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Influence of Speed-Power Abilities on Memory in Children with Different Strength of the Nervous System

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Abstract

Background

The aim of this study is to determine the effect of speed-strength training on memory in schoolchildren aged 13-14 years, taking into account the strength of their nervous system.

Materials and Methods

This case control study was conducted in a secondary school in the city of Kirov in Russia for a period of 3 months (January 12 to March 20, 2020). 40 boys and girls were engaged in physical education 2 times a week for 40 minutes. 20 schoolchildren from the control group were engaged in physical education according to the usual program. 20 schoolchildren from the experimental group additionally performed exercises for the development of speed and strength abilities. The strength of the nervous system was determined using a tapping test. Memory indicators in children were measured using the «Method of Jacobs» test. Data were analyzed using SPSS software version 16.0.

Results

40 children participant in this study. After the pedagogical experiment, the indicators in all subgroups changed. In the control group, memory indicators in children with a strong nervous system improved only by 5% ($p>0,05$), and in children with a weak nervous system from 5.5±0.5 to 5.7±0.5, this is only 4% ($p>0.05$). At the same time, in the experimental group of children with a strong nervous system, memory indicators improved by 21% ($p <0.05$), and in children with a weak nervous system from 5.1±0.7 to 6.0±0.9, this is 18% ($p <0.05$).

Conclusion

Memory performance in children aged 13-14 years will improve if we perform speed-strength exercises at each lesson in physical culture. The load for children with a strong and weak nervous system should be differentiated.

Key Words: Children, Memory, Physical education, Speed abilities, Strength abilities.

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1- INTRODUCTION

Recent studies by various authors suggest the need for a positive and effective effect on the child's body. It's not just about a healthy diet, but the physical activity that the child should receive. Physical education at school is of great importance for children in terms of their physical development. During the school period, children learn new forms and elements of movements, different combinations. A big role in this belongs to the physical education teacher (1-2). In working with schoolchildren, as a rule, exercises are used to develop motor skills, that is, exercises for dexterity and coordination abilities, these are different outdoor games. In working with the middle and senior level in school, exercises are more often used to develop strength, endurance, and speed abilities. It should be noted that the purposeful development of speed and power abilities is promoted by a favorable period – this is the age of 13-14 years, as a rule, these are schoolchildren from the 7th grade (3-5).

In our previous study, we were able to prove the effectiveness of implementing a set of exercises aimed at developing speed and strength abilities in physical education classes (6). The use of such a set of exercises in addition to the usual work program for schoolchildren aged 13-14 years contributes to the effective growth of the studied abilities. When working with children of different ages, a large number of authors recommend using a differentiated approach (7-9). This is swinging and physical education lessons. In this case, the criterion for differentiating children into groups or subgroups may be the level of physical fitness, gender, or height of the schoolchildren. In our opinion, one of the most effective and promising criteria for differentiating children into groups is typology. By typology we mean the strength of the nervous system by the process of arousal (strong or weak), (6). Quite a large number of studies are devoted to the study of the influence of physical activity of schoolchildren or athletes on their mental processes (10-12). In a new study, the goal was to determine the effect of speed-strength training on memory in 13-14-year-old, taking into account the strength of their nervous system. We aimed to improve the performance of not only speed and strength abilities, but also learn how they affect the memory performance of schoolchildren.

2- MATERIALS AND METHODS

2-1. Study design and population

In this case control study, 40 children took part in the pedagogical experiment. These were schoolchildren of secondary school number 60 in the city of Kirov (Russia), for a period of 3 months (January 12 to March 20, 2020). 20 schoolchildren from class 7a (8 girls and 12 boys) were identified in physical education classes in the control group (CG). 20 schoolchildren from class 7b (8 girls and 12 boys) belonged to the experimental group (EG). Before the study, all children were healthy and had medical admission to physical education. 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.

2-2. Methods

The pedagogical experiment was conducted in the period from January 12 to March 20, 2020. For 3 months, 20 physical education lessons were held in each class. Classes were held 2 times a week for 40 minutes each lesson. The schedule of physical education classes was unchanged. The children from the CG were engaged on Tuesdays from 8: 50 to 9: 30 and on Fridays from 9: 40 to 10: 20. The children from EG also studied on Tuesdays from 9: 40 to 10: 20 and on Fridays from 8: 50 to

9: 30. Schoolchildren from the 7a class were engaged in the standard physical education program at school (13). Schoolchildren from class 7b also went through the standard program, but at the same time, at each lesson, they additionally performed physical exercises (running, jumping, turns, squats, push-ups, pull-ups, working with dumbbells and other exercises) aimed at developing speed and strength abilities. At the same time, physical activity in children with different nervous systems was different. Children with a strong nervous system are able to switch attention more often, so they were characterized by frequent changes in exercises, unlike children with a weak nervous system. The number of series of one exercise in children with a weak nervous system was greater (6).

2-3. Measuring tools

Before the beginning of the pedagogical experiment, all schoolchildren performed the «tapping test», which determines the strength of the nervous system. The essence of the test is that schoolchildren at the command of the teacher should perform at maximum speed tapping with a pencil on a piece of paper, which shows squares with numbers from 1 to 6. From the first to the second square after 5 seconds, you can move at the command of the teacher. Based on the results of 30 seconds, a graph is plotted and the strength of the nervous system is determined (13).

After the children passed the tapping test, they had to perform another test: «Method of Jacobs», which determined the state of memory of schoolchildren (14). There are 4 squares on a piece of paper. Each square has numbers in any order, and the number of digits in the row is in ascending order (**Table 1**).

Table-1: Material for determining short-term memory (14).

First square	Second square
3524	4106
29602	29934
154063	656086
5742389	7201570
85682538	92744525
738374623	615843413
8323845207	3524836897
The third square	**Fourth square**
8372	6106
54805	79934
325318	356086
7759438	8201570
92186355	92744525
332697843	315843413
1445287167	5524836897

The essence of the test is as follows: the teacher aloud and slowly calls the numbers from each line. After each line, the schoolchildren write down the numbers in the order in which the teacher said.

Memory indicators are calculated using the formula: A+C/4

A. The Longest line length that was played correctly;

C. the Number of correctly reproduced rows greater than A (14).

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 pedagogical experiment was carried out using the SPSS software version 16.0. As a result, the average indicators in the «Method of Jacobs» test were determined, as well as the standard deviation and the percentage of increase in indicators in each subgroup. The student's T-test was used. P-value less than 0.05 were statistically significant.

3- RESULTS

After the tapping test, the children were divided into subgroups as follows:

10 children with a strong nervous system and 10 with a weak one in CG.

10 children with a strong nervous system and 10 with a weak one in the EG.

Table.2 shows the memory indicators in children aged 13-14 years from the beginning to the end of the study.

Table-2: Memory indicators in children aged 13-14 years, n=40.

Groups	Nervous system	Before Intervention Mean± SD	After Intervention Mean± SD	%	P-value
Control, n=20	Strong	5,4±0,5	5,7±0,5	+5%	>0.05
	Weak	5,5±0,5	5,7±0,5	+4%	>0.05
Experimental, n=20	Strong	5,3±0,7	6,4±0,8	+21%	<0.05
	Weak	5,1±0,7	6,0±0,9	+18%	<0.05

SD: Standard deviation.

Table 2 shows that the performance of all subgroups has improved. However, in children from CG in the subgroup with a strong nervous system, the indicators improved only by 5%, and in children with a weak nervous system from 5.5±0.5 to 5.7±0.5, this is only 4%. The results of such data may indicate the effectiveness of the application of the standard physical education program at school on the memory indicators of children aged 13-14 years. At the same time, in the EG, children with a strong nervous system improved memory performance by 21%, and in children with a weak nervous system from 5.1±0.7 to 6.0±0.9, this is 18%. Such results indicate a significant effectiveness of the implemented complex in the educational process of children aged 13-14 years on memory indicators.

4- DISCUSSION

The importance of physical education for children in school years is difficult to overestimate. Under the supervision of a teacher, children from the first grade master physical exercises and their elements that will be useful to them in later life (1-2). The results obtained in the course of the pedagogical experiment are confirmed by previous studies. The authors of such studies have established the relationship between the physical activity of schoolchildren, athletes and the indicators of their mental processes (10-12). Some authors have studied the effect of physical activity on the cognitive processes of children of different ages, and some recommendations have been made, but they differ from our study in that for

the first time the typology of the nervous system was used as a principle of differentiation of children into subgroups (15, 16). According to the results of the study obtained in all subgroups, we can say that physical culture has a positive effect on the memory development of children aged 13-14 years. It is necessary to emphasize the importance of using a differentiated approach in physical education lessons at school (7-9). This approach allows you to maximize the internal physical potential of each schoolchildren. Using Typology (nervous system strength) as a criterion for differentiating children into subgroups, it also proved its effectiveness with the results obtained during the study in the EG. And this is confirmed by previous studies (6). Thus, the aim of the study was achieved, namely, to determine the positive effect of speed-strength training on memory in schoolchildren aged 13-14 years, taking into account the strength of their nervous system.

5- CONCLUSION

If at each lesson in physical culture, schoolchildren 13-14 years old will work according to the standard program in physical culture at school, while performing a set of non-complex exercises aimed at developing speed and strength abilities, then the attention indicators of children will significantly improve, especially if the load is differentiated (by the strength of the nervous system in the process of arousal). At the same time, children with a weak nervous system are characterized by a volume load (a larger number of series, a smaller number of exercises), and more intense load is suitable for children. The study is relevant in the field of physical education and sports and promising for further research aimed at the relationship between physical activity and mental processes.

6- CONFLICT OF INTEREST: None.

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