

Correction of posture disorders using methods of rhythmic gymnastics in 8-10-year-old girls

NATAL'YA MISCHENKO¹, MIKHAIL KOLOKOLTSEV², MARINA TYRINA³, NATALYA MANSUROVA⁴, ELENA CHALAYA⁵, TATIANA VRACHINSKAYA⁶, NATALYA BALASHKEVICH⁷, AIGUL ZHUNUSOVA⁸, SERGEY AGANOV⁹, MAKSIM ANISIMOV¹⁰

¹Ural State University of Physical Culture, Chelyabinsk, RUSSIA

²Irkutsk National Research Technical University, Irkutsk, RUSSIA

³Altai State University, Barnaul, RUSSIA

⁴Reshetnev Siberian State University of Science and Technology, Krasnoyarsk, RUSSIA

⁵Siberian Federal University, Krasnoyarsk, RUSSIA

⁶Immanuel Kant Baltic Federal University, Kaliningrad, RUSSIA

⁷Semey Medical University, Non-Commercial Joint-Stock Company, KAZAKHSTAN

⁸Astana Medical University, Non-Commercial Joint-Stock Company, KAZAKHSTAN

⁹GPS Emercom of Russia St. Petersburg University, RUSSIA

¹⁰Saint-Petersburg State Agrarian University, St. Petersburg, RUSSIA

Published online: April 30, 2023

(Accepted for publication April 15, 2023)

DOI:10.7752/jpes.2023.04106

Abstract:

The widespread occurrence of posture disorders in children and adolescents in many countries actualizes further search for the use of means and methods of physical culture and sports for the effective correction of spinal deformities. *Research aim.* To develop and test a method for correcting posture disorders in 8-10-years-old girls based on the means and methods of rhythmic gymnastics. *Materials and methods.* The research project was conducted for 9 months among 28 girls aged 8-10 years on the basis of a school in Chelyabinsk (Russia). According to medical records, all of them had posture disorders in the sagittal and frontal planes, were divided into CG (14 girls) and EG (14 girls). Both groups attended PE classes according to the generally accepted curriculum, 3 times a week for 45 minutes. To correct the CG girls' posture, a typical set of physical exercises designed for a special medical group was used at each lesson. In each lesson of the traditional curriculum for EG girls, a health-improving story rhythmic gymnastics was included, which was carried out for 15-20 minutes. At the beginning and at the end of the experiment, we examined the state of active flexibility of the spine, the dynamic strength of the muscles of the back and abdomen, and tested the basic motor qualities. *Results.* At the end of the experiment, EG girls showed an increase in spinal flexibility, strength of the back muscles, abdominals, and motor qualities, $p < 0.05$. The increase in the values of the indicators was significantly greater in EG girls compared to the results of CG ones. It was possible to stabilize the value of the index of the arc angle of the spinal column deformation in 78.5% of the girls in the experimental group. In the control group, the stabilization of scoliosis in girls was registered 2.75 times less often. *Conclusions.* The proposed method of correcting posture disorders using story rhythmic gymnastics expands the list of means and methods of improving children's health. The obtained effective results of posture disorders correction in EG girls allow recommending a proven method for use in educational institutions.

Key Words: physical education, posture disorders, rhythmic gymnastics, motor qualities testing

Introduction

One of the indicators of the physical development of children is the state of their musculoskeletal system (Kashuba et al., 2017; Ivanchykova et al., 2018; Metalnikov, 2020). Its correct position is evidence of the child's harmonious physical development. The analysis of scientific literature sources indicates a significant prevalence of deviations from the musculoskeletal system in children and adolescents in various countries (Balkó et al., 2017; Kashuba et al., 2019). Musculoskeletal system disorders are most often recorded during the period of intensive growth and puberty of a young organism (Metalnikov et al., 2021)

The correct formation of a child's postural status largely depends on the body muscular system development, which performs the function of a muscular corset. The ability of the muscular system to work effectively and for a long time in static mode allows maintaining the correct position of the trunk (Kotliar et al., 2019).

One of the causes of disorders in the musculoskeletal system in children is flat feet, which shifts the center of gravity of the trunk, which causes vertebral column deformation (Romanova et al., 2022a). In more

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than 90% of children, flat feet occur simultaneously with a violation of postural status. Heredity and numerous environmental factors influence musculoskeletal system disorders.

Various deviations from the child's spine negatively affect the work of the cardio-respiratory, digestive, nervous and other functional systems of the body. As a result, physical performance, cognitive abilities decrease and the quality of life deteriorates (Kozina et al., 2017; Timnea et al., 2019).

At the first stages of posture disorders occurrence, pathological abnormalities are of a functional nature and do not require surgical treatment (Metalnikov et al., 2022). Disorders in the musculoskeletal system can be effectively corrected by physical exercises with orthopedic correction (Yarmak et al., 2017; Kashuba et al., 2019). Static exercises (Kukoba, 2011), various fitness technologies (Ivanchykova et al., 2018; Chekhovska et al., 2018), Pilates (Mischenko et al., 2020b), Fitball (Mischenko et al., 2021), health-improving gymnastic exercises (Cruz-Ferreira et al., 2013), means and methods from martial arts are practised (Mischenko et al., 2020a; Romanova et al., 2022b). According to Eidelman (2020) and Grygus et al. (2020) the effectiveness of using choreography and dance tools aimed at preventing and correcting spinal abnormalities, weight loss, improving psycho-emotional state and life satisfaction is noted. Bendíková et al., (2020) proposed an effective set of physical exercises aimed at improving the dynamic function of the spine. The approbation of these exercises showed a positive result in postural disorders correction among Czech and Slovak adolescents.

The use of physical exercises to correct posture in children is aimed at developing the strength abilities of the trunk and abdominal muscles, which form the muscular corset. It is necessary to develop the flexibility of the joints and spine to correct the pathology of the postural status in children (Kashuba et al., 2019).

Primary school education is characterized by intensive growth and development of the main body systems, mental and cognitive abilities, during this period a child is socialized. Under these conditions, physical activity plays an important role in the upbringing and development of all functional systems of children's body (Butenko et al., 2017; Afanasiev et al., 2018). According to the WHO recommendation, during this age period, children's daily physical activity should be at least 60 minutes. Numerous studies by scientists indicate low rates of children's and adolescents' physical health in many countries of the world (Yang, Dong, 2017; Görner, Reineke, 2020; Nesterchuk et al., 2020). There is a low motivation of young people to physical activity, therefore, it reduces the healing effect of physical exercises (Andrieieva et al., 2020). Especially low indicators of motivation of children are registered in traditional PE classes (Galan et al., 2021).

Therefore, in the physical culture of young people, innovative means and methods of physical education have become more often used, which are of interest to those involved (Kashuba et al., 2017; Imas et al., 2018; Nesterchuk et al., 2020). The use of such innovative technologies for the correction of posture disorders is relevant (Yarmak et al., 2017; Kashuba et al., 2019). This is due to the existing gaps in the study of the issue of posture disorders prevention and correction, in particular, with the use of elements of story rhythmic gymnastics. The study of this issue makes it possible to expand the list of effective means and methods of physical culture and health measures to correct spinal deformity.

Research aim. To develop and test a method for correcting posture disorders in 8-10-years-old girls based on the means and methods of rhythmic gymnastics.

Material & methods

The experimental project was carried out for 9 months (September 2020 - May 2021) on the basis of a secondary school of the Siberian Federal District (Russia). 28 girls aged 8-10 (9.3 ± 1.4) were selected to participate in the project, who, according to medical records, had posture disorders in the sagittal and frontal planes (round, round-bent back, flat, flat-bent, scoliosis of I - II degree). Taking into account the diagnosis of posture disorders, the girls were divided into control (CG, $n = 14$) and experimental groups (EG, $n = 14$).

Girls of both groups attended PE classes according to the generally accepted curriculum (Lyakh, Zdanevich, 2013), 3 times a week for 45 minutes. In each lesson of the traditional curriculum of EG girls, recreational story rhythmic gymnastics was included, which was also carried out for 15-20 minutes at each lesson. It presented the complexes of gymnastic, acrobatic and dance health-improving exercises proposed by us, performed in concert to rhythmic music according to the plots selected by us from cartoon films and fairy tales. The peculiarity of rhythmic gymnastics exercises is that it allows performing the correct positioning of the upper and lower limbs, maintain a straight posture, the correct line of poses and body positions, collected hands and gracefully own your body. The complexes of story rhythmic gymnastics were replaced every month with new ones, which created a high emotional uplift and interest in children. The training lesson at EG consisted of an introductory part (7-8 minutes), the main part (30-33 minutes) and the final part (5-7 minutes). In the introductory part of the lesson, walking, running, jumping, hopping, «scattered» formation and general developmental exercises were used. In the main part of the lesson, sets of exercises of story rhythmic gymnastics were used, aimed at correcting posture disorders. The final part of the lesson included exercises to relax muscles, restore breathing and cardiac activity.

High-stakes testing of the girls' in both groups spine flexibility was carried out («body bent forward from a standing position on a gymnastic bench», cm and «vertebral column bending to the side», cm). The static

and dynamic strength of the back and trunk muscles were evaluated («the time of holding the body trunk in a horizontal position lying on the hips», s; «lifting the trunk from the supine position to the sitting one in 30 seconds», number of times). To assess the level of physical fitness, such motor tests were used: «run at a distance of 60 m», s; «shuttle run 3x10 m», s; «pulling up from the hang on a low crossbar», number of times; «push-ups», number of times; «jumping rope in 1 min», number of times; «standing long jump», cm.

The completed experimental project complies with the principles of the Helsinki Declaration of 2008 in the field of biomedical scientific research. All parents have given written consent for their children to participate in the project we are carrying out. The obtained digital data were processed by generally accepted statistical methods using computer programs STATISTICA 10.0, MS Excel 2010.

Results

The distribution of posture disorders in girls CG and EG is presented in Table 1.

Table 1. Frequency of posture disorders types in the examined girls (%)

Type of posture disorder	CG (n = 14)	EG (n = 14)
Scoliosis	57.1	57.1
Slouching	14.3	21.4
Round back	14.3	14.3
Roundly concave	-	-
Flat - bent	7.1	-
Arched back	-	-
Flat	7.1	7.1

Analysis of the results shows that of all types of posture disorders, scoliosis is most common in girls (57.1%). Slouching is recorded in second place in terms of frequency of occurrence. Other types of posture disorders were recorded in isolated cases, girls with a roundly concave and arched back were absent in our study.

Due to the fact that spinal deformity is closely interrelated with the deterioration of the active flexibility of the spinal column, we tested this motor quality in the examined girls. The obtained data of the high-stakes testing of spinal flexibility in CG and EG girls are summarized in Table 2.

Table 2. The high-stakes testing results of active spinal flexibility in the observed girls at the beginning and at the end of the project (M± m)

No	Tests	CG (n=14)		EG (n=14)	
		At the beginning of the experiment	At the end of the experiment	At the beginning of the experiment	At the end of the experiment
1.	Body bent forward from a standing position on a gymnastic bench, cm	7.3±0.85	8.9 ± 1.16	7.2±0.81	10.6 ± 1.19*
2.	Vertebral column bending to the side, cm	17.4±1.42	19.0 ± 1.61	17.9±1.52	22.8 ± 1.84*

Note. *values of indicators are significant ($p < 0.05$)

At the beginning of the experiment, the spine flexibility in CG and EG girls was approximately the same, $p > 0.05$. At the end of the study, an increase in spinal flexibility occurred only in EG girls, $p < 0.05$. The increase in the value of the flexibility indicator in test No1 was 21.9% for girls in CG and 47.2% for girls in EG. In test No2, the increase in the values of the indicators was 9.2% and 27.4%, respectively.

The use of physical exercises to correct posture disorders is aimed at increasing the muscles strength that create a muscular corset of the trunk and abdomen. The results of midterm testing of the strength of the muscles of the back and abdominals are presented in Table 3.

Table 3. High-stakes testing results of the trunk and abdominal wall muscles strength o in girls at the beginning and at the end of the project (M ± m)

No	Tests	CG (n=14)		EG (n=14)	
		Start research	Final research	Start research	Final research
Static strength of the trunk muscles					
1.	Time of horizontal holding of the body lying in emphasis on the hips, s	25.6±3.43	31.2 ± 3.23	26.4±3.56	39.7 ± 3.61*
Dynamic strength of abdominal muscles					
2.	Lifting the trunk from the supine position to the sitting one in 30 seconds, number of times	9.0±2.45	10.0 ± 2.57	10.0±2.67	16.0 ± 2.82*

Note. *values of indicators are significant ($p < 0.05$)

At the beginning of the study, no significant differences were found in the strength abilities of the muscular corset of the body of girls CG and EG, $p > 0.05$. At the end of the study, muscle strength increased only in EG girls, $p < 0.05$. The static strength of the EG girls increased by 50.3%, the dynamic strength of the abdominal muscles increased by 60.0% compared to the beginning of the experiment. The increase in the values of force indicators is shown in Figure 1.

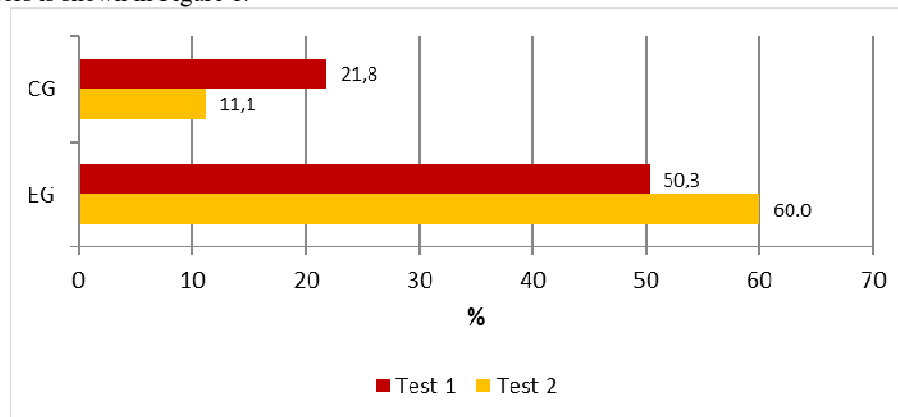


Fig. 1. The increase in the strength qualities of girls at the end of the study

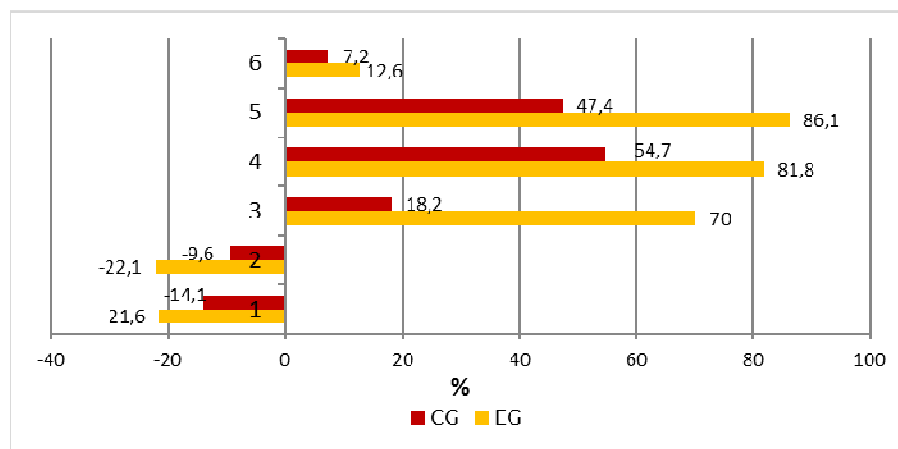
During the experiment, an increase in the physical fitness of girls in both groups was established, table 4.

Table 4. The results of testing the physical fitness of girls ($M \pm m$)

No	Tests	CG (n=14)		EG (n=14)	
		Start research	Final research	Start research	Final research
1.	Run at a distance of 60 m, s	14.9±0.85	12.8±0.76*	14.3±0.82	11.2±0.34*
2.	Shuttle run 3x10 m, s	11.4±0.73	10.3±0.56	11.8±0.77	9.2±0.42*
3.	Pulling up from the hang on a low crossbar, number of times	5.5±0.42	6.5±0.67	5.0±0.38	8.5±0.92*
4.	Push-ups, number of times	4.2±0.33	6.5±0.78*	4.4±0.36	8.0±1.11*
5.	Jumping rope in 1 min, number of times	38.0±2.82	56.0±3.23*	36.0±2.80	67.0±4.27*
6.	Standing long jump, cm.	112.4±4.14	120.5±4.39	114.4±4.12	128.6±4.45*

Note. *values of indicators are significant ($p < 0.05$)

At the beginning of the study, the physical fitness of girls CG and EG did not differ, $p > 0.05$. At the end of the study, a significant increase was found in CG in three tests; in EG girls, an increase in the values of indicators was noted in all tests, $p < 0.05$. The increase in indicators in the motor tests of girls is shown in Figure 2.



Note. 1, 2, 3, 4, 5, 6 - motor test numbers from Table 4

Fig. 2. Growth in motor test scores at the end of the research

The increase in the values of indicators in all control trials was greater in EG girls compared to CG girls. The use of plot rhythmic gymnastics made it possible by the end of the study to achieve stabilization of the value of the angle of the spinal column deformity arc in the frontal plane in 78.5% of EG girls. In the control group, stabilization of scoliosis was registered in 28.5% of children.

Dicussion

The prevalence of musculoskeletal disorders in a large number of children in different countries and the difficulty in correcting spinal deformities and flat feet (Balkó et al., 2017; Kashuba et al., 2019) points to the importance of our study. Research materials from numerous authors (Yarmak et al., 2017; Ivanchykova et al., 2018; Chekhovska et al., 2018; Kashuba et al., 2019; Grygus et al., 2020; Metalnikov et al., 2022) indicate that the leading correction method posture disorders in children are exercise. The significance of such physical activity increases with the use of innovative sports and health technologies (Chekhovska et al., 2018; Kashuba et al., 2019; Mischenko et al., 2020). The implementation of this project was relevant due to the limited research materials on the use of the rhythmic gymnastics technique for the correction of posture disorders. To do this, we have improved and tested an experimental method for correcting posture disorders using plot rhythmic gymnastics, which was included in the physical education curriculum in 8-10-year-old girls.

The results of the conducted experimental project showed significant effectiveness of the proposed method of improving girls' health, which does not contradict other proposed innovative technologies for correcting posture disorders. It is known that for posture correction it is important to increase the flexibility of the spinal column. Many researchers point to the importance of increasing the spinal column flexibility in the correction of posture (Metalnikov et al., 2021; 2022). According to our data, the use of an experimental method has significantly increased the spine flexibility, which is consistent with the results of the authors, who used various innovative technologies to correct spinal deformities to increase flexibility (Kashuba et al., 2019; Mischenko et al., 2020b; 2021).

All methods of posture correction are aimed at increasing the strength abilities of the trunk and abdominal press muscles (Kotliar et al., 2019). Our use of the experimental program also made it possible to increase the strength abilities of the trunk and abdominal muscles.

Posture disorders correction requires use of physical exercises for a long time, which can reduce motivation for monotonous physical exertion. This decrease in interest in physical activity is reported by Andrieieva et al. (2020). Our use of rhythmic exercises in the story line project activates the children's imagination, evokes empathy and inner support for the characters. This contributes to the acquisition of children not only new knowledge, but also forms motivation for physical activity. In a high-stakes study of the EG girls' motor qualities, we found a significantly meaningful increase in all values in the physical fitness tests compared with the CG girls, in which the improvement of posture disorders was carried out at traditional PE lessons with the inclusion of exercises that are recommended for a special medical group. This is consistent with the data of Galan et al., (2021), who registered low indicators of children's motivation for motor activity in traditional physical education classes.

The results of the EG girls' effective improvement obtained by us allow recommending the proposed method of story rhythmic gymnastics for wide use in the correction of posture disorders in children.

Conclusions

A method for correcting posture disorders in girls aged 8-10 has been proposed and tested. In each lesson of the traditional curriculum of EG girls, a health-improving story rhythmic gymnastics was included, which was conducted for 15-20 minutes at each lesson. It presented the complexes of gymnastic, acrobatic and dance health-improving exercises proposed by us, performed in concert to rhythmic music according to the plots selected by us from cartoons and fairy tales.

Approbation of the proposed method among the girls of the experimental group suffering from postural disorders showed a significantly significant increase in the active flexibility of the spine, the strength abilities of the muscular corset of the body and all motor qualities compared with the results of girls attending the control group.

Analysis of the obtained results shows that 78.5% of the girls in the experimental group showed stabilization of the value of the angle of the curvature of the spinal column in the frontal plane. In the CG, stabilization was registered only in 28.5% of girls. In the EG, only two (14.2%) girls showed slight deviations in posture, in contrast to the CG, where the number of girls with spinal deformity did not change. The proposed method of correcting posture disorders in girls using story rhythmic gymnastics can be recommended for use in educational institutions.

Conflicts of interest. The authors declare no conflict of interest.

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