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EFFECTIVENESS OF STATODYNAMIC GYMNASTIC EXERCISES PROGRAM IN THE DEVELOPMENT OF FLEXIBILITY IN ELEMENTARY SCHOOL STUDENTS

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The paper highlights the data of the pedagogical experiment, which demonstrates the effectiveness of the statodynamic gymnastic exercises program on the development of flexibility in younger students. The results of the study of the development of flexibility of elementary school students in physical education classes with the use of gymnastic exercises program are presented. The results obtained in the course of the experimental study of the application of specially designed exercises on the degree of flexibility development in children 9—10 years old, allowed to conclude that the use of additional, different from conventional exercises, can significantly improve the level of flexibility in younger students.

Keywords: *flexibility, joint mobility, junior schoolchildren, Physical education of younger schoolchildren, gymnastics program, flexibility development, joint gymnastics*.

Introduction. Nowadays, the physical development of elementary school students is an important part of children's development. Junior school age is an important period of refinement of the basic functions of the body, the development of vital motor skills, habits and physical qualities. The manifestation of the basic physical qualities of elementary school students depends on the features and capabilities of the functional systems of the body. Among all the physical qualities, flexibility occupies a very important place, so it should receive special attention from the very first physical education classes at school [9].

Younger school age is the most favorable period for the development of many physical qualities, including flexibility. Younger school age is a favorable period for the development of almost all joints. If the physical development in this period does not happen, the time for the formation of the physical and functional basis of future physical potential can be considered lost [15].

Younger school age can be called favorable for the formation of almost the entire spectrum of motor abilities implemented in physical activity. During this period, the foundations of movement patterns are laid, previously unknown exercises are successfully mastered, and new motor skills are acquired. Almost all of the child's motor skills demonstrate a high pace of progression. The most rapid development is observed in the indicators of flexibility [1; 4; 5; 11; 13; 18; 19].

Flexibility is considered to be one of the main qualities characterizing the health and functional youthfulness of a person. Good flexibility ensures freedom, speed and efficiency of movement, insufficient flexibility restricts movements coordination, because it limits the movement of individual body parts, at the same time, it leads to inhibition of physical development, and thus to poor health [20].

The *problem of research* is insufficiently effective choice of means and methods for the development of flexibility in accordance with the age characteristics of elementary school students in physical education classes [3; 8; 9; 12].

The *object of the research*: the educational process of children of elementary school age.

The *subject of the study*: a program of statodynamic gymnastic exercises for flexibility development in elementary school students in the physical education classes.

The *purpose of work*: to substantiate the effectiveness of the statodynamic gymnastic exercises program for the development of flexibility in younger students during physical education classes.

Tasks:

— To study and analyze the scientific and methodological literature on the topic of research.
— To reveal the dynamics of flexibility development in younger students of 9-10 years for the period of the experiment.
— To prove the effectiveness of the application of a special statodynamic gymnastic exercises program, aimed at the development of flexibility of schoolchildren 9-10 years old in physical education classes.

The substantiation of the gymnastic exercises program for elementary school children 9—10 years old.

The task of flexibility development in elementary school students is important to solve in tandem with increasing their theoretical knowledge. From the first lessons, students should be introduced to the titles of body parts and the movements they perform. Students should learn about flexion and extension, abduction and adduction, supination and pronation, circular motion, turns, and rotations. The designated movements must be mastered [2; 7; 8; 14].

The specificity of flexibility in younger students is that their musculoskeletal system, especially the spine, is plastic, so gymnastics classes should be limited to developmental exercises. The load and intensity of —exercises for flexibility should be increased gradually (especially on the development of the spine flexibility) [1; 2; 10; 12; 15; 17].

Stages of flexibility development.

The entire process of flexibility cultivation can be divided into three stages:

Stage I — "joint gymnastics". The purpose of this stage is not only to increase the general level of development of active and passive mobility in the joints, but also to strengthen the joints themselves, as well as to train the muscular-ligamentous apparatus in order to improve elastic properties and develop the strength of muscles and ligaments. This is facilitated by stretching exercises. At this stage, all joints are "worked through" [17].

It is necessary to systematically work on those joints that, without the exercise, are the least developed in daily life. Usually younger students have poorly developed mobility in extension movements, in the rotation of the arms, legs and torso [14; 17].

Stage 2 — specialized development of mobility in the joints.

The task of this stage is to develop the maximum amplitude in those movements that contribute to the fastest mastering of sports technique and on this basis — to improve sports results.

As a means of developing flexibility, the exercises that can be performed with maximum amplitude are used. They are otherwise known as stretching exercises [14; 18; 19].

The main limitations to the amplitude of motion are the antagonist muscles. Stretch the connective tissue of these muscles, make the muscles flexible and elastic is the task of stretching exercises.

Basic rules for the application of stretching exercises:

— no painful sensations are allowed;
— movements are performed at a slow pace;
— gradually increases their amplitude and the intensity of application of the supporter's force.

Exercises for the development of joints mobility is recommended to be performed by the active implementation of movements with a gradual increase of the amplitude, the use of self-grabbing, rocking, swinging movements with large amplitudes. Here the task of enhancing the development of active and passive mobility in the joints is solved [17].

Stretching exercises should be practiced throughout the year, because if there is a long break in their implementation, the joints mobility deteriorates. This, as a rule, affects sports results [11].

Stage 3 — maintaining joint mobility at the achieved level. Joint mobility cannot be maintained at the required level for a long time if stretching exercises are not practiced. Mobility in the joints worsens, so stretching exercises should be practiced throughout the year, with their load adjusted [11].

The low level of flexibility development is connected not only with anatomical and physiological properties of the body, but also with drawbacks of methodology of this quality development at the lessons, especially when efforts are directed primarily at stretching of antagonist muscles, but not at increasing the strength and amplitude of contracting muscles. It appears that in practice elementary school teachers mostly work on passive rather than active flexibility [11].

In the school practice of physical education and sports there are two main types of exercises for the flexibility development: swing or spring movements such as bending, hanging or lunging, and stretching movements made with another person or on a fitness machine [17; 19].

Flexibility exercises fall into an active, passive and mixed types. The range of equipment used for flexibility training is also divided into developing passive, active and mixed flexibility. The development of active flexibility is promoted by exercises performed both without and with weights.

When planning work on the development of flexibility it must be remembered that the active flexibility develops 1.5-2 times slower than the passive (with the help of a partner, the weight, etc.). It also takes different time to develop mobility in different joints. This parameter depends on many factors: on the structure of the joint and muscle tissue, the age of the child, and ultimately on the structure of the gymnastic exercises program [8].

Tests for assessing the level of development of flexibility in younger students.

The principal criterion for evaluating flexibility is the largest amplitude of movement that can be performed by the tested person. The amplitude of move-

ments is measured in angular degrees or by linear measures, with the use of apparatus or pedagogical tests [6; 9; 10; 12]. The equipment methods of measurement are:

1) mechanical (using a goniometer);
2) dynamoelectric (using an electrogoniometer);
3) optical;
4) radiographic.

For particularly accurate measurements of joint mobility, electrogoniometric, optical and radiographic methods are used.

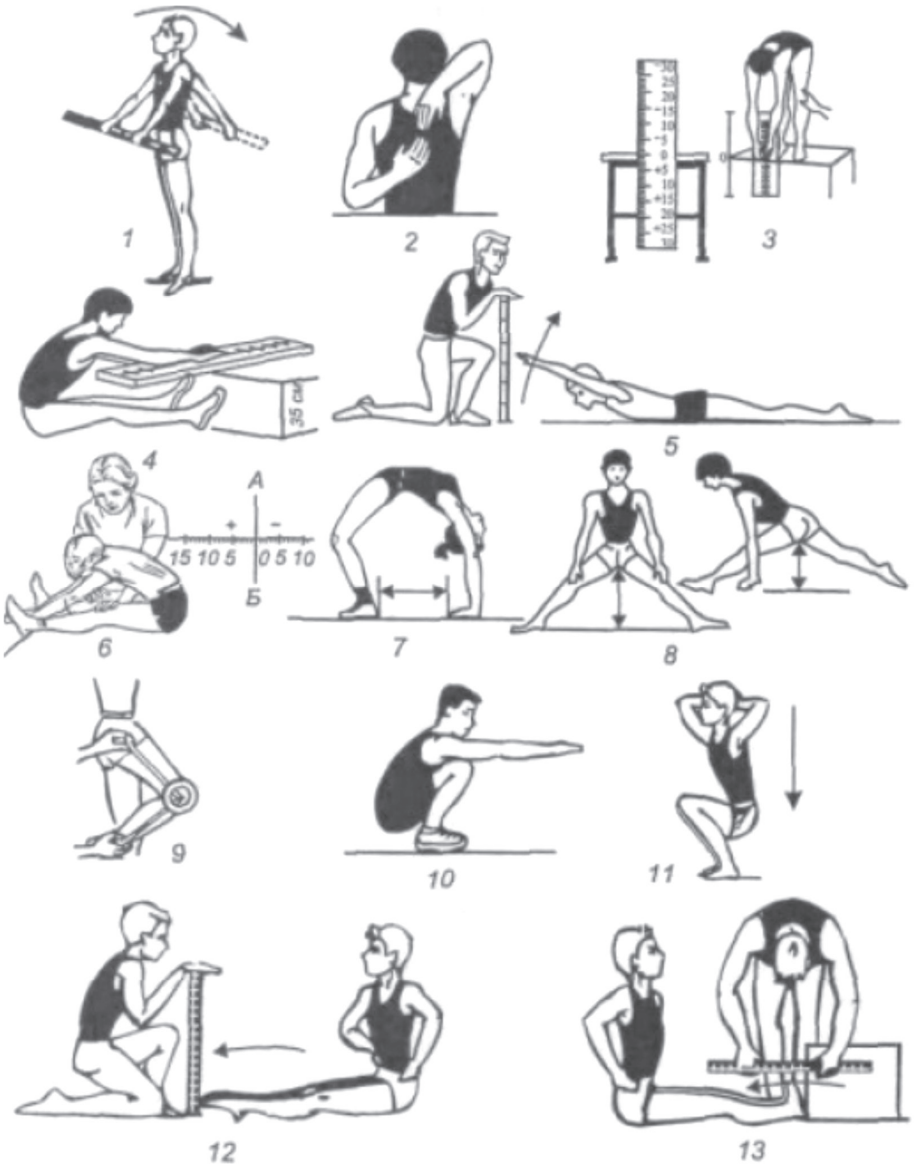
The main pedagogical tests for assessing the mobility of various joints are simple control exercises (see Figure).

1. Mobility in the shoulder joint. The test person, grasping the ends of the broom handle (rope), performs a straight arm dislocation backwards (Fig. Picture

1. The mobility of the shoulder joint is assessed by the distance between the hands during twisting: the smaller the distance, the greater the flexibility of this joint, and vice versa (Fig. Picture 2). In addition, the smallest distance between the hands is compared to the width of the subject's shoulder girdle.

Active abduction of straight arms upward in a prone position with arms stretched forward. The greatest distance from the floor to the fingertips is measured (picture 5).

2. Mobility of the spinal column. It is determined by the degree of inclination of the trunk forward (Fig. Pictures 3, 4, 6). The tested person in a standing position on the bench (or sitting on the floor)



Control exercises (tests) to assess the level of flexibility development

leans forward to the utmost without bending the legs at the knees. Flexibility of the spine is assessed using a ruler or tape by the distance in centimeters from the zero mark to the third finger of the hand. If the fingers do not reach the zero mark, then the measured distance is marked with a "minus" (- cm) sign, and if they fall below the zero mark — with a "plus" (+ cm) sign.

"Bridge" (Fig. Picture 7). The result (in cm) is measured from the heels to the fingertips of the test person. The smaller the distance, the higher the level of flexibility, and vice versa.

3. Mobility in the hip joint. The test person aims to spread the legs as wide as possible: 1) to the sides; 2) forward and backward, leaning on the hands (Fig. Picture 8). The level of mobility in this joint is assessed by the distance from the floor to the pelvis (coccyx): the smaller the distance, the higher the level of flexibility, and vice versa.

4. Mobility in the knee joints. The test person squats with arms outstretched forward or hands behind head (Fig. Picture 10). High mobility in these joints is demonstrated by a full squat.

5. Mobility in the ankle joints (Fig. Picture 12, 13).

The various joint movement parameters should be measured according to standard testing conditions:

1) the same initial positions of the body parts;
2) the same (standard) warm-up;
3) repeated measurements of flexibility are carried out at the same time, since these conditions somehow affect the mobility in the joints.

Passive flexibility is determined by the maximum amplitude that can be achieved due to external influences [16]. It is determined by the largest amplitude that can be achieved by an external force, the value of which must be the same for all measurements, otherwise it is impossible to obtain an objective assessment of passive flexibility. Measurement of passive flexibility is paused when an external force causes a painful sensation. An informative indicator of the state of joint and muscle apparatus of the test person (in centimeters or angular degrees) is the difference between the values of active and passive flexibility. This difference is called active flexibility deficit.

Organization and methods of research

In order to study the effectiveness of flexibility development, a pedagogical study was organized and conducted in 2020—2021 in the Municipal Budget Educational Institution "Secondary General Education School" no.78 of Chelyabinsk. Students (boys and girls) aged 9—10 years participated in the study.

Physical education classes were held twice a week for 40 minutes. The experimental group (EG) and the control group (KG) each consisted of 20 people (EG n = 20, KG n = 20) with the same level of physical fitness at the beginning of the study.

The following research methods were used to solve the problems set in the work:

— analysis and summarization of scientific and methodological literature on the topic of research;
— pedagogical testing;
— pedagogical experiment;
— methods of mathematical and statistical processing of the data.

Pedagogical testing. The following tests were applied to assess the level of joint mobility development:

— "Butterfly" — leaning forward while sitting on the floor;
— Dislocation of the straight arms backwards while lying on the stomach;
— "Bridge" from the starting position lying on the back;
— Fish exercise;
— Tilt to the right;
— Tilt to the left;
— Trunk flexion while sitting ;
— Extension of the feet;
— Flexion of the feet.

Experimental sets of exercises

Set of exercises no. 1 (for the preparatory part of the lesson).

1. Original position — wide stance with legs apart, arms stretched out forward. Arms abduction to the sides.

2. Original position — normal stand position 1—2 — step with a left leg back, getting down on the left knee, arms forward, 3—4 — o.p., 5—8 — the same with the right knee.

3. O.p. — n.s.p., hands up. 1 — tilt forward, hands down and back; 2 — o.p.

4. O.p. — sitting on the floor. Bending forward, with the right leg moved out to the left; 1— tilt forward, 2— move to the left leg, 3 — to the right leg, 4 — o.p.

5. O.p. — a wide stance with the legs apart, the gymnastic stick lies horizontally at the bottom, the grip of the stick from above with hands held wider than the shoulders: 1—2 — gently raise the hands with the stick up, 3—4 — dislocate the hands with the stick backwards, 5—6 — dislocate the hands with the stick upwards, 7—8 — return to the o.p.

Set of exercises no. 2 (for the final part of the lesson).

1. O.p. — n.s.p. 1 — sharp vertical arms movements, right arm downward, left arm upward, 2 —

sharp vertical arms movements, right arm downward, left arm upward.

2. O.p. — n.s.p. Arms stretched out forward, 1 — bending the trunk forward, aiming to touch the floor, 2 — return to the o.p.

3. O.p. — sitting, arms stretched out forward, 1 — lean forward, socks tugged towards oneself, 2 — return to the o.p.

4. O.p. — sitting with feet shoulder-width apart, tilt to the left leg, 2 — tilt forward, 3-tilt to the right leg, 4 — return to the o.p.

5. O.p. — wide stance with legs apart, hands on the floor, 1 — squat on the splits.

Set of exercises no. 3.

1 O.p. — n.s.p. 1 — forward body tilt, 2 — o.p., 3 — backward body tilt, 4 — return to the o.p.

2. O.p. — stance with legs apart with the back against gym wall (to any crossbar), with the hands holding the crossbar behind the head at shoulder level. 1 — bend forward. Gradually, leaning back, move the hands to lower and lower crossbars.

3. O.p. — standing on one leg. Swings with your legs. 1—4 swings with right leg, 5—8 swings with left foot.

4. O.p. — stance with legs apart, hands apart. 1 — tilt to the left, the left hand behind the back, the right behind the head; 2 — o.p.; 3—4 — the same in the other direction.

5. O.p. — standing on the left foot, right one moved further to side and down, hands on the waist.

Jumping with a change of leg on each set of repetitions.

The set of exercises no. 1 was included in the preparatory part of the lesson and took 4—5 minutes. Sets of exercises no. 2 and no. 3 were included in the final part of the lesson. The duration of the exercises was 5 minutes. The number of repetitions of each exercise is 10—15 times. Exercises were performed by the repetitive method (see Table 1).

Table 1

Metering of exercises load aimed at developing mobility in the joints of primary school children (by Zh. K. Kholodov, V. S. Kuznetsov)

Joint	Number of repetitions	
	Students, age	
	7—10	11—14
Vertebral column	20—30	30—40
Hip Joint	15—25	30—35
Shoulder	15—25	30—35
Wrist	15—25	20—25
Knee	10—15	15—20
Ankle	10—15	15—20

The composition of the program of exercises for the development of flexibility in younger schoolchildren in the experimental and control groups is presented in Table 2. In addition to dynamic exercises, the program for the experimental group is full of static exercises and action-oriented games aimed at developing flexibility.

The results of the study were processed using the Excel for Windows software package with the determination of the arithmetic mean and the arithmetic mean error. The significance of the differences was determined by the Student's method (Student's t-test).

Research results and discussion

The results of the study are presented in Tables 3—4.

As Table 3 shows, before the experiment, test scores differ slightly, i.e., children are approximately at the same level of development. Since Student's coefficients for all parameters are less than the boundary value of $t_{0.05}$, respectively, all the differences we observe at the beginning of the experiment are unreliable and the difference in the arithmetic mean values of the groups is of random nature.

Table 2

A set of exercises for the development of flexibility, conducted in the control and experimental groups

A set of exercises for the development of flexibility	
Control group	**Experimental group**
Programs of selective and complex orientation with dynamic exercises (swinging, jerking, springing movements, exercises without weights), action-oriented games	Sets no. 1, 2, 3 have selective and integrated character with dynamic (sweeps, jerking, springing movements, exercises without loads) and static exercises (with self-grips, with a partner, on equipment, with a weight); elements of joint gymnastics; action-oriented games for flexibility with the inclusion of static exercises

Table 3

Indicators of the test results of the experimental and control groups before the experiment

№	Test exercise	Group	Result	± σ	± m	t, P < 0,05
1	Tilt forward	**EG**	5,54	2,44	0,81	1,11
		CG	5,71	2,27	0,76	
2	«Butterfly»	**EG**	28,20	3,89	1,29	0,07
		CG	28,07	3,89	1,29	
3	Dislocation	**EG**	32,85	2,98	0,99	0,40
		CG	32,35	2,34	0,78	
4	«Bridge»	**EG**	55,83	1,69	0,56	0,48
		CG	55,43	1,85	0,62	
5	Fish exercise	**EG**	39,36	1,62	0,54	0,75
		CG	39,81	0,81	0,27	
6	Tilt to the right	**EG**	21,75	0,88	0,29	0,44
		CG	21,58	0,81	0,27	
7	Tilt to the left	**EG**	21,71	1,20	0,40	0,38
		CG	21,53	0,75	0,25	
8	Trunk flexion while sitting	**EG**	21,74	1,49	0,49	0,59
		CG	22,12	1,23	0,41	
9	Extension of the feet	**EG**	8,53	1,36	0,45	0,28
		CG	8,37	1,07	0,36	
10	Flexion of the feet	**EG**	7,93	1,62	0,54	0,26
		CG	7,76	1,14	0,38	

Table 4

Indicators of the test results of the experimental and control groups before the experiment

№	Test exercise	Group	Result	± σ	± m	t, P < 0,05
1	Tilt forward	**EG**	8,64	1,75	0,58	2,33
		CG	6,47	2,17	0,72	
2	«Butterfly»	**EG**	23,24	2,82	0,94	2,38
		CG	27,10	3,95	1,31	
3	Dislocation	**EG**	23,21	1,81	0,60	4,03
		CG	27,11	2,27	0,75	
4	«Bridge»	**EG**	53,07	0,97	0,32	2,87
		CG	54,99	1,78	0,59	
5	Fish exercise	**EG**	42,28	1,46	0,48	2,22
		CG	40,95	1,10	0,37	
6	Tilt to the right	**EG**	21,11	0,97	0,33	0,29
		CG	20,99	0,88	0,29	
7	Tilt to the left	**EG**	21,11	0,97	0,33	0,36
		CG	20,96	0,78	0,26	
8	Sitting torso flexion	**EG**	17,42	1,17	0,39	5,53
		CG	19,91	0,68	0,23	
9	Extension of the feet	**EG**	7,16	1,19	0,39	1,02
		CG	7,67	0,97	0,32	
10	Flexion of the feet	**EG**	5,47	1,46	0,48	2,16
		CG	6,81	1,17	0,39	

At the end of the experiment, the second testing was conducted and a statistical analysis of the results was performed (Table 4).

At the end of the experiment there was a positive dynamics of all the results of the study, in both groups there was a significant increase in flexibility in most of the studied indicators after three months of classes in the developmental stage which was fixed in static exercises performance.

The values of the tests "Butterfly", "Dislocation", "Bridge" after the experiment in the EG significantly decreased, which suggests an increase in flexibility in the hips, shoulders and spine joints, respectively.

The values of the tests "bend to the left", "bend to the right" after the experiment decreased, which suggests an increase in flexibility of the spine, however, the result is statistically unreliable, so the values of the tests before and after the experiment can be the result of natural development.

It should be noted that the experimental group results were significantly better than those in the control group. Thus, of the 10 tests, seven tests (forward bending, "Butterfly", "Dislocation", "Bridge", "Fish", bending the torso sitting, flexion of the feet) show significantly better results in the experimental group than in the control group, which proves the effectiveness of our developed methodology.

Conclusions

Analysis of the problem showed that the flexibility is one of the important qualities. In children of 09—10 years of age, there are no significant differences in flexibility between boys and girls, which creates the background for the use of a unified method of flexibility development in this age group.

The method of flexibility development using statodynamic gymnastics program was developed. The technique consists of three stages: general preparatory, developing, maintaining the achieved level. These stages are implemented in the academic year in accordance with the objectives of school physical culture.

Comparative analysis of the average index of the tests "forward bending" (8,64 cm), "Butterfly" (23,24 cm), "Dislocation" (23,21 cm), "Bridge" (53,07 cm), "Fish" (42,28 cm), torso flexion sitting (17,42 cm), flexion of the feet (5,47 cm) revealed significantly better results in the experimental group than in the control.

Statodynamic gymnastics program of exercises for the development of flexibility of younger students with the use of dynamic and static stretching exercises, joint gymnastics and action-oriented games with the inclusion of static exercises contributes to a reliable improvement of mobility in the joints, as well as the effective improvement of flexibility.

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Эффективность статодинамического гимнастического комплекса в развитии гибкости у младших школьников

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В работе освещаются данные проведенного педагогического эксперимента, которые свидетельствуют об эффективности статодинамического гимнастического комплекса на формирование гибкости у младших школьников. Представлены результаты исследования развития гибкости обучающихся начальных классов на уроках физической культуры с использованием гимнастического комплекса. Результаты, полученные в ходе проведенного экспериментального исследования использования специально разработанных упражнений на уровень развития гибкости у детей 9—10 лет, позволили констатировать, что применение дополнительных, отличных от общепринятых, упражнений, позволяет существенно повысить уровень развития гибкости у младших школьников.

Ключевые слова: *гибкость, подвижность суставов, младшие школьники, Физическое воспитание младших школьников, гимнастические комплексы, развитие гибкости, суставная гимнастика.*

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