Original Article

Development of physical and functional abilities of students of the special medical group

Georgiy Polevoy

ABSTRACT

The aim of the study

Is to improve the level of development of functional abilities and physical qualities of students with health limitations.

Methods

The pedagogical experiment was conducted in 2023 at Moscow University in Russia. The study involved 128 students aged 18-19 who have health limitations. Adaptive physical education classes were held twice a week for 90 minutes. 64 students from the control group studied according to the adaptive physical education program at a higher educational institution. 64 students from the experimental group studied according to the developed experimental program aimed at improving functions of the respiratory system and developing physical qualities.

Results

After the end of the educational experiment, the indicators in the control group improved in the Stange Test by 2.6% ($p>0.05$), the Genchi Test remained at the same level of 35±1 sec. The long jump increased by 0.5% ($p>0.05$), and the arm muscle strength improved by 4.5% ($p>0.05$). The indicators of the flexibility test decreased by 7.7% ($p>0.05$), and abdominal muscle strength decreased by 5% ($p>0.05$). These results show the low efficiency of the standard adaptive physical education program at university. In the experimental group, the average indicators in the Stange Test became higher by 5% ($p>0.05$), and in the Genchi Test by 12.5% ($p<0.05$). The standing long jump improved by an average of only 1 cm ($p>0.05$), but the abdominal muscle strength increased by 21.6% ($p<0.05$). The arm muscle strength increased by 8% ($p>0.05$), and flexibility improved by 33.3% ($p<0.05$). These results indicate the effectiveness of the experimental program.

Conclusion

The use of the experimental program for the development of physical qualities and functional abilities of students engaged in adaptive physical education at university will significantly improve flexibility, abdominal muscle strength and breath holding on exhalation. Strength of muscles of arms and legs and breath holding on inhalation will also improve.

Keywords

Adaptive physical education, Therapeutic physical education, Physical exercises, Health group, Hypodynamia, Physical activity.

INTRODUCTION

Modern society needs not only highly qualified and professionally trained, but also healthy specialists. Monitoring of physical fitness of Russian students has shown that the number of students with disabilities is 25-30%. At the same time, it is known that people's health depends on lifestyle (up to 50%), heredity (15-20%), environment (15-20%), medicine (15-20%).[1,2] In this regard, in modern society, the leading role is played by the education system focused on the formation of a healthy lifestyle of students, since this is a pedagogically dependent factor. Physical education practices occupy a central place in the structure of a healthy lifestyle.[3,4]

The need for movement is natural for the body. Lack of physical activity is one of the causes of poor posture, deterioration of foot function, overweight and other disorders in physical development; the cause of a slowdown in motor development, a decrease in the functionality of the cardiovascular and respiratory systems. Limited muscle activity delays the development of the body, worsens well-being and leads to the fact that at subsequent age stages children have difficulty mastering vital motor skills.[5,6]

Physical inactivity weakens all body functions and is a common condition for the development of most diseases. In adolescents, this leads to a lag in the physical development of all organs and systems. Chronically ill adolescents have an under-development of the heart, nervous system and blood vessels, and it also has a negative psychological impact.[7,8]

Correspondence

Polevoy G.G. Department of Physical Education, National Research University of Electronic Technology «MIET», Moscow, Russia. E-mail: g.g.polevoy@gmail.com

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As a rule, limitations in the state of health are a consequence of reduced physical activity or limitation of intense developmental loads. Decreased physical activity is a consequence of health limitations, it is a factor that supports a painful condition, or an independent cause of the disease.[9,10]

Physical education occupies a central place in the structure of a healthy lifestyle, which dictates the need to improve physical education and training of students based on modern scientific developments in the field of physiology and physical culture.[11,12]

At school, college, vocational school, or university, all students undergo a medical examination and, according to its results, students are divided into study groups: basic, preparatory, and special.[13,14]

Children from the main medical group are students who do not have health restrictions or with minor limitations, this may be a sufficient level of physical fitness. Physical activity for the students of the main group is provided in full:

- classes in the physical education program are conducted in full;
- children can attend sports sections;
- participation in competitions is mandatory.

Students from the preparatory medical group are children with insufficient physical development and poor physical fitness, who have no restrictions or minor deviations in their health status.

Permissible physical activity in the preparatory group:

- the requirements for the implementation of the physical education curriculum have been reduced;
- it is characterized by the gradual acquisition of a set of motor skills, especially those associated with increased demands on the body;
- additional classes are possible to improve the level of physical fitness.

As a rule, physical education classes in the preparatory group are conducted jointly with the main group in accordance with the curriculum.

A special medical group is children with permanent or temporary health restrictions who require limited physical activity and who are allowed to perform academic and industrial work.

It should be noted that the specifics of diseases and various contraindications for students of a special medical group significantly limit the list of means and methods of physical education and complicate the organization of the pedagogical process.

The recruitment of a special medical group (SMG) has a number of features and is carried out before the start of the school year, taking into account age, physical fitness, functional status and severity of the pathological process.

Depending on the severity and nature of the disease of students assigned to SMG, it is recommended to differentiate children into subgroups A, B and C, in order to take a more individual approach to the choice of motor modes.

1. Subgroup “A” - students with reversible disabilities. This allows us to hope for their transfer to the preparatory group after several years of classes. Students in this group are allowed to attend physical education classes at an educational institution under special programs.
2. Subgroup “B” - students with organic irreversible changes in the state of organs and systems. For them, the main and quite achievable goal of classes should be to move to the “A” subgroup.
3. Subgroup “C” - students with severe disorders of the musculoskeletal system, with residual effects after paralysis and paresis, after injuries of the upper and lower extremities, with spinal problems, flat feet. Such children usually engage in physical therapy outside the educational institution.

The main objectives of physical education in the SMG are[13-15]:

- health promotion;
- reduction of past illnesses and elimination of functional limitations;
- increasing the physical activity of organs and systems weakened by illness;
- formation of correct posture, and if necessary, its correction;
- teaching correct breathing.

The recruitment of students assigned to the SMG is carried out by a medical professional of the educational institution. Attendance of physical therapy classes by students classified as SMG for health reasons is mandatory.[16,17]

For students of the "A" subgroup, the loads gradually increase in intensity and volume in accordance with the adaptive and functional capabilities of the body. Motor modes with a pulse rate of 130-150 beats per minute are considered optimal for the cardiorespiratory system in aerobic breathing conditions and provide a good training effect. A pulse rate of more than 150 beats per minute is unacceptable, since most of those who study at the SMG suffer from hypoxia and do not tolerate intense physical exertion. Group A includes students with disorders of the musculoskeletal system and neuromuscular system, with spinal deformities and residual effects of injuries.[14,18]

Students of subgroup "B" perform physical exercises at the pulse rate of 120-130 beats/min throughout the school year, since it is under such conditions that harmonious work of the cardiovascular, respiratory, nervous systems, musculoskeletal system is achieved, the necessary abilities are formed, without making increased demands on the weakened body. The following categories of students are included in SMG "B":

1) with chronic cardiovascular diseases;
2) with dysfunctions of the endocrine and nervous systems, in the presence of limitations of the cardiovascular system;
3) with myopia (over 5 diopters);
4) who have had Botkin's disease, acute nephritis, peptic ulcer.[14,18]

The group "C" includes students with respiratory diseases, such as chronic bronchitis, bronchial asthma.

In cases when students do not fit into any subgroup by the profile of the disease, they require individual classes, on the instructions of the doctor they are sent to the therapeutic physical education room at the clinic.

Physical education classes with students of the SMG should be conducted according to specially developed educational programs. They mainly include gymnastic exercises, outdoor games, elements of sports games, athletics.[19,20]

In some cases, with severe disorders of the musculoskeletal and neuromuscular systems and significant health problems that prevent group activities in an educational institution, students are sent to physical therapy classes in special medical institutions.[17,21]

The specifics of physical education classes at the SMG are as follows [22,23]:

- different duration of parts of the class and its change depending on the nature and severity of structural and functional changes in the body caused by the disease, the reaction of the cardiovascular system to physical activity, the period of training;
- individual selection and dosing of general developmental and special exercises taking into account the indications and contraindications for existing diseases;
- constant medical-pedagogical and medical monitoring of changes in the functional state, physical fitness and health of those involved;
- correction of the curriculum taking into account weather, natural and environmental conditions.

The analysis of scientific and methodological literature revealed several of the most common approaches to enrollment of SMG, organizing and conducting physical education classes with this category of students:

The analysis of scientific and methodological literature showed that two approaches are currently most often used to enroll students on the list of special medical groups[18,24]:

1. Enrollment is carried out taking into account the level of functional and physical fitness;
2. The main principle of enrollment is taking into account nosological limitations in health.

Some authors note that when organizing classes with SMG students, it is necessary to pay attention to the level of physical development, physical fitness and functional capabilities of the body of those involved.[23-25]

Thus, there is no consensus on the issues of enrollment and distribution of students in the SMG, as well as the organization and conduct of physical education classes with this category of students. It is advisable to proceed from the fact that the enrollment and distribution of students in the SMG for physical education should be carried out taking into account the reaction of the students' body to physical activity.

Regular physical training improves not only the functioning of the respiratory system, but also affects all organs and systems. Dynamic cyclical exercises of low and moderate intensity involving large muscle groups are useful. A wide range of gymnastic, acrobatic, gaming, and professionally applied exercises are not

contraindicated, provided they are optimally dosed. The criterion for an optimally selected load is a favorable reaction of the cardiovascular system and respiratory organs.[26,27]

The positive changes achieved in therapeutic and health-improving physical training classes must be reinforced daily during independent classes at home. They help to eliminate the manifestations of the disease or its residual signs, and prevent possible complications. The established stable system of habits and needs for physical exercise will help people with chronic diseases to consciously use physical education tools to maintain and improve their own health.[24,28]

The main objectives of physical education in SMG are as follows[25,29]:

1. Maintaining and strengthening health, increasing the level of physical fitness, promoting the correct formation of the body.
2. Maintaining a healthy lifestyle.
3. Fostering students' interest and habit of systematic physical education and sports.
4. Acquiring by students the necessary knowledge of the basics of the theory, methods of organizing physical education in SMG.

To maintain control over the condition of students with certain health limitations, the teacher should suggest that they take their pulse and take long breaks to rest more often. Restorative exercises should be used: cyclical and dynamic (walking, running, swimming), performed with low intensity (pulse rate increases by 20% from baseline) and medium intensity (pulse rate increases by 20-50%).[23,26]

The physical education program at the SMG includes general development, corrective and breathing exercises. In athletics, ski training, swimming, elements of sports games, outdoor games, as well as special health-improving exercises that are indicated for certain diseases, for example, for the respiratory and cardiovascular systems, mainly cyclic exercises, for the musculoskeletal system, primarily during swimming or other types of activities in the water.[19,21]

Students' lives and studies are becoming more stressful every year, requiring the rational use of time and energy. In these conditions, physical education becomes one of the means of increasing mental and physical performance. It is a powerful factor influencing the physical and spiritual development of a person. It should be noted that there are enough students with health restrictions in universities. The organization and methodology of the educational process in physical education of these students has its own characteristics and deserves great attention. Using methods specific to SMG, students with various diseases are helped to develop motor skills and form vital motor abilities.

An analysis of the literature has shown a contradiction between the variety of methods of adaptive physical education of SMG students in higher education institutions and the lack of versatility in the organization and conduct of physical exercises, which are individual for each student depending on diseases of various body systems. The purpose of the study is to increase the level of development of functional capabilities and physical qualities of students with disabilities.

MATERIALS AND METHODS

The scientific research was conducted in 4 stages:

Stage I. January - May 2023 - The literature on the problem was studied, the experience of physical education teachers who work with SMG students was collected and improved, and an adaptive physical education program for SMG students was developed.

Stage II. From September 1 to September 15, 2023, a survey of SMG students was conducted in order to identify the level of physical and functional fitness.

To assess the state of the cardiovascular and respiratory systems, functional tests[29]:

1. were used. The "Barbell test" is the holding of breath while inhaling while standing (sec.).
2. "Genchi test" - holding your breath while exhaling in a standing position (sec.).

Physical fitness was assessed based on the results of standard control exercises.[30]:

1. The muscular strength of the legs was determined using the "Long jump from a standing position" test (cm).
2. The strength of the arm muscles was determined using the standard - "Flexion and extension of the arms in the prone position" (number of times).
3. The strength of the abdominal muscles was determined using the "Lifting the trunk from the prone position" test (number of times).

4. Flexibility was defined in the standard "Leaning forward from a sitting position" (cm).

Stage III. From September 15 to December 30, a basic pedagogical experiment was conducted.

Stage IV. Analysis and processing of the collected material, generalization of experimental data, interpretation of the results obtained and the formation of conclusions based on the results of scientific research.

The reliability of statistical characteristics was calculated using the Student's t-test. When checking the statistical significance, a 5% significance level was selected as the maximum allowable ($P<0.05$).

Main pedagogical experiment

A pedagogical experiment was conducted in the Russian Federation at Moscow University, 128 students with disabilities participated in it. The age of students is 18-19 years old (1st year of study at the university). Physical education classes were held twice a week for ninety minutes in accordance with the curriculum and class schedule. All the students were divided into two informative groups:

1. The control group (64 students) studied under the adaptive physical education program at a higher educational institution, following the recommendations of a physical education teacher.
2. The experimental group (64 students) was engaged in a developed experimental program aimed at improving the functions of the respiratory system and developing physical qualities. The forms of classes included physical exercises aimed at improving the functioning of the body's functional systems. The availability of exercises in adaptive physical education classes was solved by individualizing the dosage of exercises by adjusting the number of repetitions, the pace of movements, the amplitude, and changes in the starting and ending positions. Adaptive physical education classes were based on the principle of a gradual increase and build-up of loads, which resulted in students performing increasingly complex exercises in a complex coordination relationship.

The main part of the lesson includes elements of athletics, gymnastics, strength exercises, sports games. Much attention was paid to correct breathing and the formation of students' posture.[13-16]

Each lesson included a set of breathing exercises (10-12 minutes):

1. Initial position (IP) - lying on the back. Inhale to the count of 1-2; exhale to the count of 3-4;
2. IP - lying on the back. 1-4 - inhale; 5-8 - exhale.
3. IP - lying on the back. 1 - inhale, simultaneously turn the hands outward and move arms to the sides; 2 - exhale, return to IP; 3-4 - the same.
4. IP - sitting, hands on the waist. 1 - exhale, move elbows back; 2 - inhale, return to IP; 3-4 - the same.
5. IP - hands on the neck. 1 - exhale, move elbows back; 2 - inhale, return to IP; 3-4 - the same.
6. IP - lying on the back. 1 - inhale, raise arms up through the sides; 2 - exhale, I.P.; 3-4 - the same.
7. IP - hands behind, clasped. 1 - inhale, lower arms down, straighten shoulders; 2 - exhale, I.P.; 3-4 - the same.

Perform the exercises for 8-12 counts. The set of exercises helps to strengthen the respiratory muscles and increase the mobility of the lungs and chest.[19-23]

In the main part of the lesson, students performed general developmental exercises with light weights (1 kg stuffed balls, gymnastic sticks, 0.5-1 kg dumbbells), throwing light objects for a distance, exercises for the back and abdominal muscles, improving coordination of movements, to consolidate the skill of correct posture in combination with additional exercises. For this purpose, students consistently (lying, sitting and standing) performed various exercises for the muscles of the trunk, upper and lower extremities, including hanging on a gymnastic wall. Special corrective exercises in bending the trunk with support on an object are also included.

To develop physical qualities, repeated static exercises were performed (gradually up to one minute in each position), balance exercises on a gymnastic bench, hanging.[25-28]

In the final part, physical activity is gradually reduced. Walking, relaxation exercises, breathing exercises are used. At the end of the lesson, the pulse and posture are checked.

RESULTS

Table 1 – Results of both groups before the experiment

Tests	Control group (n=64)			Experimental group (n=64)			t	P
	M	δ	m	M	δ	m		
Stange test (sec)	37	2.6	0.9	38	3.6	1.2	0.7	>0.05
Genchi test (sec)	35	2.6	0.9	35	2.9	1.0	0	>0.05
Standing long-jump (cm)	195	24	8	199	20.1	6.7	0.4	>0.05
Bending and unbending arms in the prone position (times)	21	6.2	2.1	23	6.8	2.3	0.8	>0.05
Lifting the torso from the prone position (times).	42	7.1	2.4	40	7.1	2.4	0.3	>0.05
Forward bend from the sitting position (cm).	14	3.9	1.3	14	4.9	1.6	0.5	>0.05

Table 1 shows that before the start of the study, the groups were homogeneous (P>0.05), and after the study, the indicators in both groups were completely different (Table 2).

Table 2 – Results of both groups after the experiment

Tests	Control group (n=64)			Experimental group (n=64)			t	P
	M	δ	m	M	δ	m		
Stange test (sec)	38	2	0,7	40	2	0.7	1.7	>0.05
Genchi test (sec)	35	3	1	40	4	1.3	2.3	**<0.05**
Standing long-jump (cm)	196	24	8	200	20	6.7	0.3	>0.05
Bending and unbending arms in the prone position (times)	22	7.1	2.4	25	7.2	2.4	0.6	>0.05
Lifting the torso from the prone position (times).	40	7.0	2.3	51	8.1	2.7	2.2	**<0.05**
Forward bend from the sitting position (cm).	13	3.9	1.3	21	5.2	1.7	2.3	**<0.05**

Table 2 shows that when comparing the results in CG and EG after the end of the pedagogical experiment, a significant improvement occurred in 3 out of 6 tests. For a more detailed review, the indicators are presented in percentage terms, functional tests (Figure 1) and tests for the level of development of physical qualities (Figure 2).

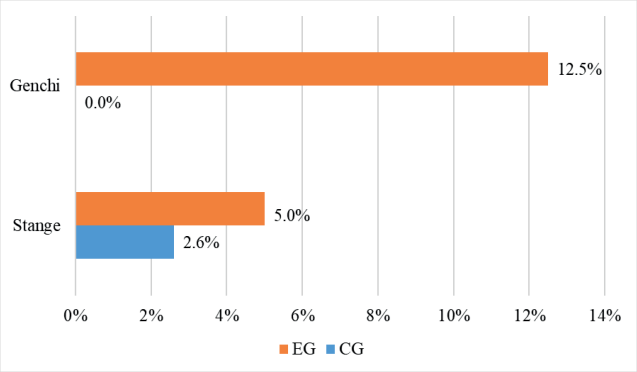

Figure 1. Indicators of students' functional abilities during the study period

Figure 1 shows that the students' performance in the Genchi Test remained the same in the CG during the study period, while in the EG the performance improved by 12.5%. As for the Stange Test, the performance in the CG increased by 2.6%, while in the EG the performance improved by 5%.

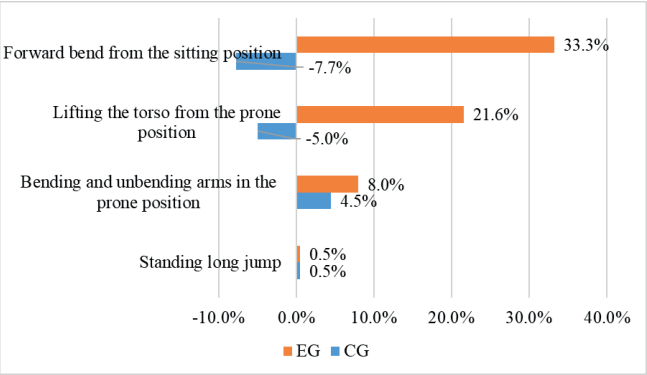

Figure 2. Indicators of physical qualities of students during the study period

Figure 2 shows that 2 out of 4 physical quality indicators in the CG worsened on average during the study period (Forward bend from the sitting position by 7.7% and Lifting the torso from the prone position by 5%), while in the EG there was a significant increase in these indicators by 33.3% and 21.6%, respectively. As for the indicators in the Standing long jump test, they improved on average in each group by 0.5%, and Bending and unbending arms in the prone position showed an advantage for students from the EG in comparison of 8% to 4.5%.

Thus, the proposed experimental program aimed at improving the functions of the respiratory system and developing physical qualities showed a more effective result in comparison with the usual program for students of the SMG.

DISCUSSION

Currently, many primary school students already have one or more chronic diseases that are directly related to the health status of primary school children. For some, the indicators deteriorate over the years of school life. In recent years, the number of diseases in primary school children has increased dramatically. Therefore, educational institutions need to create a system of group classes for students with chronic diseases and for health reasons, who are recommended to attend classes in such groups. Most of the time, the problem of such children is not solved. And such students, as a rule, sit on a bench during physical education lessons or do not attend classes at all.[14-18]

The analysis of scientific and methodological literature on the physiological characteristics of students who are to study at a SMG confirmed a stable trend in declining health indicators, the level of physical fitness of students in special medical groups, against the background of increased psychological and information overload, lack of due interest in physical education classes and a sharp decrease in the volume of motor activity in older age.[6-8]

Children began to move less and sit more in one place, which leads to a deficit in muscle activity and an increase in static tension. A growing body especially needs motor muscle activity, so its lack leads to the development of a number of diseases.[8-10]

Today, the optimal form of physical activity is a physical education lesson. A program for the development of physical qualities and functional abilities by means of adaptive physical education in students of a SMG was developed and experimentally tested. Classes that include physical exercises of various orientations have a positive effect on the indicators of motor fitness of students.

The results obtained during the pedagogical experiment showed that the indicators of functional abilities and physical qualities of students of a special medical group can not only improve, but also worsen.

For example, during the study period in the CG, the abdominal muscle strength and flexibility indicators worsened by 5% and 7.7%, respectively. Leg muscle strength improved by only 0.5%, and arm muscle

strength improved by 4.5%. The Genchi test indicators remained unchanged, and the Stange test showed an increase by only 2.6%. All changes in the indicators under the influence of the standard adaptive physical education program showed either a weak positive result or even a negative one.

The students from the EG who studied according to the experimental program were able to improve all indicators. The Stange test grew by 5%, and the Genchi test improved by 12.5% ($p<0.05$). Arm muscle strength rose by 8%, and abdominal muscle strength improved by 21.6% ($p<0.05$). Leg strength increased by 0.5% and flexibility improved by 33.3% ($p<0.05$). Thus, the program provided students of higher education institutions with improved physical fitness and functional abilities.

CONCLUSION

The use of the experimental program for the development of physical qualities and functional abilities of students engaged in adaptive physical education at university will significantly improve flexibility, abdominal muscle strength and breath holding on exhalation. The strength of the muscles of the arms and legs and breath holding on inhalation will also improve.

The theoretical significance of the study lies in the possibility of using the developed program in the process of adaptive physical education of SMG students to develop the functional abilities and physical qualities of students in class and extracurricular activities.

The practical significance of the scientific work lies in the development of practical recommendations for the application of tools and methods used in the processes by university teachers. This makes it possible to simultaneously influence physical fitness and functional state in order to improve them.

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Authors's contribution: GP: Data gathering and idea owner of this study, study design, data gathering, writing and submitting manuscript, editing and approval of final draft.

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