

## Efficiency of using track and field in physical education training for senior schoolchildren

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### Abstract:

Improving traditional physical education classes in educational institutions remains a pressing issue due to their insufficiently high effectiveness. **Purpose.** To test a modernized and creative methodology for using track and field sports training in the physical education educational process in order to improve the level of physical development and physical fitness of senior schoolchildren. **Material and methods.** The pedagogical experiment was conducted at a comprehensive school (Siberia, Russia). 40 senior schoolchildren aged 16.3±0.7 years took part in the experiment, who were divided into a control group and an implementation group. Physical education classes in both groups were conducted according to the traditional curriculum 3 times a week. Physical education training in the implementation group (IG) was conducted using the sports technology of track and field in the discipline of middle and long distance running. Physical development and physical fitness were assessed at the beginning and end of the experiment. Conventional anthropometric measurements were taken with BMI calculation and assessment of the component composition of the schoolchildren's body. Motor tests were used to determine the development of the main motor skills of girls and boys in both observation groups. **Results.** After completion of the pedagogical experiment, girls and boys in IG showed a reliable significant positive trend in the values of chest circumference, muscle tissue content in the body, as well as in speed, endurance, strength and speed-strength endurance compared to the result in the control group of schoolchildren. **Conclusions.** The conducted experiment of using track and field in an optional physical education training for senior schoolchildren has proven its effectiveness. The tested methodology of sportification in physical education training for senior schoolchildren can be used in other educational institutions for children and adolescents.

**Key Words:** sports technology, physical development, physical fitness, physical education training

### Introduction

In the correction and maintenance of health of young students, a strategic role is given to physical activity in physical education classes (Srivastav et al., 2023; Zhou et al., 2025). Currently, due to the profound change in the lifestyle of children and adolescents and the emergence of new patterns of influence of various environmental factors, modern physical education in educational institutions requires constant modernization of the educational process (Trajković et al., 2020; Kurniawan et al., 2022; Stojanović et al., 2023; Li et al., 2023; Kurnaz et al., 2024). At the same time, the low efficiency of the traditional form of physical education organization is noted (Porter et al., 2024; Novytskyi et al., 2024; Kudryavtsev et al., 2024). This form of physical education often leads to a decrease in interest in it among children involved (González-Gálvez et al., 2024; Martusevich et al., 2024), which worsens their physical activity.

According to the recommendations of the World Health Organization, adolescents aged 16–17 years should engage in moderate physical activity for at least 60 minutes a day (Bull et al., 2020). At the same time, they should perform intense and strength physical activity 3 times a week. Modern observations of researchers indicate a decrease in physical activity among young people studying (Kieslinger et al., 2021; Ruedl et al., 2023; Walker et al., 2023; Chen et al., 2025). This, in turn, reduces physical fitness in modern youth (Griban et al., 2022; Li et al., 2023; Jakubík et al., 2023; Petrušič, & Novak, 2024), disrupts metabolic processes in the body, which leads to weight gain. According to Z. Hadri et al. (2025) In Algeria, obesity is registered in 32.5% of urban boys. Modern children and adolescents have a steady decline in cardiorespiratory endurance (Noordstar et al., 2025), which is a reliable marker of human health (Fühner et al., 2021).

In such an unfavorable situation of the physical fitness of young students, a justified strategy is the use of various innovative packages of psychological and pedagogical orientation in their physical training. The introduction of volleyball into the subject "Physical Education" for schoolchildren in order to improve their physical fitness and body composition showed a positive result (Stojanović et al., 2023). Researchers (Li et al., 2023) found that the inclusion of functional training in the educational process of physical education effectively contributed to the increase in the parameters of physical fitness of schoolchildren. The use of game technologies in the extended day program led to good results in improving the physical status and increasing the coordination skill of 12-year-old schoolchildren (Kurnaz et al., 2024). This is confirmed by the studies of F.M. Clemente et al. (2023), who found that additional football classes are accompanied by a significant increase in physical fitness and an improvement in biomarkers in the body. In addition, the use of football in regular physical education classes reduces the level of aggression in high school students (Trajković et al., 2020). According to N. González-Gálvez et al. (2024), a promising direction for improving physical health, metabolic biomarkers and body composition is the use of high-intensity interval training in adolescents. At the end of the study, the schoolchildren showed improved physical fitness indicators, normalized blood pressure, heart rate, VO<sub>2</sub>max and a decrease in the content of low-density lipids in the blood.

Extracurricular activities using a comprehensive game program that contained elements of athletics and gymnastics were tested by T. Petrušič, & D. Novak (2024) in one of the schools in Slovenia. According to the authors, a reliable improvement in flexibility, speed and coordination of movements was found compared to the control group. Independent use of health running by young men and women improved not only their physical health indicators, but also the functional indicators of the cardiovascular system (Novytskyi et al., 2024). These data confirm the opinion of the researchers that running exercises are an effective means of improving cardiorespiratory endurance and body component composition (Jafarnehadgero et al., 2023; Listkova et al., 2023). However, it is necessary to remember the risks of injury during running exercises (Abrahamson et al., 2025), especially for individuals with high body weight (Lindman et al., 2025). Longitudinal observation of students who studied the subject "Athletics" revealed a significant increase in speed and speed-strength qualities, compared to the control group (Vala et al., 2022). Children and adolescents who were participants in the All-Russian program "Athletics for All!" showed a high level of physical fitness, especially endurance (Baj-Korpak et al., 2024).

The analysis of scientific literature shows that, despite the extensive information available on the use of athletics or its elements in physical activity, the materials related to the study of this issue in high school students are still not fully reflected. We believe that the optimization of physical education using psychological and pedagogical methods in conducting athletics sports training will improve the level of physical fitness and physical development of high school students.

**Research aim.** To test a modernized methodology for using athletics sports training in the educational process of physical education in order to improve the level of physical development and physical fitness of high school students.

### **Material & methods**

The experimental study was conducted at a comprehensive school in Siberia (Russia) in the 2022-2023 academic year. 40 boys and girls aged 16–17 ( $16.3 \pm 0.7$ ) were observed. At the beginning of the study, the parents of the teenagers gave voluntary written consent for their children to participate in the experiment. The conducted research work does not violate the rules and principles of the 2008 Helsinki Declaration, which regulates the moral standards of conducting experiments involving people. The study involved specialists and scientists from various universities in Russia and Kyrgyzstan.

The adolescents were divided into a control group (CG,  $n = 20$ ) and an implementation group (IG,  $n = 20$ ). All subjects attended physical education classes according to the traditional curriculum 3 times a week for 45 minutes. In IG, the optional third physical education lesson was conducted using athletics sports technology for the initial stage of training in the sports discipline of middle- and long-distance running. For this purpose, the Federal standard of sports training in the sport "Athletics" (2022) was used. The optional physical education lesson

was built on the principle of athletics training. The educational and training process included general and special physical training, teaching technical and tactical techniques of track and field running. In the warm season, classes were held at the school stadium, in the cold season in the gym. During the academic year, 2 intra-class and 2 inter-class competitions in running disciplines were held.

During the academic year, the physical development and physical fitness of adolescents in both experimental groups was assessed twice. To assess physical development, anthropometric measurements were taken: body weight, kg; body length, cm and chest circumference at rest, cm. Based on the digital data obtained, the calculated BMI indicator was determined, kg/m<sup>2</sup>, which allows assessing the state of metabolic processes in the body. We used Tanita RD-953 scales with a body composition analyzer, a Tves height meter, and a Hobby&Pro centimeter tape.

Speed abilities were assessed in sprinting over a distance of 100 m, s; endurance in running over a distance of 2000 m for girls and 3000 m for boys, m/s; speed-strength abilities were characterized in the exercise of standing long jump with a push-off with two legs, cm; strength qualities were determined by the exercise for boys - pull-ups from a hang on a high bar, for girls - flexion and extension of arms in a lying position, number of times; flexibility was assessed in the exercise of forward bending from a standing position on a gymnastic bench, cm.

The deviation of the probability distribution from the normal distribution of the sample was checked using the Shapiro-Wilk criterion. Statistical research methods were used to find the arithmetic mean ( $\bar{X}$ ), its error ( $m$ ) and the standard deviation ( $\sigma$ ). The reliability of the indicator values was calculated based on the value of the t-Student criterion. The difference in indicators was considered reliable at  $p < 0.05$ . The material was processed using the Microsoft Excel computer program.

## Results

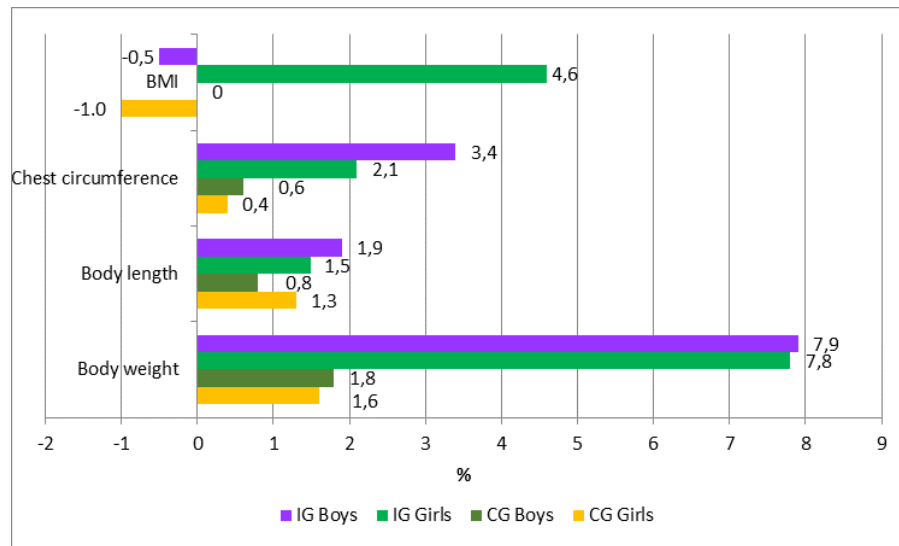
At the beginning of the experiment, the values of all physical development indicators between schoolchildren CG and IG were approximately the same,  $p > 0.05$ , which indicates the correct distribution of subjects into experimental groups for observation, Table 1.

**Table 1. Values of anthropometric indicators at the beginning and end of the experiment in schoolchildren of both groups,  $M \pm m$**

No $n/n$	Indicator	CG, n=20		IG, n=20	
		At the beginning	After intervention	At the beginning	After intervention
Girls, n =10					
1.	Body weight, kg	51.5±1.12	52.3±1.23	52.1±1.31	56.2±0.72*
2.	Body length, cm	163.5±0.73	165.7±0.95	163.8±0.82	166.3±1.76
3.	Chest circumference, cm	82.5±0.70	83.0±0.54	82.4±0.41	84.1±0.62*
4.	BMI, kg/m <sup>2</sup>	19.3±0.32	19.1±0.33	19.5±0.40	20.4±0.34*
Boys, n =10					
1.	Body weight, kg	61.3±0.83	62.4±0.72	61.5±0.52	66.4±1.23*
2.	Body length, cm	176.4±1.22	177.8±1.43	176.2±1.30	179.6±2.25
3.	Chest circumference, cm	86.7±0.81	87.2±0.94	87.0±0.83	90.0±0.61*
4.	BMI, kg/m <sup>2</sup>	19.7±0.11	19.7±0.11	20.7±0.22	20.6±0.22

Note: \* the difference between the differences is significant,  $p < 0.05$

At the end of the school year, positive dynamics of changes in the values of physical development indicators were established in boys and girls in both observation groups. This is due to the period of the ascending and youthful stage of ontogenesis at 16-17 years, when an intensive growth of anthropometric parameters is recorded. The influence of regular physical education classes on physical development plays a role. This is evidenced by reliably better parameters of some anthropometric indicators in girls and boys in the implementation group. The use of sports technology in the form of track and field classes in the educational process of physical education led to a reliable increase in the values of body weight, chest circumference and, accordingly, to an increase in the BMI indicator,  $p < 0.05$ . Among boys, body weight and chest circumference increased reliably,  $p < 0.05$ . The dynamics of the increase in the values of physical development indicators is shown in Figure 1.



**Fig.1. Dynamics of the growth of physical development indicators**

At the end of the pedagogical experiment, the greatest increase was found in the value of the body mass indicator for girls and boys IG (7.8 and 7.9%, respectively) and chest circumference (3.4 and 2.1%, respectively). The increase in anthropometric indicators for girls and boys IG was significantly greater compared to this indicator in CG. This indicates a positive effect of athletics on these anthropometric parameters. The results of the study of physical qualities in schoolchildren at the beginning and end of the experiment are presented in Table 2.

**Table 2. Values of indicators in motor tests of schoolchildren of both experimental groups at the beginning and end of the experiment, M±m**

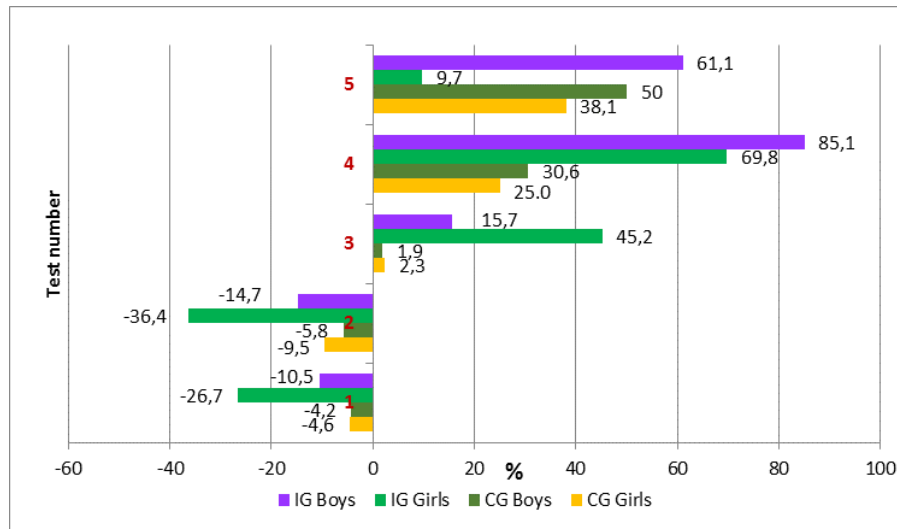
Test No.	Test	CG, n=20		IG, n=20	
		At the beginning	After intervention	At the beginning	After intervention
<b>Girls, n =10</b>					
1.	100 m run, s	19.05±0.48	18.18±0.34	19.03±0.56	13.93 ± 0.12*
2.	2000 m run, s	833.4±48.52	753.9±34.87	842.3±49.34	535.6 ± 19.88*
3.	Standing jump with push-off with both legs, cm	158.7±3.02	162.4±3.11	159.4±3.87	231.6±2.70*
4.	Arm flexion and extension in a lying position, times	8.0±1.26	10.0±1.94	8.3±1.54	14.1±2.01*
5.	Forward bend from a standing position on a gymnastic bench, cm	10.5±1.78	14.5±2.06*	10.3±1.57	11.3±1.84
<b>Boys, n =10</b>					
1.	100 m run, s	14.64±0.31	14.02±0.33	14.13±0.31	12.64±0.14*
2.	3000 m run, s	932.1±37.6	878.3±21.31	912.5±32.45	777.7±19.96*
3.	Standing jump with two legs push-off, cm	223.5±4.23	227.9±4.28	225.3±3.97	260.6±6.32*
4.	High bar pull-up, reps	7.5±1.12	9.8 ± 1.35*	7.4±1.15	13.7±1.49*
5.	Standing forward bend on gymnastic bench, cm	1.8±0.95	2.7 ± 1.02	1.8±0.72	2.9 ± 0.89

Note. \* Significant difference in the indicators at the beginning and at the end of the experiment,  $p < 0.05$ .

At the beginning of the experiment, no significant difference in the values of the indicators in the motor tests was found between the CG and IG schoolchildren,  $p > 0.05$ , which indicates approximately the same level of their physical fitness.

The implementation of the physical education program among schoolchildren made it possible to note an improvement in the physical fitness of young men and women in both experimental groups at the end of the school year. In the CG of girls and boys, a significant increase in the values of the indicators was noted only in one test,  $p < 0.05$ . It was found that in the implementation group, in strength tests, as well as in speed, speed-strength abilities and endurance, significantly higher values of the indicators were recorded compared to the beginning of

the experiment,  $p < 0.05$ . These values exceeded those of the CG schoolchildren. These data indicate a significant effectiveness of using track and field in the physical education process compared to the traditional curriculum. The increase in the values of the indicators in the motor tests of schoolchildren in both experimental groups at the end of the experiment is shown in Figure 2.



**Fig. 2. Increase in the values of the indicators in motor tests for schoolchildren of both experimental groups at the end of the experiment**

At the end of the experiment, a significantly greater increase in the values of the indicators in all motor tests (except for the flexibility test) was found in the IG schoolchildren compared to the CG. The greatest increase in the values of the indicators in girls and boys of the IG was in test No. 4 (flexion and extension of arms in a prone position and pull-ups), No. 2 (running 2000/3000 m), No. 1 (running 100 m) and No. 3 (jump from a place with a push-off with two legs).

It was found that in girls, the greatest increase in the values of the indicators was recorded in speed, speed-strength qualities and endurance compared to boys. In adolescents, the greatest increase was noted in strength and flexibility compared to girls. At the beginning of the experiment, the muscle tissue content of schoolchildren in both experimental groups did not differ from each other,  $p > 0.05$ . At the end of the experiment, when analyzing the component composition of the body of schoolchildren, a reliable difference in the muscle tissue content was found between CG and IG. In IG girls, the muscle tissue content in the body was  $27.5 \pm 2.4$  kg, which was 19.6% more than in girls in the control group ( $23.0 \pm 1.8$  kg),  $p < 0.05$ . At the same time, the fat tissue content was approximately the same. An increase in muscle tissue content in the body was also recorded in young men in the implementation group. In their component composition, muscle tissue was  $38.5 \pm 2.6$  kg, which was 14.9% more compared to young men in CG ( $33.5 \pm 2.2$  kg),  $p < 0.05$ . Young men in both experimental groups were found to have approximately the same fat content. The increase in muscle tissue content in girls and boys in IG at the end of the experiment led to an increase in their body weight compared to the result of schoolchildren in CG, Table 1.

## Discussion

The ongoing profound transformations of the economic, social, and public foundations of modern society affect the physical status of young people and necessitate the correction of the educational process of physical education of children and adolescents (Trajković et al., 2020; Kurniawan et al., 2022; Stojanović et al., 2023; Li et al., 2023; Kurnaz et al., 2024). An analysis of scientific literature indicates the extensive work carried out by specialists and scientists in the field of physical education in order to improve the physical health of children and adolescents (Martusevich et al., 2024; Kudryavtsev et al., 2024). For this purpose, various innovative packages in the physical education of young people have been tested and recommended for use. Sports games (Stojanović et al., 2023; Clemente et al., 2023; Kurnaz et al., 2024), functional training (Li et al., 2023), and high-intensity interval training in adolescents (González-Gálvez et al., 2024) have been proposed for inclusion in the physical education curriculum and have shown their effectiveness.

Researchers have found that running-oriented physical activity is an effective means of improving cardiorespiratory endurance and normalizing body component composition (Jafarnejhadgero et al., 2023; Listkova

et al., 2023). These data are consistent with the results of our studies of chest circumference and body component composition in the observed schoolchildren in the implementation group, where athletics was used in the variable part of the physical education lesson. According to the results of our study, it was shown that the chest circumference of girls and boys was significantly larger compared to schoolchildren in the control group, where physical education was conducted according to the traditional curriculum. Cyclic exercises cause the development of respiratory muscles, increase the vital capacity of the lungs, which improves the motor quality and endurance of the body to physical activity. This is confirmed by significantly higher values of the indicators in the motor tests for endurance in young men and women of the implementation group compared to the control group. These data are consistent with the opinion of some authors about the low efficiency of the traditional form of physical education (Porter et al., 2024; Novytskyi et al., 2024). At the same time, their physical activity does not meet the recommendations of the World Health Organization, according to which adolescents aged 16-17 years should engage in moderate physical activity for at least 60 minutes a day (Bull et al., 2020). Such a negative situation with the physical activity of young people indicates the need for continuous modernization of physical education among students. This will not only increase the motivational competence of those involved, but also improve the health indicators of children and adolescents,

The introduction of sports technologies using athletics into the educational process of physical education had a significant impact on the component composition of the body of girls and boys in the implementation group. According to our data, at the end of the experiment, the content of skeletal muscles in schoolchildren of this group was significantly higher compared to the control group. The girls had 19.6% more muscle tissue and the boys had 14.9% more muscle tissue compared to the comparison group. This explains the significantly higher body mass index in the schoolchildren of the implementation group compared to the control group at the end of the experiment. The increase in muscle tissue content allowed the girls and boys of the implementation group to increase their strength abilities. Their test results in motor tests for strength and speed-strength endurance were significantly higher compared to the control group of schoolchildren. These data are consistent with the results of the study by the authors (Listkova et al., 2023), who conducted observations in a group of track and field athletes and noted the development of these motor qualities.

The results of testing the motor qualities did not reveal a reliable increase in the flexibility index value in girls and boys in both experimental groups. We believe that this indicates the influence of in-depth specialization in the speed-strength discipline of track and field among schoolchildren in the implementation group. In this group, the priority of sports training is the development and improvement of strength and speed to the detriment of the development of the motor quality "flexibility".

Our study of the use of sports technology in an optional physical education lesson for senior schoolchildren has proven its effectiveness. The tested method of sportization of physical education classes for senior schoolchildren can be used in other educational institutions for children and adolescents.

## Conclusions

In order to improve the state of physical development and physical fitness of senior schoolchildren, a method of using sports training in track and field in the educational process of physical education has been proposed and tested.

A comparative analysis of the results of the study of the physical development of girls and boys in the implementation group at the end of the experiment, where the sports technology of track and field was used, revealed a reliable increase in the values of the chest circumference, body weight and skeletal muscle content compared to schoolchildren in the control group, where physical education classes were conducted according to the traditional program.

Testing of motor skills after the completion of the experiment showed a reliably high result in the values of speed, endurance, strength and speed-strength endurance in the group of girls and boys in the implementation group compared to the control group.

The use of sports technology in track and field in physical education training for 16–17-year-old schoolchildren has proven its effectiveness and can be used in the educational process of physical education of schoolchildren in other educational institutions.

**Conflicts of interest.** The authors declare no conflict of interest.

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