ADAPTED PHYSICAL ACTIVITY IN CHILDREN WITH KYPHOSIS POSTURAL DISORDERS

Velichka ALEKSANDROVA, Stoyan BAHCHEVANSKI, Zuzana KORNATOVSKA

Abstrakt
Incorrect body position will produce lasting side effects. One of the conditions for the right posture is keeping straight. The complexity of the problem is determined not only by the widespread prevalence of the disease affecting the child's organism. The aim of the present study is to analyse the impact of the adapted physical activity and aqua gymnastic on the proper body posture, physical development and psycho-emotional state of children with kyphosis postural disorders. The material of study consisted of 14 children (7 males, 7 females in the age interval 8 – 12 years, age average 10.2) selected in experimental sample (ES) and control sample (CS). It was applied the aqua-gymnastics intervention as the main methodological tool to restore the correct body posture, during standing position and during walk, in the experimental sample. The applied intervention can be recommended to experts working with children as physiotherapists, coaches, health educators.

Keywords
Adapted physical activity; vertebral distortion; aqua-gymnastics.

INTRODUCTION

The correct posture is too important for the normal function of the motor system. The meaning of the correct posture is multidimensional. It helps for the proper development of the human body in childhood when this population experience the most numerous cases of spinal distortion (Isaeva 1998; Georgieva, Kutincheva, Nikolova et al 2018).

Failure to observe the correct position of the body will produce lasting side effects. One of the conditions for the right posture is keeping straight. It is formed from early age in every person (Karakashov 1995; Nikolova, Aleksandrova, 2011). The complexity of the problem is determined not only by the widespread prevalence of the disease affecting the child's organism but also by the subsequent disturbances in the functions of all important organs and systems (Mitova 2014). A major factor in overcoming the negative phenomena is participation in systematic sport activities, exercise and motor activities with healing and prophylactic focus. They are a means of expanding the body's adaptive capabilities, physical and functional development, and the acquisition of motor skills and habits (Thenapa 2003; Mitová2014).

2 PURPOSE, HYPOTHESES

2.1 Purpose

The aim of the present study is to analyse the impact of the adapted physical activity and aqua gymnastic on the proper body posture, physical development and psycho-emotional state of children with kyphosis postural disorders.

2.2. Hypotheses

On the base of the determinate purpose follow hypotheses were selected.
Hypotheses H1: After the intervention in the children of ES will be significant positive difference in the parameter “Strength of back muscles” comparing to the children of CS.

Hypotheses H2: After the intervention in the children of ES will be significant positive difference in the parameter "Strength of abdomine muscles" comparing to the children of CS.

3 METHODS

3.1 Material and organization of the study

The material of study consisted of 14 children (7 males, 7 females in the age interval 8 – 12 years, age average 10.2) from the metropolitan school in Sophia with diagnosis of established spine distortions – kyphosis. All experienced individuals included in the investigation did not have swimming skills and do not actively engage in sports. On the base of random choose two samples were selected for the investigation – experimental sample and control sample.

- Experimental sample (ES) consisted in total of 7 children. This group uses the developed methodology of the adapted aqua gymnastic technique for vertebral distortion - kyphosis in children in extracurricular activities.
- Control sample (CS) consisted in total of 7 children. They use the standard corrective gymnastics (CG) methodology for the kyphosis postural disorders in extracurricular activities.

The aqua gymnastics in the experimental group was held twice a week for 60 minutes in an indoor swimming pool with a depth of 100 cm - 135 cm, water temperature of 27-28 ° C, in the sports centre in Sofia.

The standard corrective gymnastics in the control group was conducted according to a standard methodology, twice a week for 45 minutes at the physical education gymnasium of the Sophia secondary school under the guiding of a physiotherapist. The aim of the standard recurrent gymnastics methodology is to maximize the functional state of the spine and proper body posture.

3.2 Methodology

In the study pedagogical experiment was used as the main methodological tool, including following scientific methods:

- Intervention
- Diagnostics and testing;
- Statistics;
- Results analysis.

3.2.1 Intervention

The purpose of the aqua-gymnastics intervention methodology was to influence the kyphosis deformation and to restore the correct body posture, during standing position and during walk, in the experimental sample.

The curriculum of the intervention consisted of:

- Generalised exercises and remedial exercises;
- Specialized breathing exercises;
- Instructions for self-control in working process.

For the purpose of the study, the commonly used lesson scheme was used: preparatory warming up part (on land 5 - 10 min), main corrective part (in water 35 - 40 min) and final calming down part (in water 5-10 min).

In total of 70 activities were planned, divided into the three stages:

I. First stage – Preparatory phase

The physiological and psychomotor adaptation to the aquatic environment was carried out in this stage. The main tasks at this stage were: general physical development, acquisition of a motor habit in the water, impact on the functions of the respiratory and cardiovascular system.

II. Second stage – Basic phase

An important place in the process of physiological adaptation occupied the functional capabilities of the cardiovascular system, the tolerance to physical exercise, the capabilities of the musculoskeletal apparatus (muscle strength, movement coordination and

physical qualities), and psychomotor adaptation.

III. Third stage – Final phase

During this stage the strengthening of the motor habit, the positive results achieved and the improvement of the function of the breathing apparatus and the correct kineastatic representations for proper body and gait are achieved.

3.2.2 Diagnostics and testing

To determine the physical development, functional status and capacity and the effectiveness of the therapeutic effect on the kinetic deformation, a total of 7 indicators can be measured / tested twice (at the beginning and at the end of the study), which can be differentiated into three groups for: of kyphosis deflection; physical development; the physical ability of the experimental and control group experienced.

3.3.3 Statistics

After the applied statistical computer processing we can analyse the working material of our study. To objectify the results of the experiment, the data were systematized and subjected to variation and comparative analysis.

4 RESULTS ANALYSIS AND DISCUSSION

In the Table 1 the comparison of the respective mean values by variables for the experimental group - PRE and POST is presented.

Table 1 Comparison of mean values by variables for the experimental sample - PRE and POST

№	MARKERS	PRE	POST	p	t-criterion	
1	Magnitude of the kyphosis deformation	26.71	25.29	-1.429	1,244	-
2	Height of kyphosis	32	32,85	0,857	3,286	+
3	Mobility of Thoracis spine	1,5	2,31	0,814	4,240	+
4	Flexibility of the chest	4,4	5,61	1,214	6,879	+
5	Strength of back muscles	37,14	47,86	20,714	8,148	+
6	Strength of abdominal muscles	28,29	35,14	16,857	3,905	+
7	Complex assessment of shortened sciatic musculature	6,67	1,67	5,000	3,130	+

Here, it is clear that only the first indicator, namely the magnitude of the deformation t - the Student criterion is 1.244 i.e. under 2.45. Therefore, this indicator has no credible growth. The remaining metrics have values above 2.45 and hence the conclusion that they have a significant difference between the PRE and POST metric results.

Table 2 shows the comparison between the mean values for variables for control group - PRE and POST of the presented study.

№	MARKERS	PRE	POST	p	t-criterion	
1	Magnitude of the kyphosis deformation	26	26,43	0,429	0,411	-
2	Height of kyphosis	35,57	36,21	0,643	1,890	-
3	Mobility of Thoracis spine	1,14	1,21	0,071	0,420	-
4	Flexibility of the chest	3,33	3,59	0,257	2,030	-
5	Strength of back muscles	19,43	34,28	14,857	4,211	+
6	Strength of abdominal muscles	13,29	29,29	16,000	8,523	+
7	Complex assessment of shortened sciatic musculature	6,43	2,14	-4,29	3,133	+

Here, the mean values of the studied indicators showed that only the strengths of the abdominal and muscular abdomen were 4.211 and 8.523, respectively, as well as the complex assessment of the shortened sciatic musculature – 3.133, respectively over 2.45. These results are in line with conclusions of Rehor, Kornatovska (2013) in adolescents, that effective stretching is necessary before strengthening the abdominal muscles. Such effective stretching exercises and postures we can find in Maheshwarananda (2000), especially then in the modification for children (Maheshwarananda, 2014).

The remaining indicators are below 2.45 and therefore have a negligible difference between the initial and the final results.

Here, however, it should be noted that for the mobility of a vertebral column (2.03) and a height of the kyphosis (1.89), the results are quite close to the critical point of 2.45 for the credibility of the growth.

Comparative analysis of the growths of the two groups revealed whether there was a true difference between the growth of the experimental and control groups. For this purpose, we used the Student t-criterion for independent sampling. At a dependency level $\alpha = 0.005$, we obtained $t = 2.18$.

When comparing the results of the measurement of the deformation value of the students from the two groups at the start of the experiment no statistically significant difference was found.

When comparing the endpoints with the initial results of the size of the distortion in the control group it was found that in the final study it had an increase of 0.429 at t-0.41.

Analogous activity in the experimental group showed an increase in the test indicator - 1.429 at t -1.26. The value is much better than the control group. Despite the optimal effect achieved, the result is statistically unreliable.

This is due to the much reduced functionalities of the spine for correction imposed by the pathological deformation. The available muscular asymmetry in combination with rigid and insensitive paravertebral muscles further complicates the correction work. (Figure 1).

Figure 1 Dynamics of the parameters “Magnitude of the kyphotic deformation” in the PRE and POST phases of the experiment in ES and CS (n=14; 7 males, 7 females).

Figure 1 Dynamics of the parameters “Magnitude of the kyphotic deformation” in the PRE and POST phases of the experiment in ES and CS (n=14; 7 males, 7 females)

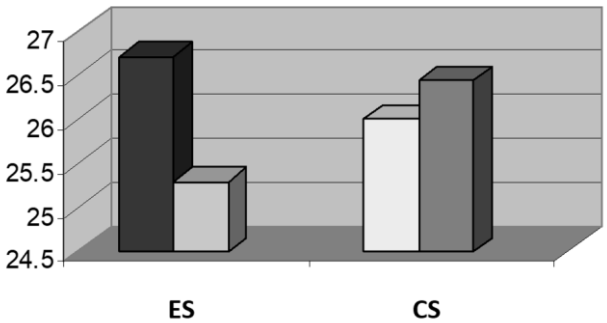
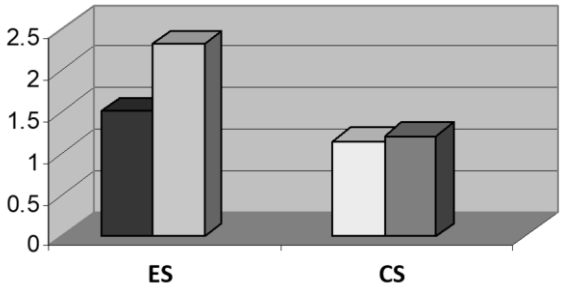


Figure 2 Dynamics of the indicator "Height of kyphosis" in ES and in CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females)



Comparing the initial results of the height of the puppies of the experimental and control group, it was found that the differences in the values were insignificant. When comparing the POST results to the PRE results in the control group, an increase of 0.643 was recorded. It declares the resolution that the PRE – POST difference in the control sample is not significant (final t=1.89, i. e. statistically unreliable difference).

The results obtained in the experimental sample showed an increase of 0.857 with a statistically significant difference (t = 3.286). Comparing the values obtained at the end of the experiment of the contingents from the two groups, a significant difference in the growth of 0.214 was found for the benefit of the experimental group.

The increased magnitude of the deformation in the final study of the students in the experimental group gives us reason to assume that correctly dosed and time-allocated aqua-exercises, PEP of the pectoral muscles, muscular trapezius and pelvic muscularity combined with isometric strength training of the body extenders are have favourably influenced the spine's functional ability in the direction of delaying and stopping the process of fixation of the kinetic deformation. (Figure 2).

Figure 2 Dynamics of the indicator "Height of kyphosis" in ES and in CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females)

The data from the initial values of the mobility of the spine in the chest show a deficit in this indicator. In both groups the magnitudes are insignificant and unreliable.

When comparing the endpoints with the initial results in the control group, a 0.071 increase was observed at t-0.420.

The increased mobility of the spine in the final study of the students from the experimental group gives us reason to assume that: the chest motorization in combination with the swelling exercises and the PIR of the shortened muscles have favourably influenced the muscul-ligational complex, which to a considerable extent his movements have improved (Figure 3).

Figure 3 Dynamics of the indicator "Flexibility of the chest" in ES and CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females)

Similar is the interpretation and analysis of the results of the chest motility study. For this indicator, the increase in the control group was 0.257 at t-2.03 versus 1.214 at t-6.873 for the experimental group.

The obvious difference in favour of the experimental group is a logical result of the application of the aqua-gymnastics methodology (Figure 4).

Figure 4 Dynamics of the "Mobility of Thoracis spine" indicator in ES and CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females)

Particularly reliable and credible are the results of the ultimate muscle strength research of the paravertebral muscles. In the final study, the growth rates were as

follows: in the experimental group – 20.714 with t-8.148 and for the control group – 14.857 with t-4.211. Again, better results are recorded in the ES. The difference in the positive increasing level between the two samples could be explained by the application of aqua-exercises for relaxation in ES (Figure 5).

Figure 5 Dynamics of the indicator "Strength of back muscles" in ES and in CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females).

Figure 3 Dynamics of the indicator "Flexibility of the chest" in ES and CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females)

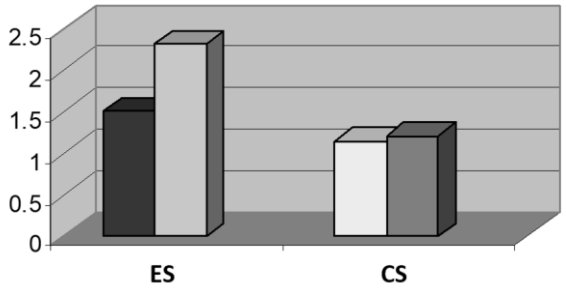


Figure 4 Dynamics of the "Mobility of Thoracis spine" indicator in ES and CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females)

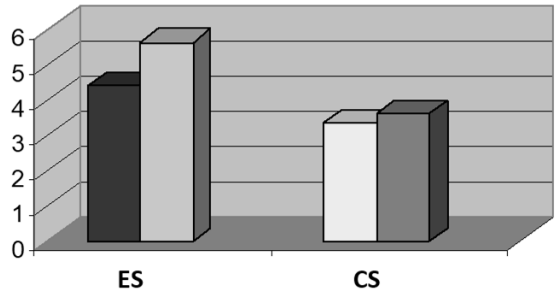
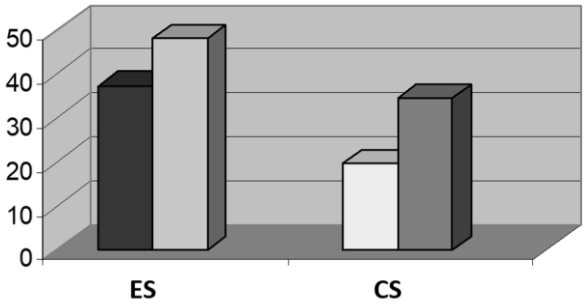


Figure 5 Dynamics of the indicator "Strength of back muscles" in ES and in CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females)



Experimental studies on abdominal muscle strength showed that differences in mean values were significant and reliable.

When comparing the data obtained, it is known that the growth rate in the EI index was 35.14s, while at CS it was 29.29s.

The difference between the two increases is clear in favour of ES. It can

be explained by the properly developed methodology. (Fig. 6).

Figure 6 Dynamics of the indicator “Strength of abdominal muscles” in ES and in CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females)

From the comparative analysis, the t - criterion (3,130 for ER and 3,133 for KG) is above the level of significance, therefore there is a credible increase.

The increase in EQ (5.00) most clearly shows the influence of the aqua - gymnastics on decreasing the degree of shortening of the nasocorrural musculature and the adequacy of the applied agents (Figure7).

Figure 7 Dynamics of the indicator “Complex assessment of shortened sciatic musculature” in ES and in CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females).

Figure 6 Dynamics of the indicator “Strength of abdominal muscles” in ES and in CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females)

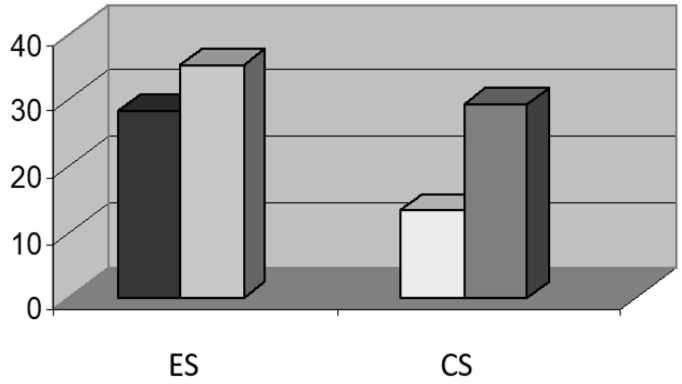
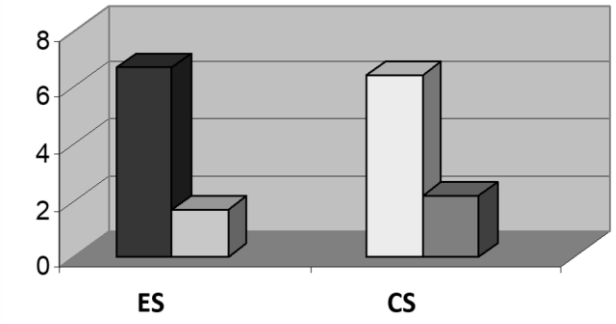


Figure 7 Dynamics of the indicator “Complex assessment of shortened sciatic musculature” in ES and in CS in the PRE and POST phases of the experiment (n=14; 7 males, 7 females)



These results correspond with analysed results of experts in physiotherapy as (Zlatkova, Savov, Ivanov, 1998, Jandová, Formanová, Morávek 2018). It seems that main determinant in this context represents breathing-exercises synchronizing. According the output of Krejčí, Tuli, Krásová (2014) it may play the crucial goal.

5 CONCLUSION

The both formulated hypotheses were verified. The applied intervention on base of Aqua gymnastic can be declared as high effective in children. The applied intervention can be recommended to experts working with children as physiotherapists, coaches, health educators, etc. On the basis of the

research carried out the following conclusions can be drawn:

1. The comparative analysis between the experimental and the control group shows the positive therapeutic effect of the adapted physical activity and the aqua gymnastic in the experimental group (EG) as well as the standard methodology in the control sample (CS) at the end of the study for influencing the kinetic deformation.
2. On the basis of the results obtained and the statistical analysis, we found a significant increase in the mean changes in some of the endpoints tested, relative to the start of the experiment in favour of the experimental group (compared to the control group) due to the applied methodology in aqua-gymnastics. For other indicators, although there is a significant change, there is no statistical reason to claim that it has occurred as a result of the applied methodology.
3. The conducted pedagogical experiment gives us reason to recommend the aqua-gymnastics and the adapted physical activity for the prevention and treatment of the postural kinetic deformations in the school and out-of-school activities.

REFERENCES

Georgieva, A., P. Kutincheva, M. Nikolova et al. (2001) Лечебно плуване при деца със сколиоза първа степен. В: сб. Спорт, Общество, Образование (Healing swimming in children with first degree scoliosis). *Спорт, Общество, Образование*. NSA PRESS.

Isaeva, L. (1998) *Физиология на ранната детска възраст*. Sophia: Sport Academy V. L.

Jandová, D., Formanová, P., Morávek, O. (2018) Výzkumná analýza dysfunkcí pohybového systému prostřednictvím Computer Kinesiology. In: Krejčí, M., Tilinger, P., Hošek, V., et al. *Výzkum adekvátního pohybového režimu v konceptu wellness*. Praha: Vysoká škola tělesné výchovy a sportu.

Karakashov, A., et al. (1995) *Вродена съединително-тъканна малостойност (Congenital connective tissue abnormalities)*. Sophia: Sport Academy Vasil Levski.

Krejčí, M., Tuli, K., Krásová, B. Stress management in young female sportsmen through breath and movement synchronizing*. Acta Salus Vitae*. 2014, 2 (1):40-51. ISSN 1805-8787.

Maheshwarananda, P.S. (2000). *Yoga in Daily Life – The System*. Vienna: European University Press.

Maheshwarananda, P.S. (2014). J*óga v denním životě pro děti a mládež*. (Yoga in Daily Life for children and youth). Praha: Mladá Fronta.

Mitova, S. (2014) Screening posturálních deformací muskuloskeletálního systému u dospívajících. Vědecké práce na RUŠ, SNA-2014, svazek 53, série 8.1, 99-102.

Nikolova, M., Aleksandrova, V. (2011) Въздействието на плуването върху 7-8 год. деца с гръбначни изкривявания – сколиоза първа степен. (The impact of swimming on 7-8 years of children with spinal distortion - first degree scoliosis). *Сп. Физичка култура*, No 2, pp68-81.

Mitová, S. (2014) Screeningové studie posturálních poruch a vertebrálních deformací u dětí. Sbírka souhrnů 15. Studentská vědecká konference "Kinesiterapie a sport" 28. dubna - Blagoevgrad, Univerzitní tisk "Neofit Rilski", Blagoevgra.

Purenović-Ivanović, T. (2017) Yoga asanas: Indications and contraindications for using in prevention and treatment of

postural deformities. *Acta Salus Vitae*, Vol 5, No 1: 45-55.

Rehor, P. R., Kornatovská, Z. (2013) Measuring of health - related benefits of physical activity in high school students. *Acta Salus Vitae*, 2013, 1 (2): 151 - 160.

Thenapa (2003) *European curriculum on adapted physical activity and sport for people with disabilities* (translation in Bulgarian). THENAPA. ADAPT CD-ROM.

Zlatkova, I., Savov, S., Ivanov, B. (1998) *Proceedings of the Scientific Conference on Sports Medicine and LFC*. Sophia: Sport Academy Vasil Levski.

CONTACTS

Assoc. Prof. Velichka ALEKSANDROVA, PhD. - Sport Academy Vasil Levski, Sophia Faculty of Physiotherapy, Touristic and Sport animation.
E-mail: vili_polito@abv.bg

Ass. Prof. Stoyan BAHCHEVANSKI, PhD. - Sport Academy Vasil Levski Sophia, Faculty of Kinesiotherapy.
E-mail: s_bahchevanski@abv.bg

Ass. Prof. Zuzana KORNATOVSKÁ, PhD, Dis. - University of South Bohemia in České Budějovice, Faculty of Education.
E-mail: zkornatovska@pf.jcu.cz