

## The Influence of Speed-Strength Training on the Vestibular Stability of Children Aged 13-14 Years with Different Strengths of the Nervous System

\* Polevoy G.G.

<sup>1</sup> Moscow Aviation Institute (National Research University), Moscow, Russia.

<sup>2</sup> Vyatka State University, Kirov, Russia.

<sup>3</sup> Moscow Polytechnic University, Moscow, Russia.

### Abstract

**Background:** This study aimed to determine the effect of speed-strength exercises on the vestibular stability of schoolchildren with different nervous systems.

**Methods:** The pedagogical experiment was conducted from January 12 to March 20, 2020 in Kirov, Russia, school number 60. The study involved children aged 13-14, 20 students from grade 7a and 20 students from grade 7b. The participants from class 7a were considered as the control group, being engaged in the usual program; and those from class 7b additionally performed speed-strength exercises. Children from grade 7b were divided into two subgroups taking into account the strength of their nervous systems, determined based on a «tapping test». Vestibular stability of schoolchildren was measured using the test of «Turns on the gymnastic bench». The data was analyzed using the Student's T-test.

**Results:** After the end of the pedagogical experiment, the indicators of vestibular stability in schoolchildren in all subgroups were improved, but in different ways. In the control group, the indicators were improved slightly, only by 6-7% ( $p>0.05$ ). However, in the experimental groups the indicators improved significantly. In children with a strong nervous system, the indicators improved by 21% ( $p>0.05$ ), and in children with a weak nervous system, by 18% ( $p>0.05$ ).

**Conclusion:** If at each physical education lesson at school children will additionally perform speed and strength exercises, then the indicators of vestibular stability will improve. Physical activity should be differentiated taking into account the strength of the nervous system of schoolchildren.

**Key Words:** Abilities, Children, Health, Physical culture, Schoolchildren, Vestibular stability.

\* Please cite this article as: Polevoy G.G. The Influence of Speed-Strength Training on the Vestibular Stability of Children Aged 13-14 Years with Different Strengths of the Nervous System. Int J Pediatr 2021; 9 (12):15054-15059. DOI: **10.22038/IJP.2021.58495.4571**

---

### \* Corresponding Author:

G.G. Polevoy, Moscow Aviation Institute (National Research University), Moscow, Russia. Email: [g.g.polevoy@gmail.com](mailto:g.g.polevoy@gmail.com)

Received date:Jun.21,2021; Accepted date:Nov.28,2021

## 1- INTRODUCTION

The problem of insufficient physical activity and health of schoolchildren is often considered in various studies. To meet the need for movement, a physical education lesson at school is of great importance during school years. At physical education classes, schoolchildren are under the supervision of a teacher, master the entire arsenal of motor actions necessary for them in later life. In school years, it is necessary to act comprehensively and harmoniously, that is, to develop all physical qualities according to age (strength, speed, endurance, flexibility and dexterity) (1-3). Purposeful development of physical qualities in a certain period of time (sensitive period) gives a significant effect on the development of these indicators. In working with younger schoolchildren, most of the work is spent on developing flexibility, coordination abilities, and speed of movement. In the middle and high school level, children work more on the development of strength and speed-strength abilities (4-6).

In a previous study, we proved the effectiveness of using a set of physical exercises aimed at developing speed and strength abilities in schoolchildren aged 13-14 years (7). The use of such exercises in physical education classes at school will be an excellent addition to the work program in the school of physical education for children in grades 1-11 (8).

It should also be noted that in working with children of different ages, especially in physical education classes, a differentiated approach should be used. The effectiveness of using a differentiated approach in physical education lessons has been proven by many studies (9-11). At the same time, in the lessons, you can assign children into different subgroups, taking into account various indicators such as, height, level of training, physical development, and some others. In our

opinion, one of the most effective criteria for differentiating children into subgroups is typology (strength of the nervous system) (7).

Separately, we should mention that a large number of studies have aimed at studying the influence of physical activity and movement on the indicators of mental processes. They have proved that physical activity has a positive effect on intellectual and mental processes.

In this study, we were to find out how a set of physical exercises aimed at the development of speed and strength abilities affects the indicators of vestibular stability of schoolchildren with different strengths of the nervous system.

## 2- MATERIALS AND METHODS

### 2-1. Study design and population

40 children took part in the pedagogical experiment. They consisted of schoolchildren of secondary school number 60 in the city of Kirov (Russia). 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 participating children.

### 2-2. Methods

This pedagogical experiment was conducted in Russia, in an ordinary school (Kirov) for 3 months. The study lasted from January 12 to March 20, with a total of 20 physical education students in each class. All lessons were held in the gym for 40 minutes 2 times a week, while the lesson schedule was the same in both subgroups. The study involved 20 children from class 7a (control group - CG) and 20

children from class 7b (experimental group-EG). Each group consisted of 12 boys and 8 girls aged 13-14. The children who took part in the study were healthy and a medical professional had allowed them to take physical education classes at school.

The children from the CG had a physical education lesson on Tuesday (the 2nd lesson in the schedule) and on Friday (the 3rd lesson in the schedule), and the children from the EG had physical education on Tuesday (the 3rd lesson in the schedule) and on Friday (the 2nd lesson in the schedule).

Schoolchildren from the CG were engaged in a standard physical education program for schoolchildren of ordinary schools (8). Schoolchildren from the EG were engaged in the same program, but in addition, after a short warm-up, they performed a set of exercises (running, turns, jumps, pull-ups, push-ups, working with dumbbells) aimed at developing speed and strength abilities. For children with strong and weak nervous systems in the EG, the load was different. For schoolchildren with a weak nervous system, the process of arousal was characterized by a volume load, namely, a rare change of physical exercises and a larger number of series. And for schoolchildren with a strong nervous system, the load was intense (more exercises, but fewer series) (7).

### 2-3. Measuring tools

Prior to the study, all schoolchildren took control tests, the strength of the nervous system was determined by Tapping test, and vestibular stability by the test of «Turns on the gym bench».

**Tapping test:** at the signal of the teacher, schoolchildren should quickly put dots in the square with the number 1 (on the A4 sheet) with a pencil, after 5 seconds go to the second square and so on to the sixth square. After that, they need to draw a graph and determine the strength of the

nervous system by the process of arousal (7).

**Turns on the gym bench:** schoolchildren must perform turns on the narrow part of the bench. The calculation takes into account half of the rotation around its axis. If the student has fallen, he gets back up and continues the exercise. The test lasts for 20 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 pedagogical experiment was carried out using the Microsoft Excel program. This allowed us to determine the arithmetic mean in the group, calculate the standard deviation, and determine the percentage increase in indicators from the beginning to the end of the study. The student's T-test was used to compare the outcomes in CG and EG groups.

## 3- RESULTS

According to the results of the tapping test, out of 20 schoolchildren in the EG, 10 were with a strong nervous system and 10 with a weak one. Similarly, the children were differentiated in CG.

**Table 1** shows the indicators of vestibular stability in schoolchildren aged 13-14 years from the beginning to the end of the study.

As presented in **Table 1**, the indicators of vestibular stability were improved in schoolchildren from both 7a and 7b. In the participants with a strong nervous system from CG, the indicators improved from  $12.7 \pm 1.2$  to  $13.6 \pm 1.2$ , i.e., the increase in indicators was 7%. In children with a weak nervous system, the indicators improved from  $12.9 \pm 1.4$  to  $13.7 \pm 1.5$ , while the

increase in vestibular stability indicators was only 6%. The results of the study in the CG indicate a weak effectiveness of the standard work program in physical

education at school, which did not have a significant impact on the development of vestibular stability in children aged 13-14 years.

**Table-1:** Indicators of vestibular stability of the children, n=20 in CG, n=20 in EG

| Groups       | Nervous system | Before research<br>M+m | After research<br>M+m | %    | P      |
|--------------|----------------|------------------------|-----------------------|------|--------|
| Control      | Strong         | 12,7±1,2               | 13,6±1,2              | +7%  | p>0.05 |
|              | Weak           | 12,9±1,4               | 13,7±1,5              | +6%  | p>0.05 |
| Experimental | Strong         | 12,4±1,0               | 15,0±1,2              | +21% | p<0.05 |
|              | Weak           | 12,3±1,3               | 14,5±1,5              | +18% | p<0.05 |

Among the EG participants with a strong nervous system, the increase in indicators was 21% (indicators improved from 12.4±1.0 to 15.0±1.2). In those with a weak nervous system, the increase in indicators was 18% (from 12.3±1.3 to 14.5±1.5). These results indicate the effectiveness of the use of speed and strength training in physical education lessons; and confirm their having a positive and significant impact on the development of vestibular stability of schoolchildren.

#### 4- DISCUSSION

Physical education at school is of great importance for the growth and development of children. The level of physical fitness of each schoolchild largely depends on his ability to engage in physical education, of course, there are children who play sports in addition, but there are not many such schoolchildren (1-3).

In Russia, there is a standard program for physical education at school. It covers the entire range of movements and passing the material; and the schoolchildren learn the entire arsenal of physical skills necessary for later life. The main goals are the comprehensive harmonious development of the schoolchildren, and the development of all physical qualities in a certain age period of schoolchildren. Despite the fact

that the Children from CG showed a positive trend in the results for vestibular stability during the 3 months of the study, it should be noted that there is a natural increase in such indicators at the age of 13-14 years. In our opinion, the standard program is not perfect; it needs some minor additions. This claim is due to the fact that the children in the CG showed improvements in the indicators of vestibular stability by 6-7%, while those from the EG improved the indicators by 18-21%. Such indicators indicate the efficiency of work in the EG. It is then revealed that a set of physical exercises aimed at the development of speed and strength abilities has a significant positive effect on the development of vestibular stability of schoolchildren aged 13-14 years.

This confirms the effectiveness of using a differentiated approach in physical education lessons. This approach has a positive effect on physical education lessons, and helps children to realize more of their physical abilities; this is, likewise, confirmed by previous studies (9-11). In this case, the criterion for dividing children into subgroups was a typological indicator, that is, the strength and weakness of the nervous system in the process of arousal. This criterion proved its effectiveness with the results in the experimental group. The effectiveness of using a differentiated

approach in working with children is also confirmed by previous studies, for example, Gavin et al., in 2017, examined a differentiated instruction in physical education- personalization of learning (9). Van Munster et al., in 2019, investigated a universal design for learning and differentiated instruction in physical education (10). Jarvis et al., in 2017, studied a differentiated pedagogy to address learner diversity in secondary physical education (11).

Thus, the objective of the study was achieved, namely, the influence of a set of physical exercises aimed at the development of speed and strength abilities on the indicators of vestibular stability of schoolchildren aged 13-14 years with different strengths of the nervous system was determined. The topic is relevant, as it affects the health and physical development of children; this is confirmed by many modern studies (12-16).

## 5- CONCLUSION

At each physical education lesson at school, after a short warm-up for 10 minutes, it is recommended to use exercises aimed at developing speed and strength abilities. When working with children of different ages, it is recommended to use a differentiated approach. One of the most effective criteria for dividing children into differentiated groups is typology (strength of the nervous system). The load for children with a weak nervous system should be voluminous, that is, a rare change of physical exercises and a larger number of series of one exercise, and for schoolchildren, with a strong nervous system, an intense load is recommended. Thus, performing exercises for the development of speed and strength abilities in physical education classes, taking into account the typology, will lead to a significant improvement in the indicators of vestibular stability.

## 6- REFERENCES

1. Shuba LV. Modern approach to implementation of health related technology for primary school children. *Pedagogics, psychology, medical-biological problems of physical training and sports* 2016; 20(2):66-71. <https://doi.org/10.15561/18189172.2016.0210>.
2. Donnelly J, Hillman C, Castelli D, Etnier J, Lee S, Tomporowski P, Lambourne K, Szabo-Reed A. Physical Activity, Fitness, Cognitive Function, and Academic Achievement in Children: A Systematic Review. *Medicine and science in sports and exercise* 2016; 48(6):1197-1222. DOI:10.1249/MSS.0000000000000901.
3. De Giorgio A, Kuvacic G, Milic M, Padulo J. The Brain and Movement: How Physical Activity Affects the Brain. *Montenegrin journal of sports science and medicine* 2018; 7(2):63-68. DOI: 10.26773/mjssm.180910.
4. Bas H, Mark DSC. Sensitive Periods to Train General Motor Abilities in Children and Adolescents: Do They Exist? A Critical Appraisal. *Strength and conditioning journal* 2020; 42:7-14. DOI: 10.1519/SSC.0000000000000545.
5. Solum M, Lorås H, Pedersen AV. A Golden Age for Motor Skill Learning? Learning of an Unfamiliar Motor Task in 10-Year-Olds, Young Adults, and Adults, When Starting From Similar Baselines. *Front. Psychol* 2020; 11:538. doi: 10.3389/fpsyg.2020.00538.
6. Ford P, Croix MDS, Lloyd R, Meyers R, Moosavi M, Oliver J, Till K, Williams C. The Long-Term Athlete Development model: Physiological evidence and application. *Journal of Sports Sciences* 2011; 29(4):389-402. DOI: 10.1080/02640414.2010.536849.
7. Georgy G Polevoy. The Development of the Vestibular Stability in Children Who

are Engaged in Football Taking into Account their Nervous System. *Indian Journal of Public Health Research & Development*, February 2019, 10(2): 317-322. 8. Kainov AN, Kuryerova GI. Working programs. *Physical Culture. Grades 1-11. Comprehensive program of physical education of schoolchildren. Teacher*, 2019; 169 p.

9. Gavin C, Tony P, Christine J, Starla MC. Differentiating Instruction in Physical Education: Personalization of Learning. *Journal of Physical Education, Recreation & Dance* 2017; 88:44-50. DOI: 10.1080/07303084.2017.1340205.

10. Van Munster M, Lauren L, Michelle G. Universal Design for Learning and Differentiated Instruction in Physical Education. *Adapted Physical Activity Quarterly* 2019; 36:1-19. DOI: 10.1123/apaq.2018-0145.

11. Jarvis JM, Pill SA, Noble AG. Differentiated Pedagogy to Address Learner Diversity in Secondary Physical Education. *Journal of Physical Education, Recreation & Dance* 2017; 88 (8): 46-54. <https://doi.org/10.1080/07303084.2017.1356771>.

12. Keyvanfar S, Amir Ali Akbari S, Tork Zahrani Sh, Nasiri M. Comparison of parenting styles in parents of 3-5-year-Old Kindergarten Children with and without developmental delay. *Int J Pediatr* 2021; 9(3): 13225-235. DOI: 10.22038/IJP.2020.50831.4040.

13. Vaziri C, Ghanbaripanah A, Tajalli P. Modeling the Cognitive Flexibility and Academic Engagement based on Self-Regulation, Psychological Hardiness and Self-Differentiation with Mediation of Family Functioning in High School Students. *Int J Pediatr* 2021; 9(3): 13281-295. DOI: 10.22038/IJP.2020.50410.4011.

14. Salarichine P, Mehrabifar F. Effect of Difficulty in Emotional Regulation on the Quality of School Life of High School Girl

Students, Kerman, Iran. *Int J Pediatr* 2021; 9(3): 13297-307. DOI: 10.22038/ijp.2021.55273.4357.

15. Jenabi E, Ayubi E, Naemi M. Is There an Association between Fetal Distress and Autism Spectrum Disorders (ASD) among Children? A Systematic Review and Meta-Analysis. *Int J Pediatr* 2021; 9(4): 1795-1802. DOI: 10.22038/IJP.2021.55739.4391.

16. Farhangnia S, Hassanzadeh R, Ghorbani S. Handwriting Performance of Children with Attention Deficit Hyperactivity Disorder: The Role of Visual-Motor Integration. *Int J Pediatr* 2020; 8(11): 12317-326. DOI: 10.22038/ijp.2020.47633.3857.