

Original article**Development of endurance in physical education lessons with the use of outdoor games**Georgiy Georgievich Polevoy^{1,2*}, Andrew Borisovich Sablin², Stanislav Vladimirovich Chernishev²**Abstract:**

Background: Endurance is of great importance for the growth and development of the body of schoolchildren, and is also the foundation for the development of other physical qualities. The low level of endurance of modern schoolchildren requires the search for new ways to improve the system of physical education. **The aim of the study:** To increase the level of endurance development in schoolchildren using outdoor games in physical education classes at school. **Study design:** Pedagogical experiment. **Research methods:** The research was carried out on the basis of secondary school number 30 in the city of Kirov, Russian Federation. The experiment was attended by 3rd grade students aged 9-10 years. The study took place from September 6 to December 26, 2022 during physical education lessons 2 times a week for 45 minutes each lesson. In total, 2 groups of 25 people were formed. Classes in the control group were conducted according to the standard program, and in the experimental group, outdoor games were additionally conducted at each lesson for 6-7 minutes. Tests that were used to determine endurance: flexion and extension of the arms while lying on the floor, running 30 meters, Vis bent arms, lifting the trunk from the supine position, running 1000 m. **Results:** After the end of the pedagogical experiment, the indicators of school children in both groups became higher. In the control group, the indicators were reliable only in the test for flexion and extension of the arms while lying on the floor. In the experimental group, by the end of the study, the results in all 5 tests showed a significant and reliable result. Flexion and extension of the arms in the prone position from $15,6 \pm 0,76$ to $19,7 \pm 0,76$ ($p < 0.05$); Running 30 meters from $6,25 \pm 0,08$ to $5,99 \pm 0,08$ ($p < 0.05$); Vis bent arms from $21,90 \pm 0,97$ to $27,10 \pm 0,97$ ($p < 0.05$); Lifting the trunk from the supine position from $22,40 \pm 0,87$ to $28,10 \pm 0,76$ ($p < 0.05$); running 1000 m from $337,7 \pm 8,01$ to $311,9 \pm 3,9$ ($p < 0.05$). **Conclusion:** If outdoor games are used in physical education lessons at school when working with children 9-10 years old, then the indicators of different types of endurance will significantly improve.

Keywords: physical qualities; physical culture; sensitive periods; general endurance; special endurance.

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Introduction

For the majority of students engaged in mental work, nervous and emotional overload is characteristic, this is the main reason for the decrease in working capacity and high morbidity among them. It should be emphasized that in modern conditions, the widespread use of means and methods of physical

culture plays a primary role in the prevention of diseases, health promotion and improving the performance of students.

Endurance is the ability to resist physical fatigue during muscular activity. The measure of endurance is the time during which muscle activity of a certain nature and intensity is carried out. For example, in

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cyclic types of physical exercises (walking, running, swimming), the minimum time to overcome a given distance is measured. In game activities and martial arts, the time during which the level of a given efficiency of motor activity is carried out is measured. In coordination activities related to the performance of precision movements (gymnastics, figure skating), the indicator of endurance is the stability of technically correct performance of the action^{1,2}.

General endurance is the ability to perform moderate intensity work for a long time with the global functioning of the muscular system. It is also called aerobic endurance. A person who can withstand a long run at a moderate pace for a long time is able to perform other work at the same pace (swimming, cycling).

Special endurance is endurance in relation to a certain motor activity, for example, strength endurance, speed endurance, coordination endurance^{3,4}.

In those engaged in various sports, endurance indicators significantly (sometimes by 2 times or more) exceed similar results of children who do not engage in sports. Very often, changes in the development of motor qualities occur already at primary school age, and therefore it is advisable to carry out the purposeful development of certain motor qualities in children at those age periods when their most intense age growth is observed. It should be remembered that the motor capabilities of the body that are not realized at a certain age are difficult to change significantly in the future.^{5,6}

The main task of developing endurance in school-age children is to create conditions for a steady increase in general aerobic endurance on the basis of various types of motor activity provided for mastering in mandatory physical education programs⁷.

The level of endurance development is currently at a low level, which cannot be met by modern requirements for physical education at school. Therefore, the problem of endurance education is very relevant and requires its further improvement^{8,9}.

A very effective means of complex improvement of motor qualities are outdoor games, which can be used in physical education lessons^{10,11}.

Outdoor games of various directions are a very effective means of complex improvement of

endurance. They also make it possible to improve such qualities as dexterity, speed, strength, coordination to the greatest extent. With rational use, the game becomes an effective method of physical education^{11,12}.

The most important result of the game is joy and emotional uplift in children. Due to this property, games, largely of a playful and competitive nature, more than other forms and means of physical culture, correspond to the education of motor abilities in students. Game types and actions require the entire complex of endurance from the student due to the fact that in order to stimulate the development of endurance, it is necessary to repeat movements many times, as well as take into account the functional capabilities of the student. Creatively working teachers strive to widely and comprehensively introduce the game or its elements into the daily life of students^{11,13}.

One of the main conditions for the high efficiency of the system of physical training of students is to strictly take into account the age and individual anatomical and physiological characteristics characteristic of individual stages of development of children and adolescents. The main criterion of biological age is considered skeletal maturity, or "bone" age. The spine reaches its final height by the age of 25. The growth of the spine in comparison with the growth of the body lags behind. This is due to the fact that the limbs grow faster than the spine. If the height of the body in length prevails in adolescents, then the height in width clearly prevails in younger schoolchildren. Bones become thicker and stronger, but the processes of ossification in them have not yet been completed^{14,15}.

The aim of the study. To increase the level of endurance development in schoolchildren with the use of outdoor games in physical education lessons at school.

The hypothesis of the study. It is assumed that the organization and conduct of outdoor games will contribute to the development of endurance among primary school age students.

Tasks:

1. Using the analysis of literary sources to create an idea of the feasibility of developing endurance through outdoor games in the lower grades.

2. Pickup outdoor games that can be aimed at developing endurance in physical education lessons for 3rd grade student.

3. Experimental test the effectiveness of outdoor games in elementary school students for the development of endurance.

Materials and methods

The research was carried out on the basis of secondary school number 30 in the city of Kirov, Russian Federation. The experiment was attended by 3rd grade students aged 9-10 years. The study took place from September 6 to December 26, 2022 during physical education lessons 2 times a week for 45 minutes each lesson. In total, 2 groups were formed:

A control group (25 children). Classes in this group were conducted in accordance with the requirements of the general education program for secondary educational institutions⁷.

Experimental group (25 children). At the physical education lesson, the introductory and final parts remained unchanged, but in the main part 6-7 minutes were given to work on the proposed set of physical exercises. The games we proposed were held in rest pauses, when the control group was resting after certain classes in the lesson, the experimental group was engaged in the complex of outdoor games proposed by us. During the main part of the lesson, the experimental group went behind a special screen dividing the gym into two parts, where they engaged in outdoor games. Basically, during one lesson, the children played one game. This contributed not only to an increase in the level of endurance among schoolchildren, but also to an increase in the motor density of the lesson. After that, the group returned to classes according to the school program.

Outdoor games are based on physical exercises, during which participants overcome various obstacles, strive to achieve a certain, pre-set goal. They are an effective means of physical education, active recreation, improve health. Outdoor games contribute to the education of will, perseverance in overcoming difficulties, teach children to mutual assistance, honesty and truthfulness. The games were selected in accordance with the requirements of the program, the age capabilities of the adolescent's body⁷.

1. Jogging

At a distance of 40-50m. from each other, two lines are drawn. Players start running at an average pace from one line. After reaching the other line, the players turn around and run back to the first line. So they run from line to line until the hardest player remains - he is the winner.

2. Bulldog

Children appoint two human catchers ("bulldogs"). The Bulldogs are standing on one side of the court, and all the others are on the opposite side. At the signal of one of the "bulldogs", all players must run to the other side. But so that the player is not caught by the "Bulldogs". The game continues until all the runners turn into "bulldogs".

3. The Onlooker

Draw a circle with chalk. Choose the driver who throws the ball up from the center of the circle, calling the name of any participant. Named (new driving) he tries to catch the ball, and the others scatter. If the driver has caught the ball since the summer, he immediately throws the ball over his head, calling the name of the next player. If the ball is picked up from the ground, then the driver shouts "Stop!", everyone should stop and freeze. Need to hit another player with the ball.

4. Cats and mice

The players stand facing each other and hold hands so that there is a sufficient distance between them. When the cat tries to get inside the circle, or vice versa to get out of it, the players are forbidden to shift their shoulders. The mouse, once outside the circle, has no right to run far away.

5. Potatoes

The players stand in a circle facing each other. Players throw the ball to each other without catching it. If the ball falls, then the player who hit the ball last sits in a circle (becomes a potato). The other players continue the game. A sitting player must catch the ball, only jump from a sitting position.

If the "potato" catches the ball, then it returns to the circle to the players, and the player who missed the ball sits in the circle (that is, becomes a potato).

6. Clock

Everyone says in chorus: "Tick-tock, tick-tock."

Choose two players who will turn the rope in the same rhythm. The others take turns jumping rope. The first one jumps once and gets to the end of the queue, the second one jumps twice and so on. A player who lost his way when jumping or made a mistake in the score – changes with one of the players twisting the jumping rope.

7. Fishing rod

Before the game starts, the driver is selected. All the guys stand in a circle, and the driver in the center of the circle with a jumping rope in his hands. He begins to rotate the jumping rope so that it slides on the floor, making a circle after a circle under the feet of the players. The players jump up, trying not to let it hit any of them. A player is considered to be caught if the jumping rope touched him no higher than the ankle. The one who touches the jumping rope stands in the middle and begins to rotate the rope, and the former driver takes his place.

To control the development of various types of endurance, control tests were taken, which are basic in the theory and practice of physical education⁷:

- 1) Flexion and extension of the arms while lying on the floor (strength endurance). The exercise is performed to failure; the pace is arbitrary. The result is the number of repetitions.
2. Running 30 meters from a low start (high-speed endurance). The result is in seconds.

3. Vis on bent arms (static endurance). The result is in seconds.
4. Lifting the trunk from the supine position (Strength endurance of the abdominal muscles). The hands are behind the head, the legs are bent at the knees, the feet are fixed, a forward tilt is performed until the elbows touch the middle of the thigh. The result is the number of repetitions within 40 seconds.
5. Running 1000 m (total endurance) from a high start. The result is time (min, sec).

Control testing for both groups was carried out under the same conditions.

Statistical processing of research results

All data was recorded in the Excel table. The results were statistically processed (Student’s t– test)^{16,17}.

Ethical clearance:

This research was conducted in compliance with the needed research ethics. In addition, consent for participation was obtained from the participants before the beginning of their involvement in the study. All data were recorded and analyzed anonymously.

Results

Analysis of the initial data showed that there were no statistically significant differences between the control and experimental groups ($P > 0.05$). This indicates the relative homogeneity of the groups at the beginning of the pedagogical experiment (Table 1).

Table 1: Comparison of endurance indicators of both groups at the beginning of the experiment

Tests	EG M±m	CG M±m	t	p
Flexion and extension of the arms in the prone position (number of times)	15,6±0,76	15,1±0,54	0,54	>0.05
Running 30 meters (sec)	6,3±0,08	6,2±0,06	0,2	> 0.05
Vis bent arms (sec.)	21,9±0,97	20,7±0,97	0,87	> 0.05
Lifting the trunk from the supine position (number of times)	22,4±0,87	22,7±1,3	0,19	> 0.05
running 1000 m (min., sec.)	337,7±8,01	342,0±11,58	0,31	> 0.05

Table 1 shows that at the beginning of the experiment in the experimental and control groups, the value of $t > 0.05$ for all 5 tests. This result is considered unreliable, and the difference between the arithmetic averages in the groups is random. Based on this, it can be argued that the groups at the beginning of the experiment are almost equal and a pedagogical

experiment can be conducted between them.

Repeated testing revealed positive dynamics of the development of various types of endurance in both the control (Table 2) and experimental (Table 3) groups. However, the increase in results in these groups is different.

Table 2: Endurance indicators in the control group at the beginning and end of the experiment

Tests	Before M±m	After M±m	t	p
Flexion and extension of the arms in the prone position (number of times)	15.1±0.54	16.9±0.65	2.13	< 0.05
Running 30 meters (sec)	6.2±0.06	6.1±0.03	1.79	> 0.05
Vis bent arms (sec.)	20.7±0.97	22.9±0.76	1.78	> 0.05
Lifting the trunk from the supine position (number of times)	22.7±1.3	24.2±1.3	0.82	> 0.05
running 1000 m (min., sec.)	342.0±0.03	336.4±0.03	0.35	> 0.05

Table 2 shows that the children from the control group showed a positive increase in indicators for all positions, despite the fact that they were engaged in the usual physical education program at school. At the same time, in the flexion and extension test, lying on the floor, the difference was significant and

reliable.

A significant increase in indicators for all 5 tests was obtained in the experimental group, in which children additionally used outdoor games in physical education lessons (Table 3).

Table 3: Endurance indicators in the experimental group at the beginning and end of the experiment

Tests	Before M±m	After M±m	t	p
Flexion and extension of the arms in the prone position (number of times)	15,6±0,76	19,7±0,76	3,83	< 0.05
Running 30 meters (sec)	6,25±0,08	5,99±0,08	2,43	< 0.05
Vis bent arms (sec.)	21,90±0,97	27,10±0,97	3,78	< 0.05
Lifting the trunk from the supine position (number of times)	22,40±0,87	28,10±0,76	4,95	< 0.05
running 1000 m (min., sec.)	337,7±8,01	311,9±3,9	2,90	< 0.05

Table 3 shows that students from the experimental group for a fairly short period of time in physical education classes were able to significantly and reliably improve endurance performance on all

5 tests. The comparison of the results between the groups after the pedagogical experiment is shown in Table 4.

Table 4: Comparison of endurance indicators of both groups at the end of the experiment

Tests	EG M±m	CG M±m	t	p
Flexion and extension of the arms in the prone position (number of times)	19.70±0.76	16.90±0.65	2.81	<0.05
Running 30 meters (sec)	5.99±0.08	6.1±0.03	0.64	> 0.05
Vis bent arms (sec.)	27.10±0.97	22.90±0.76	3.40	<0.05
Lifting the trunk from the supine position (number of times)	28.10±0.76	24.20±1.30	2.59	<0.05
running 1000 m (min., sec.)	3119±3.90	336.4±1082	2.13	<0.05

Table 4 shows that when comparing the results at the end of the experiment in the experimental and control groups, it showed significant differences (P<0.05) in 4 out of 5 tests.

Discussion

Endurance plays an essential role in optimizing vital activity, acts as an important component of physical health and, in turn, serves as a prerequisite for the development of special endurance^{7,18,19}.

The results of the pedagogical experiment in both groups showed that the age of 9-10 years is a fairly favorable period for the development of endurance. Since in a fairly short period of time, the indicators of different types of endurance improved in children in the control and experimental groups. The sensitive

period for the development of endurance is confirmed by the data obtained in previous studies^{5,6}.

One of the main ways of comprehensive education of motor qualities in school conditions is the use of special exercises and outdoor games, with the help of which it is possible not only to successfully teach children various motor skills, but also to purposefully influence the education of all motor qualities. Therefore, from primary school age, it is necessary to pay great attention to outdoor games and special exercises^{11,12,20}.

In the scientific literature there is a fairly large amount of information on physical education at school^{21,22}. The relationship between lack of physical activity and obesity has been established^{23,24,25}. The authors emphasize the importance of physical qualities for the development of schoolchildren^{26,27}. And health and longevity in general largely depends on physical culture, the performance of certain physical exercises^{28,29,30}. Despite this, there are some points in scientific research that can be improved with the help of additional research, so our topic is relevant and promising.

Elementary skills and abilities acquired by students in game conditions are not only relatively easy to rebuild with subsequent, more in-depth study of the technique of movements, but even facilitate further mastery of appropriate techniques. And at the stage of improving motor actions and repeated repetition in game conditions helps to develop students' ability to most economically and expediently perform many of the studied movements in a holistic, complete form^{10,12}. It can be assumed that the use of outdoor games of various orientations by high school students in physical education lessons at school will significantly increase the level and pace of student development. This makes the present study promising enough for further study of the scientific direction and its application in practice in physical

education classes at school.

Children from the control group during the study period showed an increase in all indicators, including a significant and reliable increase in the test of flexion and extension of the arms in the emphasis lying on the floor. This may mean that a real physical education program at school has a positive effect on the endurance indicators of schoolchildren aged 9-10 years.

Children from the experimental group for a fairly short period of the study showed a significant and reliable increase in indicators from the beginning to the end of the pedagogical experiment in all tests. Thus, we can state the effectiveness of the use of outdoor games for the development of endurance in working with children 9-10 years old in physical education classes at school.

Conclusion

If outdoor games are used in physical education lessons at school when working with children 9-10 years old, then the indicators of different types of endurance will significantly improve. The results of the study were introduced into the practice of teaching primary school students of secondary school No. 30 in Kirov, Russia.

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Author's contribution:

Data gathering and idea owner of this study: Polevoy G.G.

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