

## Teaching approaches in extracurricular physical activities for 12-14-year-old pupils under environmentally unfavourable conditions

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### Abstract:

The methodology for enhancing physical fitness of 12-14 year old pupils living under the conditions of high radiation through extracurricular basketball activities has been justified in the research. Different aspects of the problem have been considered through the prism of pupils' individual characteristics, unfavourable environmental conditions, magnitude of motor activity and physical and mental performance. Implementing rational teaching approaches to designing the content of extracurricular physical activities aimed at optimizing physical education and raising the level of physical culture into school practice has significantly improved physical condition of pupils and enhanced effectiveness of the education process in general. Comprehensive approach to solving the problem of improving physical education has increased the levels of pupils' physical and mental performance. The overall motor activity has increased by 18.8%, physical activity – by 17.9%. The results of teaching experiment show that basketball-oriented physical education is more effective under the conditions of high radiation than traditional practices. The obtained data of teaching experiment indicate the increase in physical condition and motor activity of pupils, their level of physical and mental performance and health, which proves effectiveness of the author's methodology. Therefore, it can be successfully introduced into physical education in school.

**Keywords:** physical fitness, physical skills, motor activity, physical and mental performance, radioactivity, Chernobyl catastrophe, means and methods of training, basketball section.

### Introduction

The study aims to develop organizational and methodical principles of physical education for pupils during extracurricular activities under the conditions of high radioactivity, which are targeted at improving their physical fitness and health. The Chernobyl catastrophe has posed certain economic, social and environmental problems for society. Nowadays, separate regions of Ukraine are characterized by different levels of radioactive pollution. However, scientific observations on biological effects of ionizing radiation indicate that radioactive pollution negatively affects physical condition of pupils (Antonov, 1989; Baraboi, 1988; Kovalova, 1997). The accumulated data convincingly prove the decrease in the number of healthy pupils, the increase in chronic diseases of various nosological entities in both adults and children.

It is imperative to employ all available means and methods to improve and increase pupils' physical fitness, resistance to the effects of adverse environmental factors taking into consideration limited possibilities of radically changing living conditions in radiation protection areas (Baranova, 1996; Huzhalovskiy, 1992; Kovalova, 1997; Lymar, & Minina, 1994).

The recent studies signify a negative tendency towards deteriorating health and physical condition of pupils, which results in physical exhaustion, decreased resistance to stress and delayed development of pupils' mental skills (Aleksandrovskiy, 1995; Antipkin, 1996; Antonenko, 1992; Hovorukhina, 1998). O. Kuts (1997) and S. Poliiievskiy (1998) emphasize on the fact that pupils' health is negatively affected by radiation kinesophobia rather than direct effects of radiation on the organism.

Such issues as organizing physical education of pupils and employing different forms, means and methods, which promote full physical development and health of pupils under environmentally unfavourable conditions have been extensively explored by scientific community. However, only a few researches have focused on recommendations for organizing physical activities under radioecological conditions.

Still, one should take into consideration contradictory opinions on the norms and modes of motor activity, regulation of physical loads and criteria for differentiating physical exercises for pupils in high radiation areas. Literary sources do not contain research data that can characterize specificity in organizing physical education of pupils during extracurricular activities, preserving and strengthening their health as a result of rationally organized extracurricular physical activities.

### **Materials & methods**

The following methods have been used to address the research aim: theoretical analysis and generalization of the data from scientific literature and teaching observations; teaching experiment; critical evaluation (tests); medical, biological and physiological methods; studies on mental performance based on Landolt's ring test; Kuts's instrumental techniques in order to obtain urgent information about both parameters of physical fitness and level of physical development (*Electricity Meter* is used in order to measure the frequency of arm and leg movements; a mechanical jungle gym – in order to develop muscle strength of the upper shoulder girdle; *Stopor* – in order to develop speed and strength; *Skorokhod* – in order to enhance high-speed endurance; other devices – in order to measure flexibility). The obtained data have been processed by such software applications as *Automated Workplace* and *Statgraph*. The teaching experiment involved three stages.

*The first stage* included studying special literature. Subsequently, 600 pupils aged between 12 and 14 years old, 219 parents and 32 physical education teachers, who live in radiation protection areas in Vinnytsia and Zhytomyr regions, were questioned. Also, experimental plans for extracurricular physical and recreational activities, as well as health-improving training sessions were designed.

*The second stage* was aimed at determining the level of physical fitness and motor activity of pupils, drawing conclusions on the patterns of growth and development of pupils under the conditions of high radioactivity.

Relevant data, which reflect the dynamics of physical development and performance, motor fitness and activity in 600 pupils aged between 12 and 14 from comprehensive schools in Vinnytsia and Zhytomyr regions were collected so that the objectives of the research might be addressed. According to the Law of Ukraine "On the Status and Social Protection of Citizens who Suffered as a Result of the Chernobyl Catastrophe", the main group consisted of 215 pupils.

*The third stage* involved conducting teaching experiment. It was divided into the main and monitoring experiments. The children, who live in high radiation areas, were involved into main experiment. Based on their level of health, all pupils were assigned to preparatory medical group. Apart from compulsory physical education classes, they attended basketball classes three times a week.

The experimental group pupils trained in accordance with the 1 Year curriculum requirements for children and youth sports schools. In the course of the experiment, the methods of physical training were purposefully tested. It must be noted that they are characterized by different magnitude and intensity, specificity, direction and duration of training depending on current ecological conditions. The monitoring experiment was aimed at evaluating effectiveness and influence of the proposed methodology on health, as well as pupils' level of physical performance.

The results obtained at the first stage of the research confirm that age, gender and ecology significantly affect both character and rates of motor skills development in pupils. Based on the statistical criterion (normalized deviation) and relative value (growth rates), qualitative analysis on the growth rate of physical fitness indicators has allowed determining the stages of significant changes in physical development of pupils, namely, male pupils aged between 13 and 14 and female pupils – between 12 and 13. The most rapid rates of speed, strength and speed-and-strength skills development were observed in male pupils aged between 13 and 14, flexibility – between 12 and 13; in female pupils aged between 12 and 13, with the exception of muscular strength.

Physical condition of pupils aged between 12 and 14 who live in radiation protection areas is characterized by the following features: rapid increase in body length and weight: body length increased by 10.3 cm in male pupils aged between 12 and 14 and 5.6 cm in female pupils; body weight – by 7.0 kg and 9.3 kg respectively; chest circumference – by 2.5 cm and 3.9 cm respectively; the functional state of cardiovascular and respiratory systems is within the normal range: heart rate – 84-86 bpm; arterial systolic blood pressure – 105-117 mmHg, diastolic blood pressure – 77-86 mmHg, vital lung capacity – 2300-2900 cm<sup>3</sup> in male pupils, 2000-2500 cm<sup>3</sup> in female pupils; the development of basic physical characteristics in pupils aged between 12 and 14 is characterized by heterochronism, mostly in a bottom-up way. However, the obtained results prove both age and gender differences. Thus, the conducted tests show that male pupils are more physically capable than female pupils ( $P < 0,05 \div 0,001$ ). Based on the statistical criterion (normalized deviation) and relative value (growth rates), qualitative analysis on the growth rate of physical fitness indicators has allowed determining the stages of

significant changes in physical development of pupils, namely, male pupils aged between 13 and 14 and female pupils – between 12 and 13. The most rapid rates of speed, strength and speed-and-strength skills development were observed in male pupils aged between 13 and 14, flexibility – between 12 and 13; in female pupils aged between 12 and 13, with the exception of muscular strength.

It has been found that a significant number of pupils are at a low level of physical fitness development: speed – 18.9%, endurance – 24.3%, speed and strength – 10.8%, muscular strength – 21.6%, dexterity – 16.2%, flexibility – 18.9%. The examinations were conducted within the same period of time and involved identical procedures.

Research findings on physical fitness indicate delayed development of pupils' main motor skills under unfavourable environmental conditions (see Table 1). However, it relates to speed ( $P < 0.001$ ) rather than other physical characteristics ( $P > 0.05$ ).

**Table 1**

Comparative characteristics of physical fitness in pupils aged between 12 and 14 (based on the studies in the 1980s and 1990s)

Groups	Experiment stages	Elementary		Reproductive		Productive		Creative	
		Number	%	Number	%	Number	%	Number	%
EG (277)	Ascertaining	130	47,0	90	32,5	30	10,8	27	9,7
	Formative	37	13,4	72	26,0	88	31,8	80	28,8
CG (191)	Ascertaining	80	41,9	68	35,6	26	13,6	17	8,9
	Formative	59	30,9	57	29,8	41	21,5	34	17,8

In the course of the experiment, some methodical approaches to assessing physical condition of pupils under unfavourable environmental conditions have been established. Since the very assessment was of a competitive nature and the results were assessed in accordance with the criteria for state tests, many pupils dealt with the fear of failure. When the assessment was intended as a means of achieving the goal and was accompanied by appropriate guidance, pupils were satisfied with their achievements, even those who were less physically talented or less fit.

The organization of teaching experiment consisted of several stages with relevant objectives and a range of means. The stages involved 72 physical education classes overall and basketball classes three times a week. The latter were based on the three-stage health-improving programme, which included three modes of physical loads differing in duration, capacity and magnitude.

*The first stage* mainly included 20- or 30-minute exercises, which provided for 50-60% of maximum physical loads. In turn, sports programmes were aimed at ensuring consistent development of motor skills. Initially, the main attention was focused on developing speed-and-strength skills and, eventually, speed. Flexibility was developed during the first three months and subsequently optimally maintained. Endurance was developed during all classes and the nature of its manifestation changed depending on the type of physical skills (speed, muscular strength, speed and strength).

## Results

The introduction of the experimental programme into physical education of pupils through extracurricular activities has enhanced their physical performance and improved their health. There have also been significant changes in physical fitness of experimental group pupils (see Figures 1-6).

*The second stage* mainly included speed-and-strength exercises, which were performed at an interval pace (alternated periods of workout and recovery times). The number of exercises did not exceed 8-10, whereas the number of repetitions reached 5-6.

*The third stage* provided for comprehensive approach to implementing exercises, which stimulate aerobic and anaerobic performance and improve motor skills.

During all stages, it was crucial to adhere to the following rule: optimal health effects are observed only when using physical exercises that are rationally balanced in terms of direction, intensity and magnitude taking into account individual physical characteristics of pupils.

In fact, it was decided to postpone specialized classes in order to prevent high turnover of participants. In this regard, the necessary conditions for physical training were created. The duration of classes ranged from 60 to 90 min depending on climatic conditions, as well as the level of radiation pollution.

During teaching experiment, the development level of pupils' motor skills and their mental and physical performance and health have been regularly under current and effective medical and teaching control. In order to control the dynamics of physical fitness and its individual indicators, each pupil's results have been compared with the "standard model" (state tests) of motor skills development level.

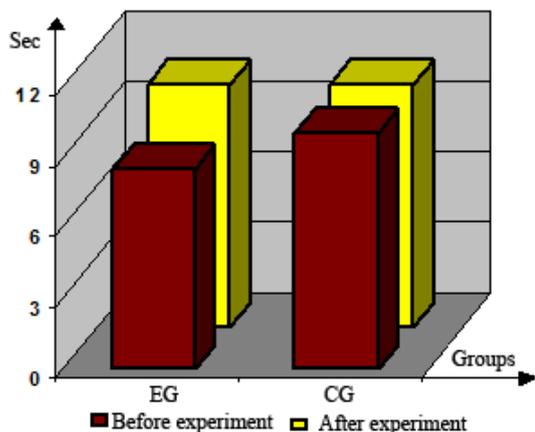


Fig. 1. Speed dynamics.

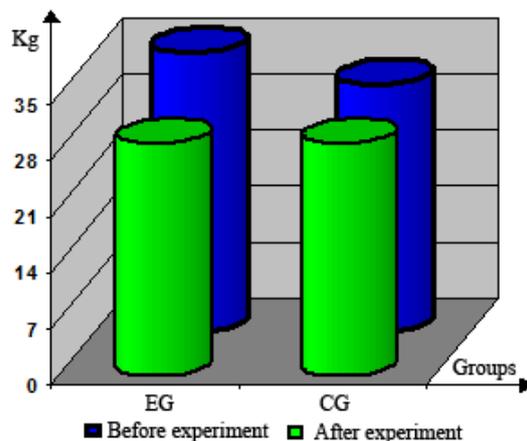


Fig. 2. Muscular strength dynamics.

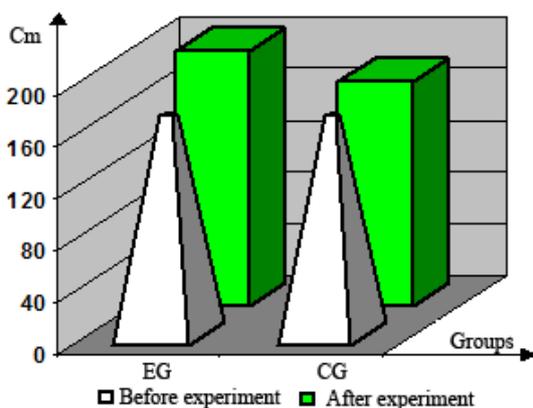


Fig. 3. Speed and strength dynamics.

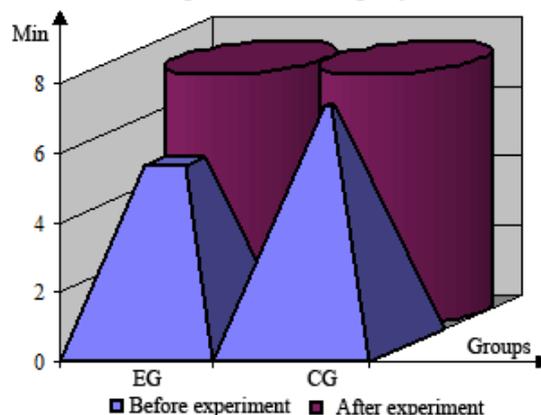


Fig. 4. Endurance dynamics.

During the experiment, the growth rate in speed development has amounted to 17.1%, muscular strength – 19.6%, speed-and-strength skills – 8.6%, endurance –17.9%, dexterity –11.2%, flexibility – 61.8%.

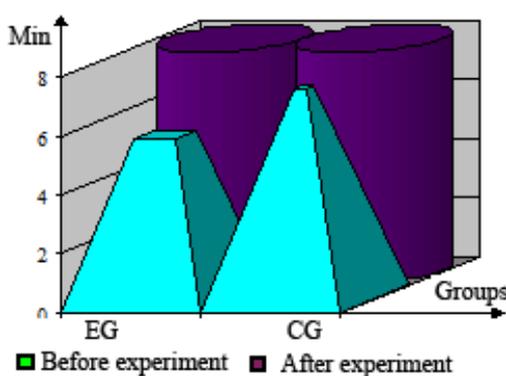


Fig. 5. Dexterity dynamics.

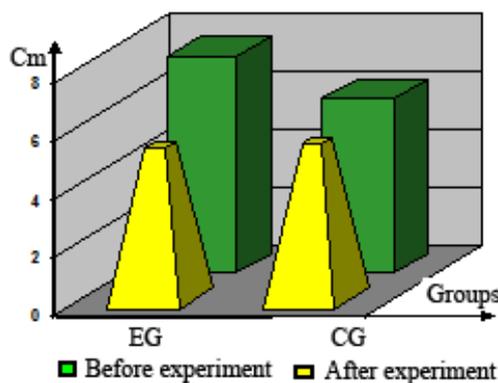


Fig. 6. Flexibility dynamics.

The programme content of basketball classes provided for mastering the main elements of basketball, technical and tactical training of pupils in the first or second year of specialized training based on developing physical skills and condition required for the game. The ratio of physical education classes and technical and tactical training of pupils was 2: 1.

In addition, preparatory health exercises were widely used at the beginning and at the end of classes. During winter and summer holidays, pupils continued to attend basketball section. Summer holidays allowed using other activities (exercises aimed at improving physical condition, general physical training and basketball practices). When planning educational activities, it was essential to provide a clear system for mastering the programme material taking into account pupils' individual characteristics, age characteristics identified at the preliminary stage of the research, facilities and other factors that could influence the effectiveness of training.

According to the results of the experiment, a set of the most effective methods and methodical techniques for developing a particular physical skill has been used. Thus, the method of various continuous exercises aimed to develop general endurance. The training effect of this method consisted in increasing mobility and condition of both cardiovascular and respiratory systems, aerobic and anaerobic capabilities of the organism and improving inter-muscular coordination. This method has rather contributed to developing volitional skills. The repeated and interval method was targeted at increasing speed and magnitude of efforts, tempo or amplitude of motions or several components simultaneously due to repeated sets with defined intensity and rest intervals. The method of cycle-based training sessions was used for adapting male pupils for physical activity. In this case, variational changes in magnitude of weights, number of repetitions, duration of working phases and rest intervals were used in order to ensure the required training effect. The working phases for cycle-based training were typically 8-30 sec, rest intervals between exercises – 30-90 sec and rest intervals between sets – 3-5 min.

The results of the experiment allow recommending such methods for developing physical skills: endurance method – the method of various continuous exercises; speed and dexterity method – the repeated and interval method; muscle strength and flexibility method – the method of cycle-based training.

Rational organization of physical education with the use of extracurricular activities has contributed to increasing pupils' motor activity, physical and mental performance. During school year, the overall level of motor activity among male pupils has increased by 18.8%, when compared with peers from control group. In addition, more than 70% of experimental group pupils have been assigned to the group with high levels of motor activity (see Table 2).

During this period of study, there have been observed significant changes in the indicators of mental and physical performance as a stable indicator of health. General physical performance has increased by 28.7%, relative physical performance – by 32.1%.

**Table 2.** Description of physical performance in experimental group pupils during school year

Indicators of physical performance	Groups	Stages of teaching experiment	n	X ± Sm	P
General physical performance (kgm/min)	EG	Before experiment	37	422,4 30,6	< 0,001
		After experiment	15	543,6 29,2	
	CG	Before experiment	37	422,4 30,6	
		After experiment	15	473,7 33,4	
Relative physical performance (kgm/min/kg)	EG	Before experiment	37	11,2 0,31	< 0,001
		After experiment	15	14,8 0,27	
	CG	Before experiment	37	11,2 0,31	
		After experiment	15	12,6 0,44	

At the end of teaching experiment, similar results on mental performance have been obtained. Compared with the initial data, the speed of visual information processing has increased by 21.7%, the accuracy factor – by 28%, the number of viewed and correctly crossed marks – by 15.3% (see Table 3).

**Table 3.** The experimental programme's influence on the indicators of pupils' mental performance

Groups	Stages	Indicators of mental performance		
		Visual information processing speed, bps	Accuracy factor, unit	Tapping test, sec
EG	Before experiment	2.17 0,02	0,57 0,04	86,4 0,22
	After experiment	2,64 0,02*	0,73 0,02*	99,6 0,33*
CG	Before experiment	2.17 0,02	0,57 0,04	86,4 0,22
	After experiment	2,23 0,06	0,68 0,07*	89,2 0,34*

Teaching effect of differentiated approach to selecting methods for developing physical skills has been identified:

- the method of interval and combined weight exercises (30-50% of maximum weight) has proved to be effective for developing speed skills;
- the method of supervised exercises at heart rate of 160-170 bpm and 1-3 min of rest in between sets has allowed developing aerobic and anaerobic endurance;
- the method of repeated and interval wight exercises (70-90% of maximum weight) has enhanced strength skills;
- the method of interval and progressive exercises (3-4 repetitions in 4-6 sets and 4-5 min of rest) has contributed to developing dexterity skills;

- the method of cycle-based training sessions with duration of 15-50 sec has improved flexibility skills.

It has been found that it is necessary to use the following parameters of differentiated physical loads in order to achieve the training effect and develop pupils' physical fitness:

- exercises should be repeated minimum 10-12 times in three sets with 30-60 sec of rest (for relatively small muscle groups – 2-3 sets with 30 sec of rest) in order to develop strength of the main muscle groups;
- exercises should be repeated minimum 4-5 times in order to develop speed-and-strength skills of lower limbs and 7-8 times – muscles of the upper shoulder girdle and back in 5-6 sets with 30 sec of rest;
- exercises should be repeated minimum 4-5 times with 10-12 sec of rest in between repetitions in 2 sets with 30-40 sec of rest in order to develop speed skills;
- exercises should be repeated minimum 4-5 times with 10-12 sec of rest in between repetitions in order to develop dexterity skills;
- 6-minute running and 5- and 10-minute movement games of high and medium intensity allow developing endurance;
- exercises should be repeated minimum 6-8 times in 3-4 sets with 10-15 sec of rest in order to develop flexibility skills.

Extracurricular physical activities have rather improved the overall performance of experimental group pupils. The surveys conducted at the end of experiment have indicated that more than 80% of pupils are highly motivated to attend physical education classes and engage in sports (at the beginning of experiment – only 38.7%).

The experimental programme has improved health of experimental group pupils, too. The results show that 39.2% of pupils rated their health as “perfect” and “good”, whereas 19.8% of them had no risk of developing cardiovascular diseases and 53.6% of them – minimum risk.

Teaching experiment conducted under the comprehensive programme has positively affected pupils' health, their resistance to infectious and other diseases. During the experiment, the cases of school absenteeism due to illness in the experimental group has decreased by 60%.

So, the conducted research proves that extracurricular physical activities allow effectively enhancing pupils' physical fitness and improving their health, since they take into account the peculiarities of physical development, physical condition and physical performance.

## Discussion

The research introduces newly developed rational teaching approaches to designing the content of extracurricular activities in schools located in environmentally unfavourable areas. It optimizes physical education, increases pupils' level of physical fitness and improves their health. For the first time, comparative analysis on specificity of physical development, functional and motor fitness, motor activity of pupils, who live in regions with radiation levels up to 5-10 Ki/km<sup>2</sup> and in clean areas, has been conducted.

The information about the factors which cause and limit physical condition of pupils and the data on individual capabilities of pupils, as well as using physical exercises to improve physical condition and enhance resistance to adverse environmental factors, optimal duration of health-improving training sessions have been confirmed and complemented.

Based on analysis of scientific methodological literary sources and generalization of advanced practices, it has been found that:

- scholars are actively searching for new forms, means and methods, which can improve physical condition and health of pupils, who live in radiation protection areas;
- motor activity is the main factor in increasing the level of physical condition and assisting the organism in adapting to adverse environmental conditions;
- there is a positive interconnection between the level of physical condition and health, provided that pupils are constantly motivated to engage in physical activity;
- physical education of pupils under the conditions of high radiation levels does not contribute to effective addressing its objectives, which is evidenced by the extremely low level of pupils' physical fitness;
- researches on discovering effective means and methods for developing pupils' physical skills, as well as preserving and strengthening their health during effective extracurricular physical activities have not been conducted yet.

## Conclusions

Anthropometric and functional surveys in the framework of conducting experimental studies suggest that the average values and growth rates of physical development and cardiovascular system indicators do not distinctly differ in pupils aged between 12 and 14 ( $P > 0.05$ ). According to the indicators of physical fitness, pupils living under environmentally unfavourable conditions achieve significantly less than their peers ( $P < 0.05 \div 0.001$ ).

The current regional programmes of physical education in comprehensive schools do not take into account specificity of radiation pollution, the data on pupils' physical condition and, therefore, do not provide for using effective forms and means of extracurricular physical activities aimed at enhancing pupils' physical fitness.

The results of teaching experiment show that basketball-oriented physical education is more effective under the conditions of high radiation than traditional practices.

Implementing rational teaching approaches to designing the content of extracurricular physical activities aimed at optimizing physical education and raising the level of physical culture into school practice has significantly improved physical condition of pupils and enhanced effectiveness of the education process in general. Applying differentiated approach to selecting means and methods for developing pupils' physical skills has positively influenced the level of their physical development:

- speed has increased by 17.1%, muscle strength – by 19.6%, speed-and-strength skills – by 8.6%, endurance – by 17.9%, dexterity – by 14.2%, flexibility – by 61.8%;
- implementing the developed methodology has varied motor activities of lessons by 60-70% and allowed pupils to successfully meet all requirements of state tests (up to 90% of experimental group pupils have obtained good results);
- introducing the experimental programme into the education process has significantly enhanced motor activity of experimental group pupils: the overall motor activity has increased by 18.8%, physical condition and health – by 17.9%; more than 70% of pupils have reached the high level of motor activity;
- comprehensive approach to increasing physical fitness has positively affected the level of physical performance: general physical performance has increased by 28.7%, relative physical performance – by 32.1%;
- during the experiment, mental performance has significantly improved: compared with the initial data, the speed of visual information processing has improved by 21.7%, the accuracy factor – by 28%, the number of viewed and correctly crossed marks has increased by 15.3%, overall progress has increased up to 3.86 points (compared with the average point of 3.74 during first months of school year).

Importance of teaching experiment consists in achieving health-improving effects. During school year, the number of school absenteeism due to illness in the experimental group has decreased by 60%. The results show that 39.2% of pupils rated their health as “perfect” and “good”, whereas 19.8% of them had no risk of developing cardiovascular diseases and 53.6% of them – minimum risk mainly due to genetic heredity and unhealthy lifestyle.

The obtained data of teaching experiment indicate the increase in physical condition and motor activity of pupils, their level of physical and mental performance and health, which proves effectiveness of the author's methodology. Therefore, it can be successfully introduced into physical education in school.

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