

# Development of Flexibility of Children with Different Types of the Nervous System Using Speed-Strength Exercises

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## Abstract

The determination of the effect of speed-strength exercises on the flexibility of 13 to 14-year-old teenagers, using a differentiated load was the aim of the study. The experiments took place at a school in Russia, 40 students aged 13-14 took part in it, they were differentiated into 2 subgroups of 20 subjects. The control group's Schoolchildren were involved in the usual program, whilst the ones from the experimental one at each physical education lesson performed a set of speed and strength exercises for 8 minutes.

After the study, the data in the control group improved from 2% to 8%, and in the experimental group from 11% to 24%. There was a significant improvement in performance and flexibility among students who purposefully performed a set of speed and strength exercises at each physical education lesson. Physical activity should be different, based on the type of nervous system of students. For students with a strong nervous system, intensive exercise is more effective, and for students with a weak nervous system, volumetric physical activity is more effective.

**Keywords:** Schoolchildren, Health, Flexibility, Typology, Physical culture

## INTRODUCTION

An analysis of the literature of recent years shows that the attention of a large number of studies is focused on the health of schoolchildren and the insufficient level of their motor activity [1, 2]. During school years, a vital foundation of motor skills and abilities of children from the first grade is formed. Under the supervision of a teacher, students perform a fairly large number of physical exercises and different combinations at each lesson. The main task of physical culture at school is the comprehensive harmonious development of the personality of students [3]. The program strongly influences the development of basic physical abilities (endurance, speed, flexibility, strength, agility). It should be noted that physical abilities are interconnected and it is quite difficult to develop one quality in isolation. That is, if we develop endurance, then it affects other abilities, this has been proven by several studies [4, 5].

In previous studies, we have proven the effect of coordination training on indicators of other physical abilities [6]. However, coordination training and dexterity development are typical for children in primary school. And for middle-level schoolchildren, the high-speed, power, and endurance load will be relevant. Physical qualities such as speed and strength abilities are best developed at the adolescent age of 13 to 14 [7, 8].

In working with school children of any age, it is important to use a differentiated or individual approach at each lesson,

while the criterion of differentiation may be the level of physical or technical training, the growth of students, or some other characteristics. This approach to working with children is quite effective and allows you to reveal almost the entire motor potential of each child [9-11]. Of course, a promising direction in the individualization of learning is the type of nervous system [12].

In this study, we set ourselves a new goal – to determine the effect of a set of exercises for the development of strength and speed for the flexibility of schoolchildren, taking into account the nervous system type.

## MATERIALS AND METHODS

### Participants

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The academic experiment was attended by schoolchildren aged 13-14 years in the number of 40 people from class 7a (control group - CG) and class 7b (experimental group - EG).

### Procedure

The study was conducted in 60 schools in Kirov (Russia). The study lasted from January 12 to March 20, 2020. There were 8 girls and 12 boys in the control and experimental groups. All the children were on health grounds of the main medical group and admitted to physical education. During the experiment period, 20 lessons in CG and 20 lessons in EG were conducted, each lesson lasted 40 minutes. Physical education classes were scheduled twice a week in class 7a (Tuesday 8.50-9.30, Friday 9.40-10.20), in-class 7b (Tuesday 9.40-10.20, Friday 8.50-9.30).

Children from class 7a were engaged in a standard program for students of grades 1-11 in physical culture at school [3].

Schoolchildren from grade 7b used the usual program and performed speed and strength exercises for 8-10 minutes after the warm-up. The simple set of exercises required maximum dedication from the students, it included such exercises as running, body turns, acceleration, pull-ups, push-ups, squats, working with dumbbells, and others. Physical activity for children in EG was different. Children with a strong nervous system work out faster, but get tired quickly, so they are characterized by frequent changes of exercises and fewer series, the contrary can be inferred from the children with weaker nervous systems [12].

All children took a tapping test, which differentiated schoolchildren by the strength of the nervous system.<sup>12</sup> According to the test results, the children were differentiated into subgroups.

Indicators of speed and strength abilities were determined by three tests:

long jump from a place with a push with two legs (leg strength) [13], lifting the torso from the supine position (torso strength) [14], flexion and extension of the arms at the stop while lying on the floor (arm strength) [15].

The flexibility of schoolchildren was determined using the test “forward-leaning from an upright position on a gymnastic bench” [3].

In the study, when calculating the results, we used the Excel program. According to the results of the study, the average values in each group, the standard deviation from the indicators were determined.

## RESULTS AND DISCUSSION

After the tapping test procedure, children in grades 7a and 7b received 10 schoolchildren with a strong and 10 with a weak nervous system in the arousal process. **Table 1** shows the results of the study in CG.

**Table 1.** Speed and strength ability indicators and flexibility in CG

Test	Strong nervous system			Weak nervous system		
	Before	After	%	Before	After	%
leg strength (cm)	185,1±4,7	190,7±4,8	+3%	189,6±4,5	197,2±4,7	+4%
torso strength (20 sec)	12,8±1,1	13,1±1,2	+2%	12,3±1,1	12,8±1,1	+4%
arm strength (20 sec)	7,8±0,8	8,0±0,8	+3%	8,2±0,8	8,4±0,8	+2%
Leaning forward from a standing position on a gymnastic bench (from the bench level cm)	7,2±1,3	7,6±1,4	+6%	7,5±1,2	8,1±1,3	+8%

**Table 1** shows that students from the CG improved their performance in both subgroups, although they studied according to the standard program, without taking into account the differentiated load. Indicators in the “leg strength” test of the stronger nervous system teenagers, increased by 3% as compared to the ones with weak nervous systems which increased by 4%. A similar phenomenon was seen in the “torso strength” with the indicators of weaker nervous system children increasing by 4% contrasted to the 2% increase in their counterparts, .3% was an increase in indicators in children with a strong nervous system in the test

“arm strength”, and in children with a weak nervous system 2%.

Flexibility indicators also did not significantly improve showing a 6% (7.2±1.3 to 7.6±1.4) increase in the stronger nerved children as compared to the 8%(7.5±1.2 to 8.1±1.3) on in the weaker ones.

Well, the usual physical education program at school is not so bad, it has a positive but not significant effect on the physical qualities of students. **Table 2** shows the results of the study in EG.

**Table 2.** Speed and strength ability indicators and flexibility in EG

Test	Strong nervous system			Weak nervous system		
	Before	After	%	Before	After	%
leg strength (cm)	197,0±6,8	224,6±7,8	+14%	188,0±4,9	218,1±5,7	+16%
torso strength (20 sec)	12,7±1,1	14,4±1,2	+13%	13,0±0,8	14,4±0,9	+11%
arm strength (20 sec)	8,0±0,8	9,1±0,9	+14%	8,5±0,5	9,5±0,6	+12%
Leaning forward from a standing position on a gymnastic bench (from the bench level cm)	7,1±1,1	8,6±1,3	+21%	7,4±1,3	9,2±1,6	+24%

**Table 2** demonstrates that in a fairly short time, the children from EG were able to significantly improve their performance on all tests. In the “leg strength” test, the weak nervous system-children showed a 16% improvement in their performance compared to the 14% in their strong nervous system counterparts. Contrarily the “torso strength” test, the indicators were higher by 13% in the stronger nerved children with the weak nerved children only showing an 11% increase. This was also similarly witnessed in the “arm strength” test where the increase of weak nerved children was lower at 12% with the strong nervous system counterparts showing a 14% increase instead.

The flexibility indicators gave a fairly significant increase throughout the whole academic experiment. Thus, in children with a strong nervous system, the level of flexibility on average became higher from 7.1± 1.1 to 8.6± 1.3 (by 21%), whilst increasing by 24% in weaker nervous system children from 7.4±1.3 to 9.2± 1.6

Such results suggest that the speed-strength abilities developed during the sensitive period in schoolchildren aged 13-14 have a significant impact on the flexibility indicators of children engaged in different physical activities, which is reliant on the typological properties of the nervous system.

According to the results of the study in the CG, it can be said that the ordinary program does not have a significant but positive effect on the advancement of the physical abilities of schoolchildren aged 13-14. The children did not perform any additional exercises, the increase in indicators was minimal. We can assume that this increase in speed-strength abilities in children in CG occurred not only under the influence of the standard program, but also a favorable period for the maturity of speed-strength abilities of teenagers between the ages of 13 and 14 [7, 8]. The results of the study are similar to the data obtained in previous studies [12].

Differentiated development of physical abilities ought to be more defined when typology of the nervous system is employed as a criterion for differentiating children into subgroups during exercise. At the same time, the load in children with a strong nervous system will be more effective if it is intense, that is, there will be more exercises since these children can get tired quickly and switch their attention faster.

Schoolchildren who have a weak nervous system are better for them a volume load, that is, an increased number of series of performing the same exercise, since such students are characterized by long-term workability. These results are confirmed by previous studies [9-12].

Children from EG had significantly improved flexibility indicators, by an average of 21-24%, while there was no targeted impact on this physical ability. In all likelihood, the development of speed and strength abilities had a significant effect on the progression of flexibility in schoolchildren between the ages of 13 and 14. Despite some studies of the interrelationships of physical abilities among themselves [4-6], this study for the first time determined a fairly stable link between the speed and strength capability and flexibility of teenagers between the ages of 13 and 14. The article is promising, since the topic of public health in different countries is relevant [16-20].

## CONCLUSION

There are a few things to note from the results of the new study. At the age of 13-14, it is necessary to develop speed-strength abilities in physical education lessons at school, as an addition to the implementation of a typical school program for students in grades 1-11. Such a period is favorable for the development of the main parameters. If you use an individual approach centered on the type of nervous system, the impact of classes will be higher.

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