



## The Effect of Prolonged Running On the Development of Endurance and Thinking Indicators of Children

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**Abstract:** The development of physical qualities in school is relevant. It is at school that the foundation of motor actions is laid. One of the most important qualities is endurance. The study's objectives were to study the indicators of endurance in schoolchildren and the influence of aerobic abilities on children's thinking. It will increase the development of mental processes and aerobic abilities of schoolchildren. The study's design is a pedagogical experiment conducted over 4 months in an ordinary school in Russia. The study involved 120 boys and girls who studied in the 3rd grade. All students were engaged in the usual program, and the children from the experimental group additionally performed a long run during the lesson. The Cooper test assessed aerobic abilities and the children's thinking by "Simple analogies." We used the Student's t-test. Before the study, there were no significant differences between classes in both tests ( $p > 0.05$ ). After the end of the study, the performance of children in the control group improved in the endurance test from 6.8% to 7.2% ( $p > 0.05$ ), and in the experimental group improved on average from 18.9% to 24.9% ( $p < 0.05$ ). The thinking of children from the control group increased by 7.3-8.4% ( $p > 0.05$ ), and in the experimental group, 23.5%-24.8% ( $p < 0.05$ ). Prolonged running in physical education classes at school increases the aerobic abilities of schoolchildren and improves their thought processes.

**Keywords:** Mental processes, physical education, physical qualities, lessons at school.

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## 1. INTRODUCTION

Children's health is important from a young age and throughout their schooling.<sup>1-3</sup> Insufficient motor activity is a big problem in modern society. Children spend much time at school for lessons, then at home for gadgets and other screens. At the same time, schoolchildren almost stopped doing physical education and sports.<sup>6-8</sup> A sedentary lifestyle is a set of diseases: weak muscles, overweight, disorders of the central nervous system, cardiac and vascular system, increased blood pressure, and shortness of breath occur with a small load. Problems with the spinal column in all departments.<sup>9,10</sup> In this case, a physical education lesson at school can help, which is aimed at the comprehensive development of schoolchildren (physical and mental), familiarization with physical culture, forming a healthy lifestyle, and introduction the laws and rules of physical education.<sup>11-13</sup> In an ordinary school in Russia, there is a standard program (methodology) for children's physical education. It considers the age characteristics of children from grades I to II.<sup>17-18</sup> According to the latest data, only half of the students in the first grade have excellent health, and by the II th grade, only 5% of healthy children.<sup>19-20</sup> Aerobic abilities are crucial for a person; they can be called endurance - a physical quality that can be developed during long-term work without reducing performance. Aerobic abilities largely depend on human health, the level of development of the respiratory, cardiac system and internal organs.<sup>21-23</sup> Other types of abilities depend on overall endurance. Endurance has a positive effect on the motor abilities of schoolchildren, but in physical education, according to the latest data, we see a decrease in these indicators in schools.<sup>24-26</sup> The sensitive period is a favorable period for developing a particular physical quality. The clever use of such a period in certain terms has a significant effect. Endurance goes through 2 packs of its development. The first is 9-10 years for boys and girls, and the second peak is 13-15 years for girls and 15-17 years for boys. Therefore, it is important not to miss the first peak of purposeful endurance development.<sup>27,28</sup> Physical culture at school contributes not only to the development of physical qualities but also has a beneficial effect on some mental processes of schoolchildren, intellectual, creative, and other types of higher nervous activity.<sup>29-30</sup> the

study hypothesizes that if we use long-running physical education classes at school, then the indicators of aerobic capabilities of children will be higher. And it is likely to have a positive impact on the thinking of schoolchildren. The study aims to assess the impact of prolonged running on the endurance and thinking indicators of children aged 9-10 years in physical education classes at school.

### Main tasks

1. Study literary sources.
2. Determine the basic physical quality.
3. to identify the influence of endurance on the thinking of children 9-10 years old.

## 2. MATERIALS AND METHODS

### 2.1. Study participants

The present study involved children from the third grade of secondary school number sixty in Kirov, Russian Federation. These are boys and girls aged 9-10 years. Before the start of the study, the students underwent a medical examination. After that, they were admitted to physical education classes at school, and informed consent to conduct a pedagogical experiment was obtained from each parent.

### 2.2. Ethical Statement

It should be noted that all procedures were carried out by the ethical standards of the Helsinki Declaration of 1964 and approved by the special Ethics committee of the Vyatka State University, dated January 17, 2020, approved protocol No. 1

### 2.3. Exclusion criteria

The exclusion criteria were unhealthy children with health abnormalities and contraindications to optimal physical activity (problems with obesity, hypertension, joint problems, and other chronic diseases). These are mostly children of a special medical group. All children were differentiated into control and experimental groups (Table 1).

Table 1. Study participants				
Participants	Control group		Experimental group	
Class	3 «A»	3 «B»	3 «C»	3 «D»
Total children in the class	33	31	32	33
Children who have received a doctor's admission and informed consent from their parents to conduct the study	30	30	30	30

Table 1 shows that some children did not participate in the study for health reasons or were refused by their parents to conduct a pedagogical study. At the same time, students could refuse to participate in the study at any time. Thus, a total of 120 schoolchildren took part in the pedagogical experiment.

### 2.4. Research procedure

The pedagogical experiment was conducted based on the public educational school 60 in Kirov, Russia, from January 10 to May 10, 2023. According to the school curriculum, physical education classes were held 2 times a week for 40 minutes in each class. During the study period, 34 physical education lessons were conducted in each class. All lessons were held according to the school schedule at the same time. Boys and

girls from the control group were engaged in the usual physical education program (methodic) at school.<sup>31</sup> School physical education aims to form a versatile, physically developed person who can actively use the values of physical culture to strengthen and maintain their health for a long time, optimize work activities, and organize active recreation. The realization of the purpose of the curriculum correlates with the solution of the following educational tasks:

- 1) health promotion, posture improvement, prevention of flat feet, promotion of harmonious physical, moral, and social development, and successful learning;
- 2) formation of initial self-regulation skills using physical culture;
- 3) mastering the school of movements;

4) development of coordination abilities (accuracy of reproduction and differentiation of spatial, temporal, and power parameters of movements, balance, rhythm, speed and accuracy of response to signals, coordination of movements, orientation in space) and conditioning abilities (speed, speed-power, endurance, and flexibility); The children from the

Experimental group were engaged in the same program, but additionally at the end of the main part of the lesson they performed a "Long run." The structure of classes was the same; however, in the Experimental group, the density of classes was higher, and classes were optimized. An example of such an activity is presented in Table 2.

**Table 2. Example of a physical education lesson in the 3rd grade**

Parts of the lesson	Lesson content	Time spent on the task (minutes)	
		Control group	Control group
The preparatory part of the lesson	Building students and declaring lesson tasks	2'	2'
	Drill exercises and walking	3'	2'
	Regular running and special running exercises	4'	3'
The main part of the lesson	The complex of general developing physical exercises, gymnastics, jumping rope	6'	5'
	Learning the technique of throwing a tennis ball	10'	9'
	Mobile game "Calling numbers"	10'	9'
	Long-running	0'	6'
The final part of the lesson	Hitch	3'	2'
	Building and summarizing the lesson	2'	2'
Total time		40'	40'

Table 2 shows that the children from the Experimental Group performed all the same tasks as the children from the Control group but slightly less in time, which allowed us to allocate part of the total duration of the lesson (40 minutes) of the time in the lesson to perform a "Long run" (6 minutes) at the end of the main part of the lesson. Several important points should be noted:

1. General endurance should be developed at the end of the main part of the lesson since, at the beginning of the lesson, a long run will tire students and their concentration for further work in the classroom. After prolonged work, even at the end of the lesson, a hitch is necessary.<sup>31</sup>
2. The basis for the development of general endurance is aerobic work; therefore, if, at some point, the student stopped running, switched to a step, caught his breath, and continued running again, then this is quite natural.
3. The time range of 6 minutes was not chosen by chance; such aerobic and continuous work is optimal for children 9-10 years old. If you do aerobic work for less time, there will be no effect; if more, children may be unable to cope. At the same time, the fact that schoolchildren need to master the school curriculum in physical culture is important.<sup>21,25,31</sup>

## 2.5. Control tests

All students who participated in the study at the pedagogical experiment's beginning and end passed 2 control tests. The reliability and validity of the test have been verified by previously conducted scientific research.

1. Overall endurance was assessed using the K. Cooper test.<sup>32</sup> As a rule, it takes place at a stadium or, as in our case, in an athletics arena with a length of 200 meters. In the middle and upper grades, the 12-minute K. Cooper test is used; however, in the lower grades, a time interval of 6 minutes is used. The meaning of the running test is very simple. It is necessary to run as much distance as possible in 6 minutes.

1) warm-up. Before the test, all the children had a warm-up lasting about 10-12 minutes to warm up the body and prepare it for the load. Intensive walking or relaxed running is used as

a warm-up, as well as a set of regular exercises for all muscle groups, which necessarily includes several stretching exercises;

2) The Cooper test. After the warm-up, the test itself begins. First, 6 minutes are recorded on the stopwatch, during which the subjects must cover as much distance as possible. If the test participants move to a step, the stopwatch does not stop.

3) The result. After 6 minutes, the distance that students overcome is measured in meters. At the end of the test, holding a hitch for 5 minutes is recommended, usually walking at a calm pace.

2. The "Simple Analogies" test determined schoolchildren's thinking indicators.<sup>33</sup> This fairly well-known test is widely used in the psychodiagnostic of schoolchildren of different genders and ages. The test has a positive rating over time according to the criterion of validity and reliability. Test for the development of schoolchildren's thinking "Simple analogies" On the A4 sheet in front of the students, there are 2 columns with words. There is one word in the first column. There are 5 words in the second column; one is similar in meaning to the word from the first column, which the Student must identify and emphasize. A fragment of the test is presented below.

Sports – painting, lantern, hockey, phone, watch;

Computer – perfume, table, bucket, keyboard, remote control;

Berry – paper, door, glass, glass, raspberry.

The result – the more correct words the Student has identified, the better his result. The test execution time is 1 minute.

## 3. STATISTICAL PROCESSING OF RESEARCH RESULTS

All the students' results were entered into an Excel spreadsheet. The average values in the groups and the standard deviation of the indicators are determined. In addition to the Excel program (2016), a special program, Biostatistica-2022, was used, which determined the Student's T-test indicators. The level of statistical significance was established at  $p < 0.05$ .

#### 4. RESULTS

It should be noted that before the beginning of the pedagogical experiment, there were no statistically significant (reliable) differences between the studied indicators between all classes

in both tests—boys and girls who study in regular classes at school. Therefore, the unit of value is metered. However, after the study's end, each class's results changed differently (Table 3).

<b>Table 3. Results of indicators of schoolchildren aged 9-10 in the Cooper test (6 minutes)</b>					
Group	Class	Before	After	%	p
Control	3 «A»	1088±41	1162±37	6.8	p>0.05
	3 «B»	1114±43	1194±28	7.2	p>0.05
Experimental	3 «C»	1018±32	1271±35	24.9	p<0.05
	3 «D»	1104±37	1312±33	18.9	p<0.05

Table 3 shows that the indicators in the K. Cooper test improved in all classes. However, in the Control group, the improvement in indicators was not statistically significant. Schoolchildren from the 3rd "A" class improved their performance by 6.8% (p>0.05), and children from the 3rd "B" class were able to improve their performance by 7.2% (p>0.05). Such results indicate the effectiveness of the usual physical education work program at school. At the same time, in the Experimental Group, where the children performed a "Long Run," the indicators significantly improved.

Schoolchildren from the 3rd "C" class improved their performance by 24.9% (p<0.05), and children from the 3rd "D" class exceeded the initial data by 18.9% (p<0.05). Such results indicate the effectiveness of using Prolonged running in physical education classes to develop endurance in schoolchildren 9-10 years old. After the K. Cooper test, all students took a test determining their level of thinking development. The test results at the beginning and the end of the study are presented in Table 4.

<b>Table 4. Results of indicators of schoolchildren aged 9-10 in the "Simple analogies" test</b>					
Group	Class	Before	After	%	p
Control	3 «A»	12.4±1.1	13.3±0.8	7.3	p>0.05
	3 «B»	13.1±1.3	14.2±1.2	8.4	p>0.05
Experimental	3 «C»	12.9±1.3	16.1±0.9	24.8	p<0.05
	3 «D»	13.2±1.6	16.3±1.3	23.5	p<0.05

Table 4 shows that the indicators in all classes also improved, but the improvement in each class was different. The positive dynamics can be explained by the natural increase in thinking indicators in this age period. First, however, let's compare the indicators of children from the control and experimental groups. It can be assumed that prolonged running positively affects the development of thinking since the initial data improved by 24.8% in the 3rd «C» class and by 23.5% in the 3rd «D» class. In both classes, the improvements were statistically significant. At the same time, in the Control group in the 3rd "A" class, the data improved by 7.3%, and in the 3rd "B" class, by 8.4%.

#### 5. DISCUSSION

Physical education at school is essential for the growth and development of children. Physical education lessons have a positive effect on physical qualities and some mental processes. The methodology of conducting physical education classes at school involves the Student mastering the entire school of movements that he will use in life.<sup>13,20</sup> It is known that a favorable period for the development of aerobic abilities is the age of 9-10 years. At this age, it is the peak for achieving maximum results in endurance among schoolchildren.<sup>27,28</sup> The results carried out earlier on sensitive periods of the development of physical qualities confirm these data. The results that Bali obtained during the study can be compared with the data of the control standards of schoolchildren from the school curriculum.<sup>31</sup>

«5» – 1200 m

«4» – 1100 m

«3» – 1000 m

In the Control group, schoolchildren had a grade of 3 before the start of the study in the 3rd "A" class and 4 out of the 3rd "B" class. After the study, the children's indicators improved slightly. Children from the 3rd "A" class showed a result for a grade of "4", and children from the 3rd "B" class for a grade of 5. Other results were obtained in the experimental group, where the children could significantly improve their endurance performance. They performed a "long run" at each lesson, even though the students worked according to the same program. Before the study, children from the 3rd "C" class passed the standards for assessment 3 and after assessment - 5. Students from the 3rd "D" class before the pedagogical experiment passed the test for the assessment of "4" and after the examination for the assessment of "5". Such results indicate the effectiveness of prolonged running in physical education for schoolchildren aged 9-10 years. As for the psychodiagnostic of children aged 9-10 years, from the beginning to the end of the study, no deterioration in thinking indicators was recorded in all classes. The well-known psychodiagnostic test "Simple Analogies" has been repeatedly positively evaluated for its validity and reliability. The standards show the level of thinking development of schoolchildren aged 9-10 years.<sup>33</sup>

1-5 – very low level of thinking development

6-10 – low level of thinking development

11-15 – the average level of thinking development

16-20 – high level of thinking development

21-25 – a very high level of thinking development

Before the beginning of the pedagogical experiment, the average group indicators of thinking in children in all classes were at the "average" level. After the end of the study, the data in all classes improved. However, in the control group,

there was a slight increase in indicators from  $12.4 \pm 1.1$  to  $13.3 \pm 0.8$  (an increase of 7.3%) in the grade 3 "A" class and grade 3 "B" class, an increase from  $13.1 \pm 1.3$  to  $14.2 \pm 1.2$  (8.4%), which also corresponds to the average level of thinking of children 9-10 years old. Such results may indicate that physical culture; physical exercises positively affect some mental processes. This assumption is confirmed by the studies of many authors who have determined the positive dynamics of mental processes under the influence of the physical activity of schoolchildren.<sup>29,30,34,35</sup> Some authors note that physical activity positively affects cognitive processes<sup>36-39</sup> and even the creative abilities of children.<sup>40</sup> The increase in thinking indicators in the Experimental Group was 24.8% and 23.5%; it was significant and reliable ( $p < 0.05$ ). It allows us to assume that Prolonged running has a qualitative, reliable, and positive impact on the development of thinking of schoolchildren aged 9-10 years. We can say that the time interval of 6 minutes for long-running in children aged 9-10 years is optimal. If the time is reduced, the effectiveness of the exercise will disappear. If the time increases, children will develop psychological and physical fatigue, making the exercise useless again.<sup>21,22,26</sup> However, future research may focus on the dosage of Prolonged Running. Of course, our research continues, as some questions can be studied further. For example, to use 3

physical education lessons per week or to study the effect of aerobic endurance on other mental and cognitive abilities.

## 6. CONCLUSION

Suppose a long run for 6 minutes is introduced into the process of physical education of schoolchildren aged 9-10 years. In that case, the indicators of aerobic abilities will significantly improve, which will also positively affect the thinking indicators of schoolchildren. Our pedagogical research indicates how the usual exercise, "Running," benefits the most important physical quality, endurance, and thinking of children 9-10 years old.

## 7. AUTHORS CONTRIBUTION STATEMENT

Georgia Polevoy, Andrew Sablin and Stanislav Chernishev conceptualization, methodology, writing original draft preparation, Performing mathematical and statistical calculations. The author has read and agreed to the published version of the manuscript.

## 8. CONFLICT OF INTEREST

Conflict of interest declared none.

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