.25	15.02	6.88	0.69			
SSD of the spinal muscles	Final result - x1	14.24	0.41	4.05	9.48	3.32	0.33	0.71*	0.12†	<0.0005
	H.P.- x2	13.53	0.48	4.84	9.36	3.48	0.35			

*P for ΔX final and initial result in each of the study groups: * $p < 0.0001$; † $p < 0.05$; ‡ $p > 0.05$*

the children. They are probably due to the reduced motor activity of the children.

After the application of the methods, the difference between the final and initial mean values for all durability tests in the children of the EG (n=100) were positive and statistically significant, i.e. there was an improvement in all tests ($p < 0.0001$). The best improvement was observed upon completion of the test of Kiel on static and strength durability of the abdominal muscles: + 0.94 seconds (Table 3) and + 0.88 seconds (Table 2) upon completion of the balance durability test.

In the children of the CG the change of the results was also observed at low absolute values of the differences (0.05 to 0.41 sec) and was statistically significant ($p > 0.05$ in the test of Kiel on DSD and SSD of the abdominal muscles). It is appropriate to examine the effect of the methods for a longer period of time.

CONCLUSION

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