

Influence of Speed-Strength Training on the Speed of Movement of Schoolchildren with Different Strength of the Nervous System

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Abstract

Background

The aim of this study was to determine the influence of speed and strength abilities of children aged 13-14 years on the indicators of speed of movement, taking into account the differentiated physical activity, which is based on the strength of the nervous system.

Materials and Methods: This case-control study was conducted in an ordinary school in Russia, 40 seventh-graders took part in the experiment. Children from the control group (n=20) were engaged in the usual program, and children from the experimental group (n=20) additionally performed speed-strength exercises at each physical education lesson. Physical activity for children in the experimental group was differentiated, taking into account the strength of the schoolchildren nervous system. All schoolchildren took tests: tapping test, speed-strength abilities were determined by three tests. The speed of movement of schoolchildren was determined by the test «Running on the spot». Two results of two groups were compared.

Results: After the pedagogical experiment, the indicators for all tests in all subgroups increased. In the control group, the indicators of speed and strength abilities in both subgroups improved by 2-4% ($p>0.05$), and the indicators of speed of movement by 4-6% ($p>0.05$). At the same time, the children from the experimental group the indicators of speed and strength abilities improved by 11-16% ($p<0.05$), and the indicators of speed of movement improved by 17-19% ($p<0.05$).

Conclusion

After focused work in physical education classes at school on speed and strength abilities the indicators will improve not only speed-power abilities, but also increase the speed of movement taking into account the typology of the nervous system of schoolchildren.

Key Words: Physical education, Speed of movement, Schoolchildren, Nervous system.

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1- INTRODUCTION

In recent decades, quite a lot of attention has been paid to the physical activity of children and their motor regime. A big role in this is played by physical education at school. As a rule, this is 2-3 lessons a week, where the schoolchildren gets a fairly good physical load. The overall harmonious development of schoolchildren is the goal of the standard physical education program in school grades 1-11 (1). During the period of study at school in physical education classes, the schoolchildren performs a large number of different physical exercises, develops such physical qualities as speed, endurance, strength, flexibility and motor abilities.

It is known that physical qualities are difficult to develop in isolation from each other, as a rule, the development of one quality leads to the development of another, the value can be either minimal or significant. (2-4). In previous studies, we have confirmed the relationship between coordination abilities and their influence on the development of other physical abilities (5). However, motor and coordination skills are more intensively formed in primary school age, and in the middle level, special attention should be paid to the development of other indicators. The sensitive period for the development of speed-power abilities is the age of 13-14 years (6-8).

Most studies that focus on working with children of different ages recommend using an individual or differentiated approach when dosing physical activity (9-11). In this case, the criterion for differentiating children into groups can be gender, age, physical development or technical training. In our opinion, one of the most effective and promising areas is typology. Typology refers to the strength of the nervous system in the process of arousal (5). In this study, we aimed to determine the influence of speed and strength abilities of children aged 13-14

years on the indicators of speed of movement, taking into account the differentiated physical activity, which is based on the strength of the nervous system of schoolchildren

2- MATERIALS AND METHODS

2-1. Study design and population

The pedagogical research was conducted in Russia, in the city of Kirov, secondary school number 60. In this case-control study, 40 schoolchildren aged 13-14 years old took part in a pedagogical experiment. Children from class 7a – 12 girls and 8 boys were identified as control group (CG), and the children of the 7b class 12 boys and 8 girls defined in the experimental group (EG).

2-2. Methods

The pedagogical experiment was conducted on the basis of the secondary school number 60 in the sports hall. Within 3 months (January 12 – March 20, 2020), 20 physical education lessons of 40 minutes each lesson were held in each class. All classes were held 2 times a week on the same days. The children from the CG were engaged on Tuesday (8.50-9.30) and Friday (9.40-10.20), and the children from the EG on Tuesday (9.40-10.20), and Friday (8.50-9.30). The children of class 7a were engaged in the usual physical education program at the school for grades 1-11 (1). The children of class 7b were engaged in the same program, but in addition, after a short warm-up, they performed several speed-strength exercises, such as running, pulling up, jumping, torso turns, bends, push-ups, working with dumbbells. Children from this group performed a load of different directions. That is, children with a strong nervous system performed intensive work (frequent changes of physical exercises), and children with a weak nervous system-a volume load (more than the number of series) (5).

2-3. Measuring tools: validity and reliability

During the period of pedagogical research, all schoolchildren passed control tests:

1. Tapping test-determined the strength of the nervous system of schoolchildren and differentiated children into subgroups (5).

Rules: On a piece of paper, schoolchildren, at the command of the teacher, must put dots in each of the six squares as fast as possible and sequentially. At the end of the test, the strength of the schoolchildren nervous system was determined and the appropriate physical activity was selected, taking into account the test result. If the number of points from 1 square decreased to the last, then these students belong to a strong nervous system, the rest - to a weak one.

2. The development of speed-power abilities was determined by 3 tests.

2-1. Long jump from a place with a push with two legs (12).

The long jump from a place with a push with two legs is performed in the appropriate sector for jumping. The place of repulsion should provide a good grip on the shoes. The participant takes the starting position: feet shoulder-width apart, feet parallel, toes in front of the line of repulsion. A simultaneous push of two legs makes a jump forward. Hand swings are allowed. The measurement is made in a perpendicular straight line from the place of repulsion to the nearest trace left by any part of the participant's body. The participant is given three attempts. The best result is counted.

2-2. Lifting the torso from the supine position (13).

Lifting the torso from the supine position is performed from the starting position: lying on the back, on the gym mat, hands behind the head "in the lock", shoulder

blades touch the mat, legs bent at the knees at right angles, feet pressed by the partner to the floor. The participant performs the maximum number of torso lifts in 20 seconds, touching the elbows of the thighs (knees), followed by a return to the starting position. The number of correctly performed torso lifts is counted.

2-3. Flexion and extension of the arms at the stop while lying on the floor (14).

Flexion and extension of the arms in the supine position is performed from the starting position: the emphasis is lying on the floor, the arms are shoulder width apart, the hands are forward, the elbows are separated by no more than 45 degrees relative to the trunk, the shoulders, trunk and legs make a straight line. The feet rest on the floor without support. The number of correctly performed cycles consisting of flexion and extension of the arms, recorded by the teacher's account aloud or using special devices (electronic contact platforms), is counted. When bending the arms, the chest should touch the floor or the contact platform with a height of 5 cm, then, extending the arms, return to the starting position to continue the test.

3. Running on the spot (15).

The speed of movement was determined by the test «Running on the spot». The result is the number of steps (movements) on the spot in 10 seconds.

2-4. Ethical consideration

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

2-5. Data Analyses

Statistical processing of the results of the experiment was carried out using the SPSS software version 16.0. The average indicators for all tests, the standard deviation and the percentage increase in indicators in each subgroup are

determined. The student's T-test was used for comparing two groups. P-value less than 0.05 were statistically significant.

3- RESULTS

As a result of the study, which involved boys and girls from class 7a and 7b, aged 13-14 years' new data was received. According to the results of the tapping test in class 7a, 10 children had a strong nervous system and 10 had a weak one. The children in grade 7b were identified in a similar way. **Table.1** shows the test results in CG from the beginning to the end of the pedagogical experiment. **Table.1** shows that for all indicators, children from the CG improved their results in a short period of time, studying according to the standard program. In children with a strong nervous system, the performance in the test «Long jump from a place with a push with two legs» improved by 3% $P>0.05$, and in children with a weak nervous system by 4% $P>0.05$. In the test «Lifting the torso from the supine

position», the indicators of schoolchildren with a strong nervous system improved from 12.8 ± 1.1 to 13.1 ± 1.2 seconds (+2%) $P>0.05$, and in children with a weak nervous system, the indicators improved from 12.3 ± 1.1 to 12.8 ± 1.1 (+4%) $P>0.05$. In the test «Flexion and extension of the arms at the stop while lying on the floor», the indicators were higher in children with a strong nervous system by 3% $P>0.05$, and in children with a weak nervous system improved by 2% $P>0.05$. The indicators of speed of movement during the study period in CG changed for the better, but also not significantly. In children with a strong nervous system in the «Running on the spot» test, the performance improved by 6%, and in children with a weak nervous system by 4%. The results of the study, shown in the CG, may indicate a slight influence of the standard physical education program at school on the speed-strength abilities and the ability of children to show speed of movement.

Table-1: Indicators of speed-power abilities and speed of movement in control group.

Test	Strong nervous system				Weak nervous system			
	Before Mean± SD	After Mean± SD	%	P-value	Before Mean± SD	After Mean± SD	%	P-value
Long jump from a place with a push with two legs (cm)	185.1±4.7	190.7±4.8	+3%	>0.05	189.6±4.5	197.2±4.7	+4%	>0.05
Lifting the torso from the supine position (20 sec)	12.8±1.1	13.1±1.2	+2%	>0.05	12.3±1.1	12.8±1.1	+4%	>0.05
Flexion and extension of the arms at the stop while lying on the floor (20 seconds)	7.8±0.8	8.0±0.8	+3%	>0.05	8.2±0.8	8.4±0.8	+2%	>0.05
Running on the spot (steps)	25.8±2.4	27.3±2.5	+6%	>0.05	27.4±2.3	28.5±2.4	+4%	>0.05

SD: Standard Deviation.

Table.2 shows the test results in the EG from the beginning to the end of the pedagogical experiment. **Table.2** shows that for a short period of three months in EG, the performance in all tests in both subgroups improved significantly. In the «Long jump from a place with a push with two legs» test, children with a strong

nervous system improved in EG by 14% $P<0.05$, and children with a weak nervous system by 16% $P<0.05$. Indicators in the test «Lifting the torso from the supine position» in children with a strong nervous system improved from 12.7 ± 1.1 to 14.4 ± 1.2 seconds ($P<0.05$), the increase in indicators was +13%, and in children with

a weak nervous system, the indicators improved from 13.0 ± 0.8 to 14.4 ± 0.9 ($P < 0.05$), the increase was +11% ($P < 0.05$). In the test «Flexion and extension of the arms at the stop while lying on the floor», schoolchildren with a strong nervous system improved by 14% ($P < 0.05$), and schoolchildren with a weak nervous system by 12% ($P < 0.05$). Significant changes in the 3 months of the study occurred in the «Running on the spot» test

in children with a strong nervous system, the indicators improved by 17% ($P < 0.05$), and in children with a weak nervous system, the indicators were higher by 19% ($P < 0.05$). Such results in the EG may indicate the effectiveness of the use of a set of speed-strength exercises in physical education lessons at school, as well as the relationship between speed-strength abilities and speed of movement of schoolchildren aged 13-14 years.

Table-2: Indicators of speed-power abilities and speed of movement in experimental group.

Test	Strong nervous system				Weak nervous system			
	Before Mean \pm SD	After Mean \pm SD	%	P-value	Before Mean \pm SD	After Mean \pm SD	%	P-value
Long jump from a place with a push with two legs (cm)	197.0 \pm 6.8	224.6 \pm 7.8	+14%	<0.05	188.0 \pm 4.9	218.1 \pm 5.7	+16%	<0.05
Lifting the torso from the supine position (20 sec)	12.7 \pm 1.1	14.4 \pm 1.2	+13%	<0.05	13.0 \pm 0.8	14.4 \pm 0.9	+11%	<0.05
Flexion and extension of the arms at the stop while lying on the floor (20 sec)	8.0 \pm 0.8	9.1 \pm 0.9	+14%	<0.05	8.5 \pm 0.5	9.5 \pm 0.6	+12%	<0.05
Running on the spot (steps)	28.0 \pm 3.4	32.8 \pm 4.0	+17%	<0.05	26.6 \pm 2.1	31.7 \pm 2.5	+19%	<0.05

SD: Standard Deviation.

4- DISCUSSION

The purpose of the study was to study of speed and strength abilities of children aged 13-14 years on the indicators of speed of movement, taking into account the differentiated physical activity, which is based on the strength of the nervous system; and the effect of such training on the speed of movement of students. In a previous study, we were able to establish an effective relationship between the physical abilities of primary school children. Namely, the purposeful development of some abilities significantly affects the performance of others. At the same time, a differentiated approach is important, in this case, it is the typological features of the manifestation of the properties of the nervous system, that is, the strength of the nervous system of

students in the process of arousal (5). In recent years, various studies have paid great attention to the health and physical activity of schoolchildren of different ages. Physical education at school is the main core in terms of mastering the school of movements, various exercises and their combinations. The benefits of physical education for everyday life can hardly be overestimated (16-18). In previous studies, the effectiveness of the use of speed-strength exercises in physical education classes at school was proved (5). The use of such exercises for children aged 13-14 years allows you to purposefully influence the developing abilities and significantly improve their performance. The results of this study confirm the opinion of some authors about a favorable period for the development of speed-power abilities at

the age of 13-14 years, since the indicators in CG increased, without an accentuated development of speed-power abilities (6-8). In this study, the position of the positive use of a differentiated approach in physical education lessons at school is again proved, children from the CG were able to significantly improve their performance in contrast to children from the CG who did not use a differentiated approach. The effectiveness of using a differentiated approach in working with schoolchildren of different ages is confirmed by previous studies (9-11). The aim of the study was achieved, as the children from the EG purposefully developing speed-strength abilities, were able to significantly improve the speed of movement in the test «Running on the spot». The relationship of physical abilities is also indicated by several studies that confirm this relationship and the influence of one physical quality on another (2-4). It should be noted that the load for the development of speed and strength abilities in schoolchildren aged 13-14 years should be different. For children with a strong nervous system, the process of arousal is characterized by an intense load, namely, a frequent change of physical exercises, due to the rapid fatigue of the strength of the nervous system. For children with a weak nervous system, a volume load is more suitable, that is, a greater number of series of exercises, since such children enter the working rhythm longer.

4-1. Study Limitation

The only one limitation of this study is the limited number of schoolchildren. This is due to the number of healthy children who were allowed to take physical education classes at school with the main medical group.

5- CONCLUSION

Based on the results the indicators of not only speed and strength abilities, but

also the indicators of speed of movement children's will improve, taking into account the differentiated physical activity, which is based on the strength of the nervous system.

6- CONFLICT OF INTEREST: None.

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