THE DYNAMICS OF INDICATORS OF THE CARDIOVASCULAR RESPONSE TO STANDARD PHYSICAL LOAD OF THE 10th-11th GRADES BOYS UNDER THE INFLUENCE OF CROSSFIT EXERCISES

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Abstract. Indicators of the cardiovascular system response to standard physical load of high school boys under the influence of CrossFit exercises are presented in the article. The comparative analysis of the obtained data is made in the age aspect. The results at the beginning of the research and the obtained data at the end of the research are displayed.

Keywords: CrossFit, heart rate, physical education, high school students.

Introduction. In recent years there was a steady trend towards deterioration of pupils' health in general secondary education. According to the data of the Ministry of Health of Ukraine, approximately 90% of children and teenagers have different disorders of health conditions and 59% have poor physical preparation [5].

Scientists in the field of physical education note that the reasons for the decline in the level of physical health are incorrect organization of the educational process, the unsustainable distribution of time for study and rest, the intensification of the educational burden, the disregard of physical and labor education, the slow-moving lifestyle [1, 3, 4, 6, 7]. Low-mobility lifestyle is reflected by negative changes on the activity of the cardiovascular system (force of heart contractions weakens, arterial hypertension, ischemic heart disease develops and vegetative-vascular dystonia progresses) [5].

Physical culture plays the leading role in the nation's recovery with a wide variety of its manifestations [7]. Application of different means of physical education

contributes to reduction of morbidity, increase of body adaptation, unfavorable factors of external environment, increase of functional reserves of different age-old population [4]. It should be noted that recently a decline in interest in physical education, mainly through the monotony and non-modernity of educational material has been observed at pupils [5]. Therefore, the question of finding new means, methods and approaches to optimizing the content of the educational process [6], which will contribute to improving the level of physical health at pupils of senior school age, becomes relevant.

A number of researchers have dealt with the issue of optimization of physical education at school by including innovative, modern and interesting types of motor activities for pupils [2, 5, 7]. However, the works showing studies of the cardiovascular system response to standard physical load of senior school-age children under the influence of CrossFit exercises weren't found. Thus, the above-mentioned led to the direction of our research. We propose to include a variable module "CrossFit" in the educational process on physical education of the 10th-11th grades boys because today it has gained a wide popularity among the investigated age-old contingent.

Connection of the work with scientific programs, plans, themes. The research was conducted in accordance with the Thematic Plan of the research work of Kharkiv state academy of physical culture for 2016-2020 under the theme "Improvement of physical education in various educational institutions" (the state registration number 0115U006754) and for 2020-2026 "Improvement of the physical education process of different segments of the population" (the state registration number 0120U101110).

The purpose of the research is to determine the impact of CrossFit exercises on cardiovascular response rates on standard physical load of boys of senior school age.

Research tasks:

1. To evaluate the cardiovascular system response to standard physical load of the 10th-11th grades boys.

2. To analyze test indicators in the age aspect.

3. To detect changes in the investigated indicators after application of CrossFit exercises in physical education of the10th-11th grades pupils.

Material and methods of the research. The research was carried out on the basis of the general secondary education institutions No. 146 and № 57 in Kharkov during the 2017-2018 academic year. It was attended by 52 pupils of the 10th -11th grades. All the children, who took part in the research, were almost healthy and under the supervision of a school doctor.

During the research pupils of control groups were engaged only in the generally accepted state physical culture program for the10th-11th grades of general secondary education institutions and the educational process on physical education of pupils of main groups was supplemented by the developed by us variable module "CrossFit". The content included theoretical information, special physical training (elements of gymnastics, athletics and weightlifting, kettlebell lifting, general development exercises) and technical training (specially selected CrossFit exercises "Burpee", "Box Jump", "Farmer's Walk", "Good morning", "Bear crawl", "Floor wipers" and "Burpee bench jump", etc.). At the end of the research of the module "CrossFit" students performed the complex of exercises, which consisted of special and technical elements of CrossFit in a minimal period of time and with a marked number of rounds ("Cindy", "Annie", "Fran", etc.).

Age and anatomical-physiological peculiarities of pupils were taken into account during classes. Load and dosing increased gradually taking into account the individual capabilities of pupils. Also, CrossFit exercises were included in the preparatory part of the lesson of other variable modules in the system of organized breaks and were offered in the form of homework.

The following **methods** were used to solve the tasks: theoretical analysis and generalization of scientific methodological literature; medical and biological methods for determining the cardiovascular system response to standard physical load; pedagogical experiment; methods of mathematical statistics.

The cardiovascular system response to standard physical load was determined by the Ruffier index. Heart rate for 15 s at rest (bpm^{-1}), heart rate for the first 15 s immediately after load (bpm^{-1}) and heart rate for the last 15 s of the first minute of renewal (bpm^{-1}) are measured.

Results of the research and their discussions. Considering the obtained results, there were found the lack of reliable differences in indicators of pupils of control and main groups over all investigated parameters (p>0,05).

The analysis of the results, which characterize the cardiovascular system response to standard physical load (Ruffier index) in the age aspect, showed that heart rate indicators for 15 s in rest, for the first 15 s after load and for the last 15 from the first minute of renewal with age significantly improve at 10th -11th grades boys of both investigated groups (p<0,05-0,001). The exception is indicators of heart rate at rest and for the last 15 from the first minute of the resumption of control groups, where there is the improvement in results with age, but unreliably (p>0.05).

Comparing the obtained results according the Ruffier index with the evaluation scale presented by S. D. Poliakov and co-authors [8], it is clear that indicators of the 10th grades pupils of both studied groups are the score 2 points, which is lower than the "average" level. Pupils of the 11th grades of main and control groups have a score 4 points, which are "above the average" level.

Analyzing the obtained results after using the CrossFit exercises (Tab. 1), it was found that heart rate for 15 s in rest, for the first 15 s the following load and for the last 15 from the first minute of resumption significantly improved at boys of the 10th -11th grades (p<0,05-0,001). The exception is the data of the 11th grade pupils, where heart rate for 15 s in rest also become better, but is unreliable (p>0,05).

Considering the data obtained after the experiment in the age aspect, it was found that the character of differences didn't change significantly in comparison with the output data in pupils of main groups.

The analysis of results of pupils of control groups obtained after the experiment found insignificant changes in the cardiovascular system response to standard

physical load. The trend remained unchanged in comparison with the initial data in the age aspect.

Table 1

The comparison of average indicators of the cardiovascular system response to standard physical load of the 10th -11th grades boys of main groups before and after the experiment

Indicators			10 grade		11 grade	
		n	$\overline{X} \pm m$	n	$\overline{X} \pm m$
HR for 15 s (bpm⁻¹)	P_1	Before the experiment	15	22,13±0,32	10	19,70±0,42
		After the experiment	15	21,33±0,39	10	19,30±0,82
	t			4,00		0,61
	p			p<0,01		p>0,05
	P_2	Before the experiment	15	30,40±0,48	10	27,30±0,82
		After the experiment	15	29,73±0,46	10	26,10±0,81
	t			3,57		2,34
	p			p<0,01		p<0,05
	P_3	Before the experiment	15	23,73±0,36	10	22,00±0,47
		After the experiment	15	21,60±0,38	10	20,70±0,86
	t			8,34		2,62
	p			p<0,001		p<0,05

When comparing the data of main and control groups obtained after using the CrossFit exercises, it was found that the indicators of main groups are better than the results of pupils control groups, but these differences are unreliable (p>0,05).

Comparing the repeated results according to the Ruffier index with the evaluation scale presented by S. D. Polyakov and co-authors [8], it is clear that the data improved by 1 point and began to meet the rating – 3 points ("average" level) at boys of the 10th grade of main group. The indicators of the 11th grade boys of main groups and the 10th-11th grades pupils of control groups remained unchanged, as at the beginning of the research in the 10th grade meet the rating – 2 points ("below the average" level) and in the 11th grades have the rating 4 points ("above the average" level).

Thus, after applying the CrossFit exercises in physical education of high school students, the cardiovascular system response to standard physical load improved in comparison with the initial researches, which makes it possible to recommend to physical culture teachers to use the developed by us variable module "CrossFit".

Conclusions:

1. It was established that the cardiovascular system response to standard physical load of the 10th grades boys meets the score 2, which is "below the average" level and the results of the 11th grades pupils are 4, which is "below the average" level.

2. In the age aspect there is generally a reliable pattern of improvement in results with age both before and after the experiment (p<0,05-0,001).

3. Using in the process of physical education of the 10th-11th grades boys of the developed by us variable module "CrossFit" contributed to improvement of the level of the cardiovascular system response to standard physical load of pupils of main groups.

The further research prospect in this direction can be carried out by determining the degree of impact of CrossFit exercises on the physical health level of high school students.

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