

Enhancing quality of life during outpatient physical rehabilitation for 6-7-year-old children with impaired postural status

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Abstract:

Scientific literature underscores a significant prevalence of musculoskeletal disorders in children, often stemming from hereditary connective tissue dysplasia, detrimentally impacting their quality of life. Consequently, developing effective physical rehabilitation methods for children becomes imperative. This study aims to assess various components of quality of life among children with hereditary connective tissue disorders and musculoskeletal complications during the outpatient phase of physical rehabilitation. **Material & methods.** The research project was carried out on the basis of medical institutions in the city of Barnaul (Russia) from 2014 to 2023. The quality of life was assessed in 60 children aged 6-7, having connective tissue disorders and complications from the musculoskeletal system and their parents using the Pediatric Quality of Life inventory PedsQL questionnaire. Quality of life testing was performed at the research beginning, in 1 and 3 years after the start of rehabilitation. After 10 years, the condition of the posture and muscular system of the observed children was assessed. Generally accepted rehabilitation measures were performed for patients of the main group (n=30) and the comparison group (n=30). In addition to traditional wellness activities, the main group included course theoretical and practical classes at the organized school «Posture Correction» for parents and their children. Practical classes included teaching children and parent's physical exercises on the wall bars ("Swedish wall"), orthopedic ball, breaststroke swimming, wearing a corset, following a calcium-containing diet and a balanced vitamin composition of food. **Results.** In the course of follow-up after 1 and 3 years, the number of complications in the main group of patients statistically significantly decreased, the quality of life in children and parents improved, $p < 0.05$. During the control after 10 years, physiological posture and the normal status of the trunk muscles were determined in all patients in the main group, which was confirmed by the electro-neuromyographic examination method. In patients and parents of the comparison group, the quality of life did not change in dynamics, muscle weakness at the level of the thoracic spine, myofascial pain syndrome was noted. **Conclusions.** Significant positive results of physical rehabilitation of children with connective tissue dysplasia and the musculoskeletal system complications have been obtained when using means and methods of physical culture in rehabilitation on the basis of the established school of "Posture Correction". The proven technique can be used for children's rehabilitation at the outpatient stage of recovery.

Key Words: physical education, physical training, quality of life, physical activity, dysplasia, physical rehabilitation

Introduction

It is generally believed that the correct postural status of a child indicates his/her harmonious physical development (Kashuba et al., 2017; Ivanchykova et al., 2018; Romanova et al., 2022). An analysis of scientific literature sources indicates a significant prevalence of deviations from the musculoskeletal system in children, adolescents and youth in various countries (Balkó et al., 2017; Kashuba et al., 2019; Metalnikov et al., 2020; Teran-Wodzinski, & Kuma, 2023).

There are many reasons that lead to impaired posture in humans. One of them is connective tissue dysplasia (Bennett et al., 2022). At the same time, hereditary disorders of connective tissue development are increasingly registered in childhood (Lobanov et al. 2019). According to V. Konev et al. (2017), such a pathological process occurs in every fifth child during a mandatory medical examination. The genesis of connective tissue dysplasia is based on various disorders of the collagen and elastin fibers formation as a result of genetic predisposition (Wesley et al., 2021). A variety of clinical manifestations in violation of its development has been established. The most important are complications from the bone and joint structures that develop during the child's life. In such patients, up to 67% are diagnosed with an asthenic physique, up to 58% with kyphoscoliotic posture disorder (Kononova et al., 2016) and ligamentous weakness. When considering the issue of disability in patients with dysplastic processes, attention should be focused on the fact that these processes themselves are not a nosological form. As a child grows up, a number of complications often appear at the time of linear growth, which can lead to disability. Scientists especially often observe deviations from the normal state of the musculoskeletal system during the period of intensive growth and puberty of a young organism and affect the age from 5 to 8 and from 11 to 13 (Gun et al., 2024).

All deviations from the child's musculoskeletal system negatively affect the work of the cardiorespiratory, digestive, nervous and other functional systems of the body. As a result of deviations in the postural status, physical performance decreases and cognitive abilities deteriorate (Kozina et al., 2017; Timnea et al., 2019). There is evidence that disorders associated with connective tissue dysplasia reduce physical fitness in children (de Koning et al., 2023), which leads to symptoms of hypokinesia in them. The authors note a decrease in below-average values of overall endurance, hand muscle strength and agility compared with the test results of healthy children. The correct formation of a child's postural status largely depends on the body muscular system development and the ability of the muscles to work in static mode for a long time to maintain the correct position of the trunk. Connective tissue dysplasia is accompanied by pain in the joints and spine, fatigue (Benistan et al., 2023; Molander et al., 2024) and is accompanied by sleep disorders (Schubart et al., 2024). Such patients often experience feelings of anxiety and depression (Estrella, & Frazier, 2024). Medical experts note that in children with musculoskeletal system pathology against the background of hereditary connective tissue dysfunction, the quality of life is significantly reduced. In addition, studies by J. Warnink-Kavelaars et al. (2021, 2022) indicate a deterioration in mental health in such children. The decline in the quality of life continues in children and adolescents during their adulthood (Estrella, & Frazier, 2024).

The therapeutic and preventive approaches used to compensate for possible dynamic negative effects in this category of patients are a complex process (Garreth et al., 2023). Against the background of the therapeutic measures implementation, it is important to develop the muscular system for effective coordinated muscle work in an isotonic mode. It allows maintaining the correct position of the trunk (Buryk-Iggers et al., 2022). It is also important to stimulate coordinated contraction of the trunk, neck and lower extremities muscles.

Currently, therapeutic and preventive measures include therapeutic physical education, training of motor functions using adaptive equipment, and physiotherapy (Clark et al., 2024). It is important to teach proper behavior to parents with children who suffer from connective tissue dysplasia (Wesley et al., 2021), Interaction with this category of patients and their parents requires additional individual approaches, new algorithms in therapeutic physical culture and physiotherapy. The authors are P. Molander et al. (2024), propose an interdisciplinary method of rehabilitation for patients with connective tissue dysplasia. However, the authors did not receive a significant positive result. In the scientific literature, insufficient attention is paid to therapeutic and preventive approaches to improve the patients' and their parents' quality of life (Teran-Wodzinski, & Kuma, 2023). It leads to dissatisfaction in such patients with their medical care (Estrella, & Frazier, 2024). The scientific literature does not fully reflect the issues of longitudinal monitoring of children who have connective tissue dysplasia with pronounced postural status disorders.

We believe that the study of these issues will make it possible to optimize measures aimed not only at improving children with connective tissue dysplasia quality of life, but also to increase the effectiveness of physical rehabilitation associated with musculoskeletal disorders correction. This is especially important and necessary at the outpatient stage of children's recovery.

Purpose is to evaluate the components of the quality of life in children having hereditary disorders of their connective tissue genesis and complications from the musculoskeletal system at the outpatient stage of physical rehabilitation.

Material & methods

The research project was carried out on the basis of medical institutions in the city of Barnaul (Russia) from 2014 to 2023. At the stage of outpatient follow-up, a dynamic assessment of the state of quality of life, clinical manifestations, laboratory parameters and physical rehabilitation of 60 patients who had hereditary connective tissue dysplasia was carried out. At the beginning of the research project, the age of the patients was 6-7 (6.4±1.3 years). The sick children were divided into the main (n = 30) group and the comparison group (n = 30). In each group, the children were divided by gender into 15 people. At the beginning of the research project,

voluntary informed consent was received in writing from the parents for the examination and physical rehabilitation of their children. The conducted project does not violate the ethical principles that apply to biomedical research involving humans, as set out in the Helsinki Declaration of 2008.

All patients were diagnosed with moderate severity of hereditary connective tissue dysplasia. Pathological manifestations were pronounced kyphoscoliotic posture, increased mobility in all large, medium, and small joints of the extremities, deformities of the chest by the type of keel-shaped or funnel-shaped and pathological foot installations.

Laboratory data were evaluated at the beginning of the research work in all patients. A significant criterion for evaluating collagen was the state of oxyproline in the blood and urine. The serum level of oxyproline in patients of the main group was 29.30 ± 0.39 mmol/liter, in patients of the comparison group 28.42 ± 0.61 mmol/liter. The indicators turned out to be statistically higher in comparison with the data in healthy children (15.08 ± 0.06 mmol/liter), $p < 0.001$. The values of the oxyproline content in urine differed in the groups. In patients of the main group, oxyproline excretion was 25.32 ± 0.41 $\mu\text{m}/\text{mg}$, in the comparison group 26.63 ± 0.42 $\mu\text{m}/\text{mg}$, in healthy people 19.51 ± 0.03 $\mu\text{m}/\text{mg}$, $p < 0.001$. The urinary calcium index in patients of the main group was 3.81 ± 0.07 mmol/liter, in patients of the comparison group 3.79 ± 0.08 mmol/liter was higher than in healthy subjects (2.34 ± 0.08 mmol/liter), $p < 0.001$.

The analysis of the quality of life parameters state in patients of both observation groups and their parents was carried out. We used the Peds QL (Quality of Life Scale (PedsQL 4.0 Generic Core Scales) questionnaire, which was proposed by Vami et al. (1999). The questionnaire has demonstrated high effectiveness in assessing the quality of life of children and their parents and is simple, reliable, valid and flexible in many clinical studies (Fernández-Pérez et al., 2022). Children and their parents were asked to answer 23 questions, arranged in four scales, which assessed the physical, emotional, social quality of life and functioning in a preschool institution.

The indicators of the presented parameters were evaluated by the sum of the points. The maximum number of points is 100. The higher the score, the better the quality of life of the person being examined. Testing the children's and their parents' quality of life was carried out at the beginning of the research project after 1 and 3 years against the background of physical rehabilitation measures, after 10 years the dynamics of changes in functional indicators and clinical manifestations of the disease were evaluated.

To improve the trophic muscles, all children underwent back massage (along the spine) for 10 sessions for 15 minutes once every 4 months, electrical stimulation of the back muscles for 10 sessions once every 6 months and included traditional therapeutic physical culture to stabilize the parotid muscles and abdominal wall muscles. For children in the main group theoretical and practical seminars were held at the organized school «Posture Correction» in addition to basic treatment.

One of the important conditions of the school's activity was the involvement of children' of the main group parents in this work. The theoretical part provided for familiarization with the information of children and their parents on issues of musculoskeletal system disorders associated with connective tissue dysplasia. Slides, presentations, films, and videos were used for this purpose. Practical classes for children were a group therapeutic physical culture with the inclusion of physical exercises using a wall bars and an orthopedic sports ball. They used therapeutic swimming in the "breaststroke" style. The children of the main group and their parents were taught how to perform physical exercises.

The children performed physical exercises on the wall bars. They presented two exercises: «moving up» and «hanging on hands», in a position with back to the wall bars. In this position, the child released his/her legs, while holding onto the crossbar with his/her hands for the maximum time. These exercises were alternated with the following, performed on an orthopedic ball with a physical therapy instructor's support: in the initial position on the «lying on stomach» with his/her legs and arms straightened, the child bent backwards and stayed in this position for as long as possible. Physical exercises were conducted daily for 10-14 days every 4 months. After the first two or three sessions, parents were advised to perform daily physical exercises for children at home. In some cases, individually, through parents, the wearing of a corset was prescribed for 6 months for 4 hours a day. An important role was assigned to observing the nutritional characteristics of children in the main group. For this purpose, a diet was developed and offered to patients by a dietitian.

They recommended parents to use food products containing a large amount of animal and vegetable proteins, macro- and microelements, especially calcium, vitamins, which ensured intensive synthesis of collagen fibers in the children's body.

Statistical parameters were processed and analyzed using the program STATISTICA 10.0 for Windows (Stat Soft, Inc.). The statistics presented in the work have the notation – n – the absolute number of patients and parents in the groups; $M \pm m$, where M is the average value, m is the standard error. The reliability of the difference was assessed by the value of the Student's criterion t for dependent samples. $P < 0.05$ was taken as the critical level of significance.

Results

At the beginning of the research project, the results of the respondents' responses to the PedsQL questionnaire indicate that the values of quality of life indicators did not differ significantly between the children of the main group and the comparison group and the responses of their parents, $p > 0.05$, Table 1.

Table 1. Quality of life indicators values according to the responses of children and their parents at the beginning of the research project, $M \pm m$

Components of the quality of life	Children			Parents		
	Main group, n=30	Comparison group, n=30	P_1	Main group, n=30	Comparison group, n=30	P_2
Physical component	66.5±5.1	64.2±6.3	0.79	61.1±6.1	59.8±5.5	0.93
Emotional component	72.5±6.8	68.0±6.3	0.59	56.9±5.1	60.9±5.7	0.53
Social component	61.6±5.9	58.7±5.1	0.32	55.7±5.8	56.9±5.3	0.77
Children's functioning in kindergarten	56.7±5.4	58.8±6.3	0.79	56.5±4.8	54.2±4.7	0.76
Total score	64.3±2.6	62.4±2.7	0.75	57.5±2.3	57.9±2.4	0.76

Note: p_1 – significant differences between the responses of the children in the main group and the comparison group, $p < 0.05$; p_2 – significant differences between the responses of the parents in the main group and the comparison group, $p < 0.05$

An analysis of the response indicators values of children and their parents indicates that children in both groups rate their quality of life higher than their parents. The values of the indicators in each component of the children's quality of life were higher than the results of their parents' responses. The total response score of the children of the main group and the comparison group was significantly higher (64.3±2.6 and 62.4±2.7 points, respectively) in relation to the results of their parents' responses (57.5±2.3 and 57.9±2.4 points, respectively), $p < 0.05$. It may indicate that children underestimate the severity of their disease and the consequences of its complications. A year after the start of treatment and the continuation of physical rehabilitation measures in children of the main group, the values of indicators in emotional and social functioning, the sum of points were significantly higher compared with the results of children in the comparison one, $p < 0.05$, Table 2.

Table 2. Quality of life indicators values in children and their parents 1 year after the start of follow-up, $M \pm m$

Components of the quality of life	Children			Parents		
	Main group, n=30	Comparison group, n=30	P_1	Main group, n=30	Comparison group, n=30	P_2
Physical component	76.3±5.2	65.1±5.8	0.213	71.5±6.4	63.7±5.7	0.283
Emotional component	81.3±8.2	63.5±6.4	0.049	74.8±7.2	63.9±6.2	0.198
Social component	76.8±7.2	56.7±5.2	0.031	83.6±7.2	58.8±6.3	0.015
Children's functioning in kindergarten	76.6±7.1	58.9±5.6	0.098	74.9±7.3	56.2±5.5	0.032
Total score	77.7±5.6	61.1±4.8	0.028	76.2±6.4	60.6±4.4	0.029

Note: p_1 – significant differences between the responses of the children in the main group and the comparison group, $p < 0.05$; p_2 – significant differences between the responses of the parents in the main group and the comparison group, $p < 0.05$

The quality of life indicator value in the children of the main group was significantly higher in the physical component (76.3±5.2 points) and the functioning of children in kindergarten (76.6±7.1 points) compared with the comparison group (65.1±5.8 and 58.9±5.6 points, respectively).

The parents of the children in the main group significantly improved the responses of indicators in the social component and the functioning of children in kindergarten, $p < 0.05$. It indicates the successful adaptation of these children to attend preschool compared to children from the comparison group.

The total score for assessing the quality of life according to the responses of parents of children from the main group was significantly higher compared to the values of this indicator of parents from the comparison one (76.2±6.4 and 60.6±4.4 points), $p < 0.05$. The increase in the quality of life indicators values in children of the main group to the indicators of the comparison group is shown in Figure 1.

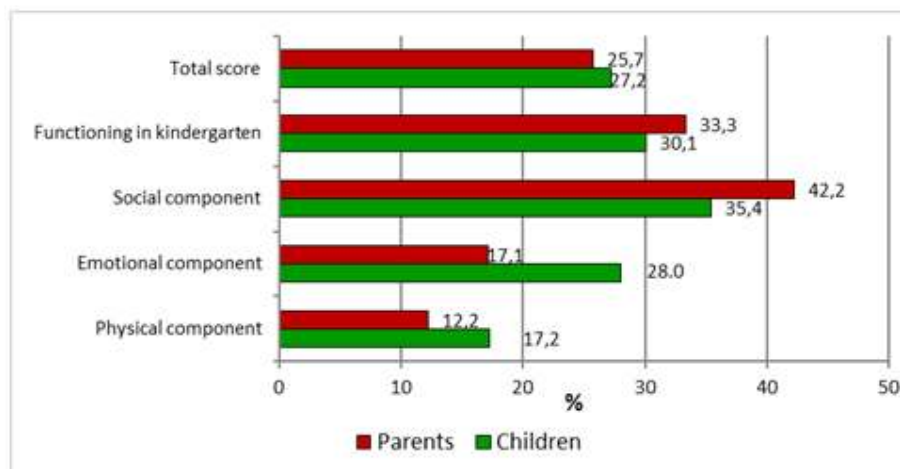


Fig. 1. The increase in the values of quality of life indicators in children of the main group in relation to the indicators of the comparison group in 1 year

According to the response of the children in the main group, their total quality of life score was 27.2%, the parents had 25.7% more than the value of this indicator in the comparison group, Figure 1. A significant increase in the quality of life indicators values for children of the main group was established in the social component (35.4%) and the functioning of children in kindergarten (30.1%). The parents of the main group also showed the largest increase in these components (42.2 and 33.3%, respectively).

The comparative increase in the indicators values of the quality of life components of children and their parents in both observation groups 1 year after the start of the research project compared with the indicators at the beginning of the research is shown in Figure 2.

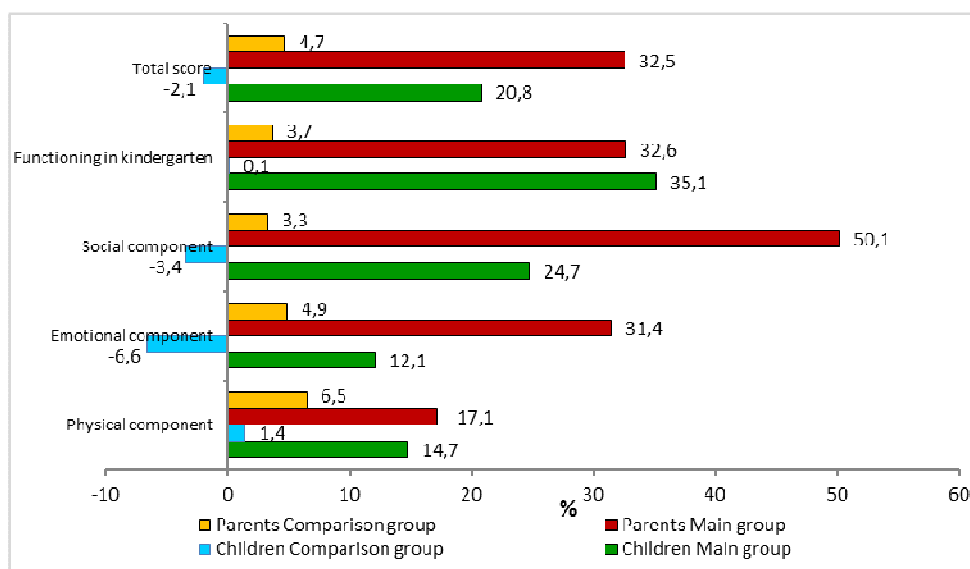


Fig. 2. An increase in the quality of life of children and their parents in both observation groups in 1 year of physical rehabilitation

At the end of the first year of the research project, it was found that the children of the main group and their parents registered an increase in the indicators values in all components of quality of life. The largest increase in children was noted in the indicators of children's functioning in kindergarten (35.1%), the social component (24.7%) and the total quality of life score (20.8%). In the children of the comparison group, the increase in indicators was significantly less. In the social component, a decrease in the quality of life was noted in the total points, as evidenced by the negative value of the indicators. Among the parents of both observation groups, an increase in the values of the quality of life was noted. In the parents of the main group, this increase in indicators was significantly greater than the increase in the parents in the comparison one.

After 3 years of follow-up, the quality of life indicators values in the main group and the comparison group turned out to be higher in both children and their parents than in the comparison group, Table 3.

Table 3. Quality of life indicators values in children and their parents 3 year after the start of follow-up, M±m

Components of the quality of life	Children			Parents		
	Main group, n=30	Comparison group, n=30	P ₁	Main group, n=30	Comparison group, n=30	P ₂
Physical component	87.5±8.6	66.2±6.1	0.035	81.5±8.1	67.6±6.2	0.158
Emotional component	89.4±8.6	61.1±6.3	0.006	88.7±8.4	64.8±5.2	0.014
Social component	86.9±8.3	57.8±6.1	0.008	88.5±8.2	61.8±6.3	0.009
Children's functioning in kindergarten	96.8±9.1	59.8±5.7	0.001	94.9±8.7	59.2±5.2	0.001
Total score	90.2±6.2	61.2±4.3	0.001	88.4±5.6	63.3±4.9	0.001

Note: p₁ – significant differences between the responses of the children in the main group and the comparison group, p < 0.05; p₂ – significant differences between the responses of the parents in the main group and the comparison group, p < 0.05

After 3 years from the beginning of physical rehabilitation, a significantly higher value was found in all components of the quality of life in children of the main group and their parents (with the exception of the physical component in parents), p < 0.05 compared with the comparison group. The increase in the physical component in the children of the main group was 32.2% more than in the children from the comparison one. This quality of life parameter evaluates a person's physical activity, walking and running quality, and physical pain conditions. An even greater percentage increase in children of the main group (46.3%) was found in the emotional component, which evaluates the quality of night sleep, indicates the presence of anxiety, disturbance, and mood in the patient. A fairly high value of the increase in the social component (50.3%) and the functioning of children in kindergarten (61.8%) was shown. The social component shows the researcher the level of interaction with other children, and life activity in a preschool institution shows the role functioning of a child, how often he skips kindergarten due to illness. The parents' total quality of life indicator value was approximately the same as in the responses of their children and turned out to be 39.7% higher compared to the results of the survey of parents of the comparison group. The increase in the quality of life indicators values for all children and their parents after 3 years compared with the indicators at the research beginning is shown in Figure 3.

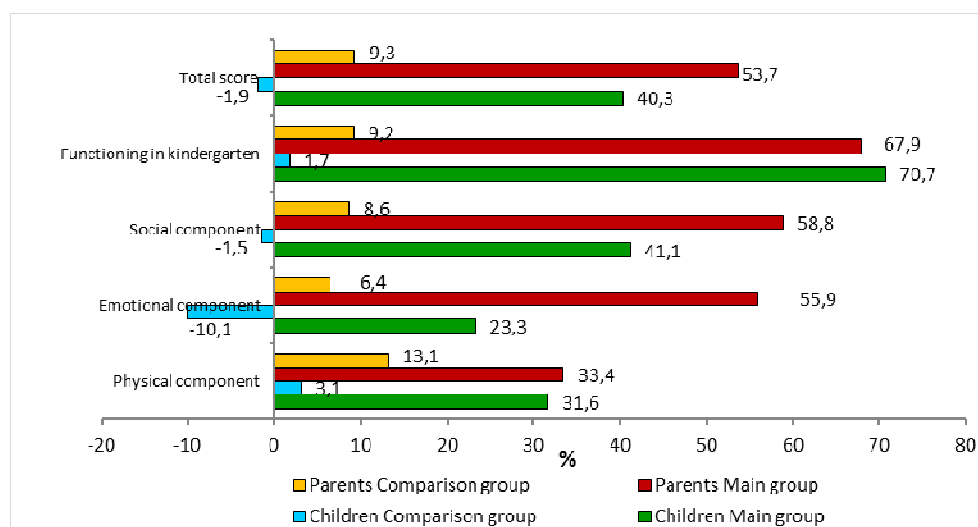


Fig. 3. An increase in the quality of life of children and their parents in both observation groups after 3 years of physical rehabilitation

After 3 years, it was found that the children of the main group and their parents registered an increase in the indicators values of all quality of life components, which significantly exceed the indicators in the comparison group. The greatest increase in the children of the main group was noted in the indicators of the child's functioning in kindergarten (70.7%), the social component (41.1%) and the total quality of life score

(40.3%). In the children of the comparison group, the increase in indicators was significantly lower in all components and in the total score. There was a decrease in the quality of life in children of the comparison group, as evidenced by the negative value of the component indicators. Among the parents of both observation groups, an increase in the values of the quality of life growth was noted. In the parents of the main group, this increase in indicators was significantly greater than the increase in the parents in the comparison one, Figure 3. 10 years after the start of the research project, we conducted a survey of children with musculoskeletal disorders in both observation groups, Table 4.

Table 4. The state of statics and dynamics of functional changes in patients of the main group and the comparison group 10 years after the beginning of physical rehabilitation

Characteristics of symptoms	Main group, n=30		Comparison group, n=30		p
	Absolute number	%	Absolute number	%	
Pain syndrome in various parts of the spine, sacrum and coccyx	0	0.0	15	50.0	<0.001
Pain due to pressure, percussion of the spinous processes of the spine	0	0.0	10	33.3	0.0008
Hypertonicity of the back muscles	0	0.0	25	83.3	<0.001

Note: the significance of differences in the indicators values, $p < 0.001$

After 10 years, 50.0% of the children in the comparison group had pain and discomfort in the thoracic and lumbar spine, sacral and coccygeal joints ($p < 0.001$). Palpation of the spinous processes in the thoracolumbar region showed pain in 33.3% ($p = 0.0008$), increased tone of the parotid muscles (according to the electro-neuro-myographic examination method) in 83.3% ($p < 0.001$).

Physiological posture was noted in all patients of the main group and no abnormalities were detected according to the results of an electro-neuro-myographic examination of the muscles of the parotid region.

The longitudinal dynamic observation of children with musculoskeletal system disease associated with hereditary connective tissue dysplasia showed that the inclusion of comprehensive theoretical and practical training of children and their parents in the school "Posture Correction" in the traditional program of therapeutic and rehabilitation measures showed significant effectiveness in improving the quality of life of patients and posture normalization. The proposed method of teaching children and parents can be used in the practice of outpatient rehabilitation for children with impaired postural status.

Discussion

The significant spread of postural status disorders in the world among children and adolescents (Balkó et al., 2017; Kashuba et al., 2019; Metalnikov et al., 2020; Teran-Wodzinski, Kuma, 2023), necessitates the scientific search for effective methods not only for treatment, but also for the use of means and methods in rehabilitation and physical education. Disorders of the musculoskeletal system are often associated with connective tissue dysplasia (Lobanov et al. 2019; Metalnikov et al. 2020; Bennett et al., 2022). This leads to serious kyphoscoliotic disorders of posture (Kononova et al., 2016) and weakness of the ligamentous apparatus of all joints (Romanova et al., 2022).

Along with the clinical manifestations of musculoskeletal system diseases, the quality of life of patients with such a diagnosis decreases. It is due to the limitations of his/her physical activity, the presence of pain and discomfort in the spine, limitations of role function and the ability to attend preschool, communicate with peers, and more. Therefore, the analysis of the quality of life indicators of children and their parents can be considered a marker of the condition of the disease and an assessment of the recovery processes from the disease occurring in the body. Recent scientific data indicate not only a deterioration in the quality of life of children with connective tissue dysplasia, but also their mental health (Warnink-Kavelaars et al., 2021, 2022). The negative trend of deterioration in the quality of life continues during the period of human adulthood (Estrella, & Frazier, 2024).

In this regard, long-term monitoring of children with musculoskeletal disorders is very relevant. Our research covers a long time period of observation (from 2014 to 2023). It allowed us to reliably assess the changes taking place in the body, their persistence and give the patient recommendations for further maintenance of physiological posture.

The first stage of our research project was devoted to assessing the initial level of the quality of life of children with musculoskeletal system disorders caused by hereditary connective tissue dysplasia and their parents. The Pediatric Quality of Life inventory Peds QL questionnaire (Vami et al., 1999) was used for this purpose. The group of children ($n = 60$) with impaired postural status was divided into the main group and the comparison group. An analysis of the indicators of the quality of life components based on the results of the children's and their parents' responses showed approximately the same uniformity. It has been found that many

children with impaired musculoskeletal system function and their parents' responses indicate pain in the spine, discomfort, fatigue, sleep disturbance, decreased role functions and skipping kindergarten. These data are consistent with the results of similar studies by other authors (Warnink-Kavelaars et al., 2021; Molander et al., 2024; Schubart et al., 2024). We have supplemented the basic rehabilitation program for children in the main group. For this purpose, the school «Posture Correction» was created for children and their parents, where theoretical and practical seminars on training in rehabilitation measures were held. The theoretical part provided for familiarization with the information of children and their parents on issues of musculoskeletal system disorders associated with connective tissue dysplasia. Slides, presentations, films, and videos were used for this purpose. Practical classes for children were a group therapeutic physical culture with the inclusion of physical exercises using a wall bars, orthopedic sports ball and therapeutic swimming in the style of «breaststroke». These data are consistent with the opinion of other researchers (Clark et al., 2024) on the need to include motor function training using adaptive equipment and physiotherapy in therapeutic physical education. It is important in rehabilitation to teach proper behavior to parents with children who suffer from connective tissue dysplasia (Wesley et al., 2021).

Insufficient parents' knowledge of issues related to hereditary connective tissue dysplasia complicates the process of children's treatment and rehabilitation. It is indicated by research by Bennett et al. (2022). Therefore, we consider the broad involvement of parents in their children's health improving to be the right direction of rehabilitation. Health-improving physical exercises were performed by children daily for 10-14 days every 4 months. After the first two or three sessions, parents were advised to monitor and adjust the constant performance of daily physical exercises by children at home. We agree with Buryk-Iggers et al. (2022) that, against the background of therapeutic measures, it is important to develop a muscular system for effective coordinated muscle work in an isotonic mode. It allows maintaining the correct position of the torso. It is especially necessary to stimulate the contraction of the trunk, neck and lower extremities muscles.

Individually, through parents, we prescribed wearing a corset for 6 months for 4 hours a day. We noted a similar recommendation for wearing a corset in the work of other researchers (Benistan et al., 2023). The authors noted a reduction in pain when wearing a corset and an improvement in the patients' quality of life. During the research project, we assigned a significant role to observing the nutritional characteristics of the children in the main group. Recommended products, minerals, multivitamins, the use of which was aimed at the production of collagen in the body.

The assessment of the children's and their parents' quality of life components was carried out at the beginning of the research project after 1 and 3 years against the background of physical rehabilitation measures. In addition, after 10 years, the dynamics of changes in functional parameters and clinical manifestations of the disease in the patients we observed were evaluated.

It was found that after 1 and 3 years, there was an improvement in quality of life indicators according to a survey of children and their parents in the main group. There was no improvement in the components of quality of life in children and parents in the comparison group. It indicates the effectiveness of the «Posture Correction» school that we have created. We believe that the established increase in children's physical activity, the disappearance of pain syndrome in children of the main group led to an improvement in the indicators of other quality of life components. It may be evidenced by an increase in the overall quality of life indicator compared to the research beginning. The increase in the total value of the quality of life indicator was 20.8% more in the first year, and 40.3% more in the third year compared to the initial data. The quality of life of the children in the main group was significantly higher according to the results of their parents' survey. In the comparison group, the increase in indicators was significantly lower for both children and their parents.

A control examination after 10 years showed that all patients in the main group had physiological posture, no pain, discomfort in the spine and hypertension of the spinal muscles were noted. According to the electro-neuromyographic examination of the muscles in the parotid region, no pathological changes were detected in them. In the comparison group, 50.0% of children had pain and discomfort in the thoracic and lumbar spine and sacrococcygeal joint. Pain syndrome was noted in 33.3% of children when pressing on the spinous processes in the thoracolumbar region, an increased tone of the parotid muscles is recorded, which causes a feeling of fatigue.

The obtained data of the research project indicate a significant rehabilitation effect of the proposed technique and the resulting pronounced lasting wellness effect. It allows us to recommend, at the outpatient stage of observation, the creation of a school of "Posture correction» to use the proposed methodology in the practice of improving the health of children with musculoskeletal disorders.

Conclusions

In a dynamic ten-year scientific research, the effectiveness of physical rehabilitation in 6-7-year-old children with pathological hereditary changes in the connective tissue development and postural status complications in the form of kyphoscoliotic posture, chest deformity, increased mobility in all joints of the extremities and pathological foot position was analyzed.

The organizational form of physical rehabilitation measures with the creation of the «Posture correction» school in outpatient conditions has been tested. The key section of physical rehabilitation measures in the proposed method of improving children's health is given to the involvement of sick children's parents in this work. They were introduced to the disease, taught the basics of physical exercises using a wall bars, an orthopedic sports ball and therapeutic breaststroke swimming. The attention of parents was drawn to the use of a corset by children, compliance with the peculiarities of the diet, which provided for compliance with a calcium-containing diet and a balanced vitamin food composition.

It was noted that during the three-year period of medical examination in children of the main group a state of physiological posture and a well-developed muscular corset was achieved ($p < 0.001$) in contrast to the comparison one.

The children of the main group had almost no pain syndrome and the physical component of the quality of life improved significantly. It, in turn, had a positive effect on the emotional and social components of the quality of life of the children in the main group. Among them, there is a high indicator of the children's functioning in kindergarten, as indicated by the absence of missed visits to preschool due to illness and good parameters of the role function with other children. After 10 years, children who were in the main group had no abnormalities in postural status, no pain syndrome and a well-developed muscular corset, unlike children in the comparison group. These data indicate the high efficiency of the proposed method of physical rehabilitation for sick children with hereditary connective tissue dysplasia complicated by musculoskeletal system pathology.

The proposed and tested organizational form of outpatient physical rehabilitation of sick children with their parents' involvement in improving their health can be recommended for use in children's medical institutions.

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

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