Journal of Physical Education and Sport ® (JPES), Vol. 24 (issue 5), Art 127, pp. 1109 - 1117, May 2024
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Physical rehabilitation for children with osteochondrosis

POLEVOY G.G.
Moscow Aviation Institute, Moscow, RUSSIA

Published online: May 31, 2024
Accepted for publication : May 15, 2024
DOI:10.7752/jpes.2024.05127

Abstract
Background. Addressing the rehabilitation needs of children with cervical osteochondrosis often involves the development of specialized techniques and additional exercises for home use. **Objective:** In this study, we aimed to enhance the musculoskeletal function of high school children with cervical spine osteochondrosis improve their physical development and fitness levels through adaptive physical education in extracurricular settings, and facilitate independent individual home exercises. **Methods:** A total of 38 schoolchildren, boys and girls aged 14-16 diagnosed with cervical spine osteochondrosis participated in the pedagogical experiment. The study was conducted from February 25 to May 25, 2023 in multiple secondary schools in Kirov, Russia. Both groups of students followed the standard program three times a week. Children from experimental group B additionally performed sets of physical exercises from the experimental methodology. The study used tests that evaluate the static strength of the abdominal and back muscles, the flexibility and endurance of the cervical spine and the speed and strength abilities of the arm muscles. When analyzing the results, their statistical processing was carried out using the arithmetic mean, square deviation, error and difference. Confidence at $p<0.05$. **Results:** According to the results of the study, it was found that children from the control group were able to slightly improve the studied indicators to 10.6%, the increase in indicators from the beginning to the end of the study on all tests turned out to be unreliable ($p>0.05$). In the experimental group, the indicators of the static strength of the abdominal muscles increased from 54.0 to 71.0, the static strength of the back muscles increased from 53.0 to 82.0, the flexibility of the cervical spine in the right side increased from 6.0 to 10.0. Changes in the indices of flexibility of the cervical spine to the left (from 6.0 to 10.0), speed and strength abilities of the hands (from 42.0 to 64.0), endurance of the cervical spine lying on the back (from 56.0 to 80.0), endurance of the cervical spine lying on the stomach (from 83.0 to 102.0). All these indicators have changed significantly and have a reliable character ($p<0.05$). **Conclusion.** If you perform special physical exercises in physical education classes at school and additionally perform some of them at home, then the indicators of schoolchildren diagnosed with cervical osteochondrosis will become significantly higher, namely, the indicators of static strength of the abdominal and back muscles, flexibility and endurance of the cervical spine and speed-strength abilities of the arm muscles will improve.
Keywords: Physical therapy, Spinal disease, Physical exercises, Intervertebral disc, Cervical spine.

Introduction

An urgent problem of the younger generation is the increase in the number of children suffering from diseases of the musculoskeletal system. Modern man is characterized by a sedentary, sedentary lifestyle. At the same time, the muscles of the trunk and neck perform a constant load, which, with their small but constant static tension, support working and household poses. When they get tired, the entire load falls on the spinal column and, first of all, on the intervertebral discs. In addition, excessive static muscle tension contributes to the obstruction of venous outflow and accelerates the processes of fibrosis, sclerosis and secondary degenerative changes in the spine (Ma et al., 2020; Yin et al., 2022; Wilhite et al., 2023).

Osteochondrosis literally translates as a pathological change in bone and cartilage tissues of a destructive nature. Recently, osteochondrosis of the spine has significantly rejuvenated. According to some authors, only 8% of graduates of grades 9-11 are recognized as healthy. In recent years, the number of children with various functional disorders and diseases of the spine has increased to 67% (Cauci et al., 2017; Krasin et al., 2022).

To date, there is no unified theory of the development of spinal osteochondrosis in children. Therefore, the tasks of both health-improving physical culture and physical rehabilitation in this pathology are not fully defined (Stich et al., 2015; Fonseca et al., 2022).

In medical practice, there are the following types of osteochondrosis: cervical, lumbar, thoracic, combined. With cervical osteochondrosis, aching pains appear in the back of the head, side and back of the neck. Pain can radiate to the arm, forearm or fingers, and sensitivity is impaired. The pain can be aching, pulling or stabbing. Head movements are difficult. Cervical osteochondrosis is a very dangerous disease, since in the affected part of the spine, in addition to the spinal cord, there are arteries that feed the brain, and their pinching is fraught with the most severe consequences, because the nutrition of the brain is disrupted. That is why with

Corresponding Author: POLEVOY G.G., E-mail: g.g.polevoy@gmail.com

cervical osteochondrosis, headaches, dizziness, fainting, numbness of the tongue, tinnitus, hearing impairment, vision, laryngeal diseases, increased blood pressure are observed (Olstad et al., 2022; Michaela & Martina, 2024). The main attention in the occurrence of osteochondrosis is given to the improper load on the intervertebral discs. Intervertebral discs play the role of shock absorbers that soften the pressure on the spine under stress. Back muscles are an important source of nutrients for the disc (Cauci et al., 2017; Fonseca et al., 2022; Krasin et al., 2022).

The most common causes of osteochondrosis may be hypothermia, infection, congestion, excessive consumption of table salt, alcohol and smoking. Often exacerbations of osteochondrosis are provoked either by sharp mechanical influences, or by the development of inflammatory processes in the spinal roots, or by an improper lifestyle (Stich et al., 2015; Olstad et al., 2022; Michaela & Martina, 2024).

Systematic muscular overstrain during labor operations associated with prolonged fixation of the working posture can lead to the development of pathology of the cervical spine. Of particular importance in this regard for knowledge workers (including schoolchildren) is the long-term maintenance of a posture associated with reading, writing, working on a computer, in which the head is tilted forward and, consequently, cervical lordosis is smoothed. In all these cases of lordosis smoothing, pressure increases on the anterior segment of the intervertebral disc, whose nutrition is limited due to the many hours and daily maintenance of this position, and degenerative changes develop in this particular area. Therefore, it is the cervical-brachial and lumbar localization of osteochondrosis that are the most diagnosed (Cauci et al., 2017; Fonseca et al., 2022; Krasin et al., 2022).

An integrated approach should be used to treat osteochondrosis. Normalization of lifestyle, which allows optimizing motor activity, is of undoubted importance (Stich et al., 2015; Olstad et al., 2022; Michaela & Martina, 2024). Of course, the prevention of osteochondrosis should begin from early childhood. Proper physical education, prevention of sudden overloads and posture disorders are an important aspect of it. Reducing injuries, static and dynamic overloads of the spine is important in preventing osteochondrosis (Stich et al., 2015; Olstad et al., 2022; Michaela & Martina, 2024). In the prevention and treatment of osteochondrosis, systematic exercises in therapeutic physical gymnastics are essential. When practicing therapeutic gymnastics, blood circulation in the muscles improves (Nguyen et al., 2021; Garzonio et al., 2022; de Zoete, 2023).

A review of the literature on the problem shows that many research authors offer their own methods of therapeutic physical education. The method of using physical exercises is based on the principle of controlling your feelings and physical condition (Sterling et al., 2019; Nguyen et al., 2021; Ling et al., 2023).

In some cases, the authors suggest orthopedic treatment, which consists in the use of breathing exercises aimed at unloading the spine. This weakens reflex-painful muscle spasm and compression of the intervertebral discs (Nguyen et al., 2021; Garzonio et al., 2022; de Zoete, 2023). There are techniques that prove the effectiveness of using special simulators that allow you to put stress on the muscles surrounding the affected area. This contributes to the flow of blood and nutrients to this place (Sterling et al., 2019; Nguyen et al., 2021; Ling et al., 2023). All the authors emphasize that in osteochondrosis of the spine, the use of physical exercises allows you to normalize the pressure on the spine and relieve the affected spinal cord roots (Nguyen et al., 2021; Garzonio et al., 2022; de Zoete, 2023). Physical education for cervical osteochondrosis, like other physical activities, requires the right approach and compliance with certain rules. Following these rules will allow you to get the maximum positive effect from the exercises (Sterling et al., 2019; Nguyen et al., 2021; Ling et al., 2023).

Thus, today the problem of cervical osteochondrosis is acute, which can be solved with the help of physical exercises. In this study, we aimed to improve the function of the musculoskeletal system in high school students with osteochondrosis of the cervical spine, improve their physical development and level of physical fitness through adaptive physical education in extracurricular institutions and facilitate independent individual home exercises.

Tasks:

1) To study the current health problems of schoolchildren

2) Determine the causes of osteochondrosis and its effect on humans

3) To develop a methodology for the use of physical rehabilitation tools for osteochondrosis of the cervical spine.

Methods:

Study participants

The pedagogical experiment involved boys and girls aged 14-16 who were diagnosed with osteochondrosis of the cervical spine. A total of 38 schoolchildren participated in the study.

Organization of the study

The study was conducted from February 25 to May 25, 2023 on the basis of several secondary schools №42, №46, №54, №60 and No. 66 of the city of Kirov.

2 groups were formed to conduct the study:

The control group consisted of schoolchildren from school No. 42 (7 children), from school No. 46 (5 children), from school No. 54 (7 children). There are 19 children in total.

The experimental group consists of schoolchildren from school No. 60 (11 children), from school No. 66 (8 children). There are 19 children in total.

In all schools of the city of Kirov in Russia, physical education classes are held 3 times a week for 40 minutes. All students in both groups studied according to the standard curriculum of educational institutions (Kainov & Kuryerova, 2019).

Children from the control group were engaged in a standard physical education program at school. It is important to note that children who are diagnosed with cervical osteochondrosis, as a rule, do not participate in outdoor games and sports games with their peers. This is a medical health recommendation. In this part of the lesson, children from the control group watched their peers who participate in outdoor games or had the opportunity to repeat previously passed material. As a rule, this is 7-8 minutes of the total duration of the lesson in some classes. At that time, children from the experimental group performed sets of physical exercises from the developed methodology (7-8 minutes). Also, students from the experimental group received homework in the form of a set of exercises that had to be done at home before the next physical education lesson. An example of a physical education lesson in both groups is shown in table 1.

Table 1. Physical education lesson in control and experimental groups

Parts of the lesson	The control group	The experimental group
Preparatory (5 minutes)	To prepare the body for the upcoming load: pulse check, general warm-up.	
Main (30 minutes)	Fulfilling the main purpose and objectives of the lesson, for example, studying the high jump using the "scissors" method. Improving the skill of throwing a tennis ball at a distance.	
	Outdoor or sports games	A set of exercises from an experimental technique
The final (5 minutes)	To reduce the emotional background of those involved and bring the body into a calm state: pulse measurement and breathing exercises	

The requirements that were imposed on the experimental method:

1. Compliance of the exercises used with the age characteristics of the students;
2. Accessibility of the exercises used to perform them;
3. Follow the principle of consistency from simple to complex;
4. Increasing interest in the classes being held.

The main means of the proposed technique are self–massage, general developmental exercises without objects, general developmental exercises with a gymnastic stick, with a stuffed ball, breathing exercises, coordination exercises, special complexes of therapeutic gymnastics, which gradually increased the load on the cervical spine and contributed to improving mobility in the cervical spine, thereby preventing the exacerbation of osteochondrosis of the cervical spine.

The complexes used exercises in which students learned proper breathing, exercises were used to increase the vertical size of the intervertebral openings, exercises for muscle relaxation were used to increase the mobility of the vertebrae in the cervical region, as well as special exercises to strengthen the muscles of the shoulder girdle. A separate complex consisted of tasks that the students completed at home.

An approximate set of exercises that allows you to teach proper breathing when performing exercises:

The starting position is standing, arms along the body.

1. Raise your arms up, pull up – inhale; return to the starting position – exhale.
2. Tilt to the left side with your right hand raised up while inhaling.
3. The same exercise, but during exhalation.
4. Raise your hands up – inhale, sit down slowly, exhaling, and wrap your arms around your knees.
5. Raise your arms up through the sides, rising on your toes – inhale, lean forward freely, lowering your arms – exhale
6. Starting position – standing, hands on the belt. Circular movements of the pelvis to the right and left. Breathing is arbitrary.
7. Easy running (3-4 minutes); follow your breathing – inhale for 3 steps, exhale for 4 steps.

An approximate set of exercises that allows you to increase the mobility of the vertebrae in the cervical spine:

The starting position is standing, arms along the body.

1. Turn your head to the far right position, try to turn your head a little further with light springy movements, then the same thing to the left.
2. Lower your head down, trying to press your chin to your chest as much as possible. Try to lower your head even lower with light springy movements.
3. Pull your head back while retracting your chin. Try to move your head a little further back with light springy movements.
4. The palm of one hand on the forehead. Tilting your head forward, while pressing your palm on your forehead, counteracting the movement of the head, for about 10-15 seconds, then rest for the same amount of time.

5. The same thing, but the palm is in the temple area. Tilting the head to the side, simultaneously press on it with the palm of your hand, counteracting the movement of the head for about 10-15 seconds. Rest.

6. Raise your shoulders as much as possible and hold them in this position for 10-15 seconds. Relax, lower your shoulders and take a deep breath.

7. The starting position is lying on the gym mat. Lying on your side, lift your head 1-3 cm, hold it in this position for 10-15 seconds

8. The same thing, but lying on your stomach, lift your head 1-3 cm, hold it in this position for 10-15 seconds.

An approximate set of exercises that allows you to strengthen the muscles of the shoulder girdle:

The starting position is standing, arms along the body.

1. Lower and raise your shoulders: left – up, right – down. Then both shoulders are up. Perform slowly at first, then increase the tempo.

Raise your arms up, spread them apart and lower them down. Repeat 10-15 times standing and sitting, first at a slow pace, then at a fast pace.

Raise your arms up to shoulder height, spread them apart, lift them over your head and return to the starting position. Let go of your hands. Do the same thing while sitting.

Raise your arms to the sides at shoulder height and make rotational movements with them. Do the same thing while sitting at a slow and then fast pace.

An approximate set of exercises for homework:

1. Starting position – lying on the gym mat, spread your arms apart, slightly turning your torso to the left, reach your left palm with your right hand. Do the same thing the other way. Repeat 7-8 times.

2. Starting position – lying on your back with your knees bent, take hold of the edge of the sofa or the headboard with your hands. Slowly raise the torso, trying to reach the hands with the feet of the feet. Repeat the exercise 7-8 times.

3. Starting position – sitting on a chair, slowly raise your head up, lower it, then tilt your head to the right, to the left (the amplitude of movements is small) repeat 7-8 times.

4. Starting position – sitting on a chair. Slowly bend forward (back straight, head stretches forward); return to the starting position.

To assess the effectiveness of the experimental exercise technique, control tests were used, which were conducted before and after the experiment (Kainov & Kuryerova, 2019):

1. The static endurance of the abdominal muscles was measured by holding the legs at a 90-degree angle on the Swedish wall.

2. The static strength of the back muscles was measured by holding the "boat" position while lying on your stomach.

3. The strength of the arm muscles was assessed by the number of flexion and extension of the arms in the prone position.

4. The flexibility of the cervical spine was evaluated to the right and left sides so that the chin was turned to the side as much as possible.

5. The strength of the muscles of the cervical spine was assessed by holding the head lying on the back, on the stomach (the head must be lifted).

The main indications for the use of therapeutic gymnastics are:

1) lack of sufficient physical activity;
2) osteochondrosis of the cervical, thoracic, lumbar spine at any stage;
3) scoliosis and other diseases of the spine;
4) diseases of the cardiovascular system;
5) respiratory and digestive diseases.

Despite the wide therapeutic effect, the use of therapeutic physical culture is undesirable in the following cases:

1) for any diseases occurring in an acute form;
2) in case of exacerbation of existing chronic diseases;
3) within a month after the viral infection;
4) within a year after a myocardial infarction;
5) in the presence of malignant neoplasms;
6) with a tendency to bleeding;
7) in the case of an aortic aneurysm;
8) with tachycardia over 100 beats per minute;
9) in case of violation of the heart rhythm and conduction of the heart muscle;
10) in case of hypertension, blood pressure is over 160/100;
11) in severe form of diabetes mellitus.

Methods of mathematical statistics. When analyzing the results, their statistical processing was carried out using the following indicators:

1. The arithmetic mean (M)
2. The average square deviation (Q)
3. The average error (m)
4. The average error of the difference (if t is calculated > than t is tabular, then P<0.05, then the results are reliable).

When using this research method, data is obtained confirming or refuting the hypothesis put forward in the study.

Results

To evaluate the effectiveness of the experimental exercise technique, various functional tests and tests were used, which were conducted before and after the experiment. The average results of both groups, which were obtained before the start of the pedagogical experiment, are presented in Table 2.

Table 2. Indicators of the control and experimental groups before the start of the study

Types of abilities	The control group			The experimental group			T	P
	Mn	Qn	mn	Mn	Qn	mn		
Static strength of the abdominal muscles	47,0	9,7	5,7	54,0	7,2	4,2	t=0,98	p>0,05
Static strength of the back muscles	64,0	4,8	3,6	53,0	9,7	5,7	t=1,63	p>0,05
Flexibility of the cervical spine to the left side	6,0	1,4	0,8	6,0	1,4	0,8	t=0	p>0,05
Flexibility of the cervical spine to the right side	6,0	1,4	0,8	6,0	0,9	0,5	t=0	p>0,05
Speed and strength abilities of the arm muscles	46,0	14,5	6,5	42,0	9,7	5,7	t=0,39	p>0,05
Endurance of the cervical spine lying on your back	59,0	9,7	5,7	56,0	22,8	13,4	t=0,20	p>0,05
Endurance of the cervical spine lying on your stomach	76,0	4,8	2,8	83,0	7,2	4,2	t=1,38	p>0,05

The results of testing at the beginning of the pedagogical experiment showed that the studied students in the control and experimental groups did not differ in static endurance of the muscles of the trunk and legs, flexibility and endurance of the cervical spine. This indicates that the groups are homogeneous according to these indicators. This fact allows us to objectively verify the effectiveness of the experimental technique.

After the end of the pedagogical experiment, all students took control tests again, the test results are shown in Table 3.

Table3. Indicators of the experimental and control groups after the study

Types of abilities	The experimental group			The control group			T	P
	Mn	Qn	mn	Mn	Qn	mn		
Static strength of the abdominal muscles	71,0	9,7	5,7	52,0	10,7	6,3	t=2,23	p>0,05
Static strength of the back muscles	72,0	7,3	4,2	69,0	2,4	1,4	t=0,68	p>0,05
Flexibility of the cervical spine to the left side	10,0	0,9	0,5	6,0	1,4	0,8	t=4,25	**p<0,05**
Flexibility of the cervical spine to the right side	10,0	0,9	0,5	6,0	1,4	0,8	t=4,25	**p<0,05**
Speed and strength abilities of the arm muscles	64,0	12,1	7,1	47,0	2,4	1,4	t=2,35	p>0,05
Endurance of the cervical spine lying on your back	80,0	12,1	7,1	61,0	3,2	1,5	t=2,38	**p<0,05**
Endurance of the cervical spine lying on your stomach	102,5	9,7	5,7	83,0	4,8	2,8	t=3,07	**p<0,05**

Table 3 shows changes in the studied indicators with positive dynamics in both groups. However, not all indicators are reliable (p>0.05). For example, the indices of flexibility and endurance between the control and experimental groups in the cervical spine significantly improved (p<0.05).

Table 4 shows the changes in the indicators in the control group from the beginning to the end of the pedagogical experiment.

Table 4. The indicators of the control group at the beginning and at the end of the study

Types of abilities	At the beginning of the study			At the end of the study			T	P
	Mn	Qn	mn	Mn	Qn	mn		
Static strength of the abdominal muscles	47,0	9,7	5,7	52,0	10,7	6,3	t=0,58	p>0,05
Static strength of the back muscles	64,0	4,8	3,6	69,0	2,4	1,4	t=0,87	p>0,05
Flexibility of the cervical spine to the left side	6,0	1,4	0,8	6,0	1,4	0,8	t=0	p>0,05
Flexibility of the cervical spine to the right side	6,0	1,4	0,8	6,0	1,4	0,8	t=0	p>0,05
Speed and strength abilities of the arm muscles	46,0	14,5	8,5	47,0	2,4	1,4	t=0,10	p>0,05
Endurance of the cervical spine lying on your back	59,0	9,7	5,7	61,0	2,4	1,4	t=0,66	p>0,05
Endurance of the cervical spine lying on your stomach	76,0	4,8	2,8	83,0	4,8	2,8	t=1,77	p>0,05

Table 4 shows that the average group indicators of various types of abilities in the control group at the end of the pedagogical experiment do not have significant differences and are unreliable (p>0.05).

At the same time, table 5 shows changes in indicators in the experimental group from the beginning to the end of the pedagogical experiment.

Table 5. Indicators of the experimental group at the beginning and at the end of the study

Types of abilities	At the beginning of the study			At the end of the study			T	P
	Mn	Qn	mn	Mn	Qn	mn		
Static strength of the abdominal muscles	54,0	7,2	4,2	71,0	9,7	5,7	t=5,27	**p<0,05**
Static strength of the back muscles	53,0	9,7	5,7	82,0	7,3	4,2	t=4,09	**p<0,05**
Flexibility of the cervical spine to the left side	6,0	1,4	0,8	10,0	0,9	0,5	t=4,94	**p<0,05**
Flexibility of the cervical spine to the right side	6,0	0,9	0,5	10,0	0,9	0,5	t=5,71	**p<0,05**
Speed and strength abilities of the arm muscles	42,0	9,7	5,7	64,0	12,1	7,1	t=3,41	**p<0,05**
Endurance of the cervical spine lying on your back	56,0	22,8	13,4	80,0	12,1	7,1	t=3,58	**p<0,05**
Endurance of the cervical spine lying on your stomach	83,0	7,2	4,2	102,5	9,7	5,7	t=2,79	**p<0,05**

Table 5 shows that in the experimental group, the indicators of the static strength of the abdominal muscles increased from 54.0 to 71.0, the static strength of the back muscles increased from 53.0 to 82.0, the flexibility of the cervical spine in the right side increased from 6.0 to 10.0. Changes in the indices of flexibility of the cervical spine to the left (from 6.0 to 10.0), speed and strength abilities of the hands (from 42.0 to 64.0), endurance of the cervical spine lying on the back (from 56.0 to 80.0), endurance of the cervical spine lying on the stomach (from 83.0 to 102.0). All these indicators have changed significantly and are of a reliable nature (p<0.05). Such results indicate the sufficient effectiveness of the experimental technique.

In order to visually assess the effectiveness of the experimental technique in comparison with the standard program, we determined the percentage increase in indicators in each test from the beginning to the end of the experiment and presented the results in the form of a diagram (Figure 1).

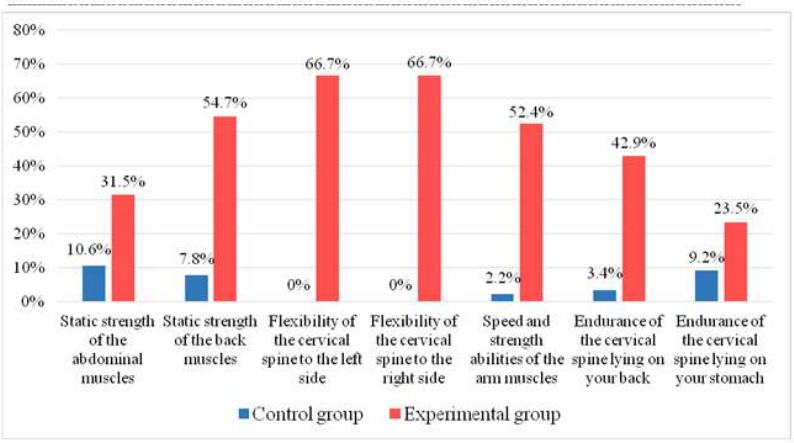

Fig. 1. The increase in indicators in both groups from the beginning to the end of the study

Figure 1 shows that the experimental method, in comparison with the standard program, gives the best result in all indicators. Therefore, it can be concluded that it is more effective in the treatment of cervical osteochondrosis.

Discussion

The problem of osteochondrosis is one of the urgent health problems of the younger generation and is associated with an increase in the number of children and adolescents suffering from diseases of the musculoskeletal system (Weaver et al., 2020; Requejo et al., 2022; Masrun et al., 2023; Kozina et al., 2024; Nikšić et al., 2024). At the same time, the main role of physical exercises in restoring impaired spinal functions is noted today by all leading scientists (Connolly et al., 2020; de Jesus et al., 2022; García-Hermoso et al., 2020; Rodríguez-Rodríguez et al., 2020). This problem needs to be solved, since it is in childhood that all the main pathological motor stereotypes are formed, which only become fixed with age and lead to a deterioration in the functioning of the entire musculoskeletal system (Cauci et al., 2017; Fonseca et al., 2022; Krasin et al., 2022).

In our previous studies, we emphasized the acute problem of school children's health, the issue of insufficient motor activity and a weak level of physical development (Polevoy, 2021; Polevoy, 2022; Polevoy, 2024). In the current study, the focus was on rehabilitation of the musculoskeletal system, as it is important in the daily lives of both children and adults (Stich et al., 2015; Olstad et al., 2022; Michaela & Martina, 2024).

To solve this problem, a methodology has been developed for using various means of physical rehabilitation to restore the musculoskeletal system, improve the indicators of physical development and physical fitness in children of senior school age in regular forms of classes and additional individual classes at home. According to the results of this study, children who were assigned to the control group and engaged in the usual physical education program at school were able to only slightly improve some of the studied indicators. The data improved to 10.6%, the increase in indicators from the beginning to the end of the study for all tests turned out to be unreliable ($p>0.05$). Such data indicate the low effectiveness of the standard program in the prevention and treatment of children with cervical osteochondrosis at this age, as well as the fact that in physical education classes, children with cervical osteochondrosis need to use special exercises to strengthen the neck muscles, instead of watching their peers play sports or outdoor games. As for the children from the experimental group, the average level of their indicators from the beginning to the end of the study showed a positive and significant increase. For example, the static strength of the abdominal muscles increased by 31.5%, the static strength of the back muscles increased by 54.7%, and the flexibility of the cervical spine on both the right and left improved by 66.7%. The speed and strength abilities of the arms improved by 52.4%, and the endurance of the cervical spine lying on the back became 42.9% higher, and on the stomach 23.5%. All indicators from the beginning to the end of the study in the experimental group have changed significantly and are reliable ($p<0.05$). Therefore, it can be concluded that the technique we have developed is more effective in the treatment of cervical osteochondrosis than the standard physical education program at school. Of course, the problem of cervical osteochondrosis is not new, there are several studies that are aimed at solving such a problem. However, many of them often offer special simulators, a multi-stage training system or training (Nguyen et al., 2021; Garzonio et al., 2022; de Zoete, 2023). Many authors are unanimous in the opinion that physical exercise has a beneficial effect on the treatment of cervical osteochondrosis, however, in some cases these exercises are called secondary, along with other means of prevention and treatment (Sterling et al., 2019; Nguyen et al., 2021; Ling et al., 2023). The uniqueness of this study lies in the fact that in a fairly short period of time (3 months) we managed to achieve significant progress in the rehabilitation of the cervical spine, to fix the muscular corset around the spinal column. It is recommended that at each physical education lesson for 6-7 minutes during play exercises or outdoor games in which children with cervical osteochondrosis do not participate, perform special sets of physical exercises aimed at strengthening the muscular apparatus. It is also recommended to use the exercise complexes of the current study at home. It does not take much time, does not require much effort or special simulators, but has an effective positive effect. It is recommended to use physical exercises available for children during classes with school-age children, they should be regular and constant in order to ensure the growth or maintenance of an optimal level of fitness of the body. It is necessary to gradually increase the intensity, complexity and duration of training sessions (Sterling et al., 2019; Nguyen et al., 2021; Garzonio et al., 2022; de Zoete, 2023 Ling et al., 2023). There is no doubt that the current study could be improved, for example, by including additional tests or involving students of a different age. This is one of the directions for future research.

Conclusion

The standard physical education program at school has a positive, but not significant effect on the treatment of osteochondrosis of the cervical spine of schoolchildren.

If the standard physical education program at school is supplemented with special physical exercises for the treatment of cervical osteochondrosis and apply them at every physical education lesson and give homework to students, then their performance will significantly improve. The indicators of static strength of the abdominal and back muscles, flexibility and endurance of the cervical spine and the speed and strength abilities of the arm muscles will increase significantly. The study expands the theoretical section of the standard physical education program at school and makes a practical contribution to the system of physical education of children at school. The practical experience gained during the pedagogical experiment can be used in working with children in any general educational school in physical education classes, as well as at home, since special devices or special physical training are not required to perform a special set of exercises.

References

Cauci, S., Viganò, M., de Girolamo, L., De Luca, P., Perucca Orfei, C., Banfi, G., Lombardi, G., Brayda-Bruno, M., & Colombini, A. (2017). High Levels of Circulating Type II Collagen Degradation Marker (CTx-II) Are Associated with Specific VDR Polymorphisms in Patients with Adult Vertebral Osteochondrosis. International journal of molecular sciences, 18(10), 2073. https://doi.org/10.3390/ijms18102073

Connolly, S., Carlin, A., Johnston, A., Woods, C., Powell, C., Belton, S., O'Brien, W., Saunders, J., Duff, C., Farmer, O., & Murphy, M. (2020). Physical Activity, Sport and Physical Education in Northern Ireland School Children: A Cross-Sectional Study. International journal of environmental research and public health, 17(18), 6849. https://doi.org/10.3390/ijerph17186849

de Jesus, G. M., de Oliveira Araujo, R. H., Dias, L. A., Barros, A. K. C., Dos Santos Araujo, L. D. M., & de Assis, M. A. A. (2022). Attendance in physical education classes, sedentary behavior, and different forms of physical activity among schoolchildren: a cross-sectional study. BMC public health, 22(1), 1461. https://doi.org/10.1186/s12889-022-13864-9

de Zoete, R. M. J. (2023). Exercise Therapy for Chronic Neck Pain: Tailoring Person-Centred Approaches within Contemporary Management. Journal of Clinical Medicine, 12(22):7108. https://doi.org/10.3390/jcm12227108

Fonseca, J. P., Figueiredo, P., & Pinheiro, J. P. (2022). Osteochondroses in children's sports practice - a rare case of van neck-odelberg disease. Journal of rehabilitation medicine. Clinical communications, 5, 4593. https://doi.org/10.2340/jrmcc.v5.4593

García-Hermoso, A., Alonso-Martínez, A. M., Ramírez-Vélez, R., Pérez-Sousa, M. Á., Ramírez-Campillo, R., & Izquierdo, M. (2020). Association of Physical Education With Improvement of Health-Related Physical Fitness Outcomes and Fundamental Motor Skills Among Youths: A Systematic Review and Meta-analysis. JAMA pediatrics, 174(6), e200223. https://doi.org/10.1001/jamapediatrics.2020.0223

Garzonio, S., Arbasetti, Ch., Geri, T., Testa, M., Carta, G. (2022). Effectiveness of Specific Exercise for Deep Cervical Muscles in Nonspecific Neck Pain: A Systematic Review and Meta-Analysis. Physical Therapy, 102(5):pzac001. https://doi.org/10.1093/ptj/pzac001

Kainov AN, Kuryerova GI Working programs. Physical Culture. Grades 1-11. A comprehensive program of physical education for schoolchildren. Teacher. 2019:169

Kozina, ZH., Berezhna, Ya., Boychuk, Yu., Kozin, O., Golenkova Yu., Polishchuk, S., Sanjakumar, S. (2024). Assessment of reaction speed and nervous system characteristics: implications for physical exercise selection in humanities students' physical education. Journal of Physical Education and Sport, 24 (3), 513-520. DOI:10.7752/jpes.2024.03062

Krasin, E., Schermann, H., Snir, N., Tudor, A., & Behrbalk, E. (2022). A Quick and Comprehensive Guide to Differential Diagnosis of Neck and Back Pain: a Narrative Review. SN comprehensive clinical medicine, 4(1), 232. https://doi.org/10.1007/s42399-022-01321-y

Ling, J., Thirumavalavan, J., Shin, C., Lee, T. M., Marco, R. A. W., & Hirase, T. (2023). Postoperative Rehabilitation to Improve Outcomes After Cervical Spine Fusion for Degenerative Cervical Spondylosis: A Systematic Review. Cureus, 15(5), e39081. https://doi.org/10.7759/cureus.39081

Ma, C., Zhang, Y., Zhao, M., Bovet, P., & Xi, B. (2020). Physical Activity and Sedentary Behavior among Young Adolescents in 68 LMICs, and Their Relationships with National Economic Development. International journal of environmental research and public health, 17(21), 7752. https://doi.org/10.3390/ijerph17217752

Masrun, Khairuddin, Umar, Valyauma. (2023). Implementation of fun game training model toward improving kid's locomotor movement and concentration. Journal of Physical Education and Sport, 23 (12), 3364-3370. DOI:10.7752/jpes.2023.12385

Michaela, S., Martina, M. (2024). Effect of an exercise program on the body posture of young school-aged pupils. Journal of Physical Education and Sport, 24(3), 747-753. DOI:10.7752/jpes.2024.03088

Nguyen, T. M., Nguyen, V. H., Kim, J. H. (2021). Physical Exercise and Health-Related Quality of Life in Office Workers: A Systematic Review and Meta-Analysis. International Journal of Environmental Research and Public Health, 18(7):3791. https://doi.org/10.3390/ijerph18073791

Nikšić, E., Rašidagić, F., Mekić, A., Beganović, E. (2024). Basic motor skills among 2nd–9th-grade elementary school students. Journal of Physical Education and Sport, 24(2), 253-259. DOI:10.7752/jpes.2024.02030

Olstad, K., Aasmundstad, T., Kongsro, J., & Grindflek, E. (2022). Osteochondrosis and other lesions in all intervertebral, articular process and rib joints from occiput to sacrum in pigs with poor back conformation, and relationship to juvenile kyphosis. BMC veterinary research, 18(1), 44. https://doi.org/10.1186/s12917-021-03091-6

Polevoy, G. G. (2021). Development of the ability to unite movements of schoolchildren with the help of exercises classics. Int J Hum Mov Sports Sci, 9(4), 797-806. doi: 10.13189/saj.2021.090426.

Polevoy, G. (2022). The influence of burpee on the stability of attention of schoolchildren. Motriz: rev educ fis, 28. doi 10.1590/S1980-657420220004422.

Polevoy, G. (2024). Endurance and a sensitive period for its development in children. Journal of Physical Education and Sport, 24(3), 544-551. DOI:10.7752/jpes.2024.03065

Requejo, J., Strong, K., Agweyu, A., Billah, S. M., Boschi-Pinto, C., Horiuchi, S., Jamaluddine, Z., Lazzerini, M., Maiga, A., McKerrow, N., Munos, M., Park, L., Schellenberg, J., & Weigel, R. (2022). Measuring and monitoring child health and wellbeing: recommendations for tracking progress with a core set of indicators in the Sustainable Development Goals era. The Lancet. Child & adolescent health, 6(5), 345–352. https://doi.org/10.1016/S2352-4642(22)00039-6

Rodríguez-Rodríguez, F., Cristi-Montero, C., & Castro-Piñero, J. (2020). Physical Activity Levels of Chilean Children in a National School Intervention Programme. A Quasi-Experimental Study. International journal of environmental research and public health, 17(12), 4529. https://doi.org/10.3390/ijerph17124529

Sterling, M., de Zoete, R. M. J., Coppieters, I., & Farrell, S. F. (2019). Best Evidence Rehabilitation for Chronic Pain Part 4: Neck Pain. Journal of clinical medicine, 8(8), 1219. https://doi.org/10.3390/jcm8081219

Stich, S., Stolk, M., Girod, P. P., Thomé, C., Sittinger, M., Ringe, J., Seifert, M., & Hegewald, A. A. (2015). Regenerative and immunogenic characteristics of cultured nucleus pulposus cells from human cervical intervertebral discs. PloS one, 10(5), e0126954. https://doi.org/10.1371/journal.pone.0126954

Weaver, R. G., Armstrong, B., Hunt, E., Beets, M. W., Brazendale, K., Dugger, R., Turner-McGrievy, G., Pate, R. R., Maydeu-Olivares, A., Saelens, B., & Youngstedt, S. D. (2020). The impact of summer vacation on children's obesogenic behaviors and body mass index: a natural experiment. The international journal of behavioral nutrition and physical activity, 17(1), 153. https://doi.org/10.1186/s12966-020-01052-0

Wilhite, K., Booker, B., Huang, B. H., Antczak, D., Corbett, L., Parker, P., Noetel, M., Rissel, C., Lonsdale, C., Del Pozo Cruz, B., & Sanders, T. (2023). Combinations of Physical Activity, Sedentary Behavior, and Sleep Duration and Their Associations With Physical, Psychological, and Educational Outcomes in Children and Adolescents: A Systematic Review. American journal of epidemiology, 192(4), 665–679. https://doi.org/10.1093/aje/kwac212

Yin, N., Yu, X., Wang, F., Yu, Y., Wen, J., Guo, D., Jian, Y., Li, H., Huang, L., Wang, J., & Zhao, Y. (2022). Self-Reported Sedentary Behavior and Metabolic Syndrome among Children Aged 6-14 Years in Beijing, China. Nutrients, 14(9), 1869. https://doi.org/10.3390/nu14091869