



# The Influence of Speed and Strength Abilities on the Overall Endurance of Children aged 13–14 years with Different Typologies

Georgiy Polevoy 

Department of Physical Education, Moscow Aviation Institute, Moscow, Russia

## Abstract

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**\*Correspondence:** Georgiy Polevoy, Department of Physical Education, Moscow Aviation Institute, Moscow, Russia. E-mail: [g.g.polevoy@gmail.com](mailto:g.g.polevoy@gmail.com)  
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**AIM:** The aim of this study was to determine the effect of a set of speed-strength exercises on the development of general endurance in schoolchildren aged 13–14, taking into account the differentiated load.

**METHODS:** The pedagogical experiment was conducted on the basis of secondary school 60 in Kirov, Russia. The study involved 40 schoolchildren from the 7<sup>th</sup> grade, who were differentiated into the control and experimental groups of 20 people in each class. Children from the control group (CG) were engaged in physical education according to the standard program, and children from the experimental group additionally performed exercises for the development of speed and strength abilities with different loads. The strength of the nervous system was determined by tapping test, speed-strength abilities were determined by tests – flexion and extension of the arms at the stop while lying on the floor, long jump from a place with a push with two legs, and lifting the torso from the supine position. Overall endurance was determined by the “3 km ski run” test.

**RESULTS:** In the CG, there was an improvement of only 2–4%. In the experimental group, there were significant improvements of 11–16%.

**CONCLUSION:** If schoolchildren perform exercises for the development of speed and strength abilities at physical education classes at school every time, then not only the indicators of these abilities will improve, but also the indicators of the overall endurance of children aged 13–14 will improve. Our results allow us to supplement the standard physical education program at school and effectively develop the physical qualities of schoolchildren aged 13–14.

## Introduction

In recent years, much attention has been focused on the health of school-age children. What should be the standard of their motor regime, what should be the activity and other issues that are dealt with in detail in some studies. To meet the need for motor activity of school-age children, physical culture at school is of great importance. Not every child is additionally engaged in the sports section. A physical education lesson is mandatory to attend and is included in the standard physical education program for students of grades 1–11 [1]. During school years, children receive a huge arsenal of motor skills and abilities, the main goal of physical education at school is the comprehensive and harmonious development of schoolchildren.

It should be noted that all physical qualities are somewhat dependent on each other. That is, by developing one physical quality, we indirectly influence another [2], [3]. Hence, in our previous study, we established the influence of coordination abilities on indicators of other physical qualities [4]. At the same time, it is important to note that coordination abilities, dexterity and some other qualities are more

characteristic of primary school children, as a rule, these are outdoor games or elements of sports games, and the emotional mood of students plays a great role here. However, as the adolescent body matures, the proportion of physical activity increases already in the middle and in high school, the development of strength, endurance, and speed qualities comes to the fore. Thus, the age of 13–14 years is a favorable period for the development of speed and strength abilities [5], [6].

A differentiated approach as a method of working with children should be implemented in every lesson. This approach allows us to reveal the inner needs of each student in his motor activity [7], [8], [9]. There are a considerable number of criteria for differentiating children into groups or subgroups, among them, in our opinion, the typological criterion is one of the most promising. Namely, the strength of the nervous system in the process of excitation [10].

In this study, the goal is to determine the effect of a set of speed-strength exercises on the development of general endurance in schoolchildren aged 13–14 years, taking into account the differentiated load, which is based on the strength of the nervous system of students.

## Methods

### Participants

Forty schoolchildren took part in the pedagogical experiment. Children from class 7a were assigned to the control group (CG), and children from class 7a and 7b to the experimental group (EG). There were 12 boys and eight girls in CG and 12 boys and eight girls in EG.

All procedures met the ethical standards of the 1964 Declaration of Helsinki. Informed consent was obtained from all parents of the children included in the study.

### Procedure

The study was conducted on the basis of an ordinary school in the city of Kirov in Russia. From January 12, 2020, to March 20, 2020, 20 lessons were held in each class, each of which lasted 40 min. Physical education classes were held 2 times a week at the same time. After a preliminary warm-up at a physical education lesson, students from CG were engaged on Tuesday from 8.50 to 9.30 and on Friday from 9.40 to 10.20, and students from EG were engaged on Tuesday from 9.40 to 10.20 and on Friday from 8.50 to 9.30.

The students from the CG were engaged in the usual program [1], and the children from the EG additionally performed a set of speed and strength exercises (jumps, torso turns, pull-ups, push-ups, working with dumbbells, acceleration, and others). Physical activity was different. Children with a strong nervous system changed exercises more often, and children with a weak nervous system were forced to repeat more than one series of exercises due to long working out [10].

All students took control tests

Tapping test (assessment of the strength of the nervous system) [10].

The level of development of speed and strength abilities was determined by three tests

1. Long jump from a place with a push with two legs [11]
2. Lifting the torso from the supine position [12]
3. Flexion and extension of the arms at the stop while lying on the floor [13].

The assessment of overall endurance was determined by the test "skiing 3km" [1].

The results of the study were processed using the Excel program. The student's t-test was also used to determine the statistical significance of the study results. The average in each test and the standard deviation are determined. Meanwhile, the percentage of the effectiveness of the impact in groups and subgroups was determined.

## Results

As a result of the tapping test, students from grades 7a and 7b received ten children with strong and weak nervous systems. Table 1 shows the test results in CG from the beginning to the end of the pedagogical experiment.

Table 1 shows that, according to all indicators, the students from the CG were able to improve their performance, despite the rather short-time interval allotted for the pedagogical experiment. In children with a strong nervous system, the indicators in the "Long jump from a place with a push with two legs" test improved by 3% ( $p > 0.05$ ), and in schoolchildren with a weak nervous system by 4% ( $p > 0.05$ ). In the test "Lifting the torso from the supine position" in children with a strong nervous system, the indicators improved by 2% ( $p > 0.05$ ), and in children with a weak nervous system – by 4% ( $p > 0.05$ ). In children with a strong nervous system in the test "Flexion and extension of the arms at the stop while lying on the floor," the indicators improved from  $7.8 \pm 0.8$  to  $8.0 \pm 0.8$  ( $p > 0.05$ ), the increase was +3%, and in children with a weak nervous system, the indicators became higher from  $8.2 \pm 0.8$  to  $8.4 \pm 0.8$  ( $p > 0.05$ ), and the increase in indicators was +2%. In the test for the development of general endurance, the indicators in children with a strong nervous system improved by 6% ( $p > 0.05$ ), and in schoolchildren with a weak nervous system, the indicators became 3% ( $p > 0.05$ ) higher than they were before the start of the study ( $p > 0.05$ ).

Such results in CG indicated a slight but positive impact of the standard physical education program at school on the indicators of speed and strength abilities and indicators of general endurance.

Table 2 shows the results of the EG tests at the beginning and end of the study.

Table 2 shows that over a period of 3 months, children from EG were able to significantly improve

**Table 1: Indicators of speed-strength abilities and general endurance in CG**

Test	Strong nervous system				Weak nervous system			
	Before	After	%	p	Before	After	%	p
Long jump from a place with a push with two legs (cm)	185.1 ± 4.7	190.7 ± 4.8	+3%	p > 0.05	189.6 ± 4.5	197.2 ± 4.7	+4%	p > 0.05
Lifting the torso from the supine position (20 sec)	12.8 ± 1.1	13.1 ± 1.2	+2%	p > 0.05	12.3 ± 1.1	12.8 ± 1.1	+4%	p > 0.05
Flexion and extension of the arms at the stop while lying on the floor (20 s)	7.8 ± 0.8	8.0 ± 0.8	+3%	p > 0.05	8.2 ± 0.8	8.4 ± 0.8	+2%	p > 0.05
Skiing 3 km (min)	18.8 ± 2.3	17.7 ± 2.2	+6%	p > 0.05	19.6 ± 2.6	19.0 ± 2.5	+3%	p > 0.05

**Table 2: Indicators of speed-strength abilities and general endurance in EG**

Test	Strong nervous system				Weak nervous system			
	Before	After	%	p-value	Before	After	%	p-value
Long jump from a place with a push with two legs (cm)	197.0 ± 6.8	224.6 ± 7.8	+14%	p < 0.05	188.0 ± 4.9	218.1 ± 5.7	+16%	p < 0.05
Lifting the torso from the supine position (20 sec)	12.7 ± 1.1	14.4 ± 1.2	+13%	p < 0.05	13.0 ± 0.8	14.4 ± 0.9	+11%	p < 0.05
Flexion and extension of the arms at the stop while lying on the floor (20 sec)	8.0 ± 0.8	9.1 ± 0.9	+14%	p < 0.05	8.5 ± 0.5	9.5 ± 0.6	+12%	p < 0.05
Skiing 3km (min)	19.2 ± 2.7	16.1 ± 2.3	+16%	p < 0.05	19.8 ± 2.3	17.0 ± 2.0	+14%	p < 0.05

their performance on all tests in both subgroups. In the “Long jump from a place with a push with two legs” test, schoolchildren with a strong nervous system improved their performance by 14% ( $p < 0.05$ ), and children with a weak nervous system by 16% ( $p < 0.05$ ). In the “Lifting the torso from the supine position” test, schoolchildren with a strong nervous system improved their performance by 13% ( $p < 0.05$ ), and children with a weak nervous system by 11% ( $p < 0.05$ ). In the “Flexion and extension of the arms at the stop while lying on the floor” test, the indicators improved from  $8.0 \pm 0.8$  to  $9.1 \pm 0.9$  ( $p < 0.05$ ) in children with a strong nervous system, the increase was +14%, and in children with a weak nervous system, the indicators became higher from  $8.5 \pm 0.5$  to  $9.5 \pm 0.6$  ( $p < 0.05$ ), and the increase in indicators was +12%. The indicators in the general endurance test also increased significantly. In the 3 km cross-country skiing test, children with a strong nervous system had a 16% ( $p < 0.05$ ) increase in indicators, and children with a weak nervous system had a 14% ( $p < 0.05$ ) increase in indicators.

Such results suggested that a set of physical exercises aimed at the development of speed and strength abilities has a positive effect on the development of the abilities themselves and has a positive effect on the indicators of overall endurance in children aged 13–14 years with different strength of the nervous system.

## Discussion

The results of the study obtained after the end of the pedagogical experiment are similar to some studies that were conducted earlier [5], [6], [7], [8], [9], [10].

For example, children from CG improved their performance during the experiment period, although they were engaged in a standard physical education program at school. Such results confirm a sensitive period for the development of speed-strength abilities and general endurance in 13–14 years [5], [6]. The positive result in CG was not significant, children with strong and weak nervous systems managed to improve their skills by only 6%, this indicates a slight influence of the standard physical education program on the studied indicators. These results are similar to our previous study [10]. This is confirmed by the statistical analysis in the conducted study. It should be noted that for a more effective impact on the physical activity of

schoolchildren, the standard program for students in grades 1–11 should be supplemented with additional physical exercises and modern techniques.

This study proves the effectiveness of using a differentiated approach in working with children. Since the children from EG surpassed the students from CG in terms of indicators. This position is also held by other authors [7], [8], [9]. The criterion for differentiating children into groups or subgroups may be height, age, gender, or the level of physical or technical training. However, the typological criterion turned out to be no less effective method of differentiating schoolchildren into subgroups. The children in the EG performed the load differentially, that is, schoolchildren with a strong nervous system cope better in conditions of intense load, for example, frequent changes of physical exercises. Children with a weak nervous system take longer to work out, so the volume load will be more effective for them.

The results shown in the EG suggest that the accentuated development of speed and strength abilities of schoolchildren aged 13–14 has a significant positive effect on overall endurance indicators. The results of the relationship of some physical abilities are confirmed by some scientific studies [2], [3], [14].

## Conclusion

Thus, if a set of physical exercises aimed at developing speed and strength abilities is performed in physical education classes at school, then the indicators of schoolchildren will become higher, as well as their overall endurance indicators will improve. At the same time, the load for schoolchildren aged 13–14 years should be differentiated. When differentiating children into subgroups, it is effective to use the typology of the nervous system (the strength of nervous processes). The age of 13–14 years is favorable for the development of speed and strength abilities of students. The study is relevant and promising for studying the interaction of physical abilities.

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