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IMPACT OF CROSSFIT EXERCISES ON THE LEVEL OF PHYSICAL PREPAREDNESS OF HIGH SCHOOL-AGE PUPILS

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Purpose: to determine the degree of change in the level of physical fitness of the 10^{th}–11^{th} grade pupils under the influence of CrossFit exercises.

Material and methods: theoretical analysis and generalization of scientific-methodological literature; pedagogical testing, pedagogical experiment, and methods of mathematical statistics. The tests were used to determine the level of physical fitness of the 10^{th}–11^{th} grade pupils: raising straight legs in a hanging (number of times); running in place with the intensity of 70% from maximum to pronounced fatigue (s); "shuttle" run 4–9 m (s); run 60 m (s) and cross split (cm). The studied results were compared to norms and evaluated with a certain number of points. Statistical analysis: the study materials were processed using the licensed program Excel. The research involved 113 pupils of the 10^{th}–11^{th} grades.

Results: at the beginning of the school year, the stating research was carried out, according to which the "average" level (3 points) of physical fitness among 16–17-year-old pupils was established. According to the results of the primary research, pupils were divided into main and control groups for conducting the formative experiment. Pupils of the control groups were engaged by the generally accepted state program on physical education for 10–11 grades of general secondary education institutions, and the educational process on physical education of pupils of the main groups was supplemented by the variable module "CrossFit". According to researches obtained after the pedagogical experiment, it was established that the level

of physical fitness increased to “above the average” (4 points) in pupils of the main groups, and changes weren’t found on the assessment scale in the researched control groups. In the age aspect, there is mainly the improvement in results with age, both in main and control groups ($p>0,05$). The reliable prevarication of the data of boys, over the indicators of girls, was revealed, mainly, in the article ($p<0,05–0,001$).

Conclusions: the positive impact of CrossFit exercises on the level of physical fitness of the 10^{th}–11^{th} grade pupils of main groups was revealed.

Keywords: variable module, CrossFit, high school pupils, physical fitness, physical culture lessons, motor activity.

Introduction

Nowadays the problem of reducing the level of physical preparedness, and as a result of the health of young students, remains urgent. Several leading specialists [2, 6, 10, 11] note that, according to statistics, nearly 60% of older school-aged children have health abnormalities and low levels of physical preparedness. The main reasons for this problem are the peculiarities of education in a modern school, namely: an increase in the volume of educational information, intensification of the passage of material, modernization, and complication of educational programs. All this leads to an increase in mental load and a decrease in motor activity of children [5].

Physical culture is an effective means of compensating for the lack of motor activity of a modern pupil [2]. However, according to the results of several authors [1, 3, 15, 19, 22, 24] today, acting lessons are ineffective, uniform, insufficiently stimulating the curiosity of pupils for physical education and sports activities. Therefore, the problem requires the search for new interesting forms, innovative means, methods, and principles of improving the physical education system, increasing the volume and diversity of types of motor activity [1, 2, 4, 10].

The number of scientists pay considerable attention to optimizing the content of physical culture lessons [2, 11, 20, 21, 23, 25]. Numerous researches determined the positive impact of innovative types of motor activity on the physical preparedness of pupils of different age periods. So, N. Bazylevych, O. Tonkonoh (2017) found an

improvement in the level of physical preparedness of younger pupils under the influence of fitball aerobics; T. M. Bala, I. P. Masliak (2014) established a positive dynamics of indicators of the level of speed development under the influence of cheerleading exercises in the 5^{th}-6^{th} grade pupils; T. I. Suvorova, M. S. Moroz, A. H. Karabanov (2011) found that a tendency is reflected to improve physical preparedness data in high school-age pupils under the influence of athletic gymnastics classes. It should be noted that the analysis of literary sources showed the absence of scientific works that would raise the issue of the impact of CrossFit exercises on the level of physical preparedness of high school pupils. Thus, the above indicates the relevance and usefulness of the research.

The purpose of the research is to determine the degree of change in the level of physical preparedness of the 10^{th}–11^{th} grade pupils under the influence of CrossFit exercises.

Connection of the work with scientific programs, plans, topics. The research was carried out by the Thematic Plan of the research work of Kharkiv State Academy of Physical Culture for 2015–2020 on the topic "The improvement of the process of physical education in educational institutions of various profiles" (the state registration number is 0115U006754) and for 2020–2026. "The improvement of the process of physical education of various segments of the population" (the state registration number is 0120U101110).

Material and Methods of research

The following *methods* were used during the experiment: theoretical analysis and synthesis of scientific-methodological literature; pedagogical testing, pedagogical experiment, and methods of mathematical statistics.

The tests presented by L.P. Serhiienko [13; 14] and V. A. Romanenko [12] were used, namely: hanging straight leg raises (number of times); running in place with the intensity of 70% from maximum to pronounced fatigue (s); "shuttle" run 4x9 m (s); run at 60 m (s) and cross split (cm).

Statistical analysis: the study materials were processed using a licensed program Excel. Calculated: the arithmetic mean of the variation series ($\overline{X}$) – for the

characteristic of the population according to individual parameters; representativeness mistake (m) for determining the deviation of the arithmetic mean from the corresponding parameters of the general population; reliability of differences (p) – was calculated to establish the homogeneity of control and main groups, the degree of differences in indicators in the age aspect and changing the average values of the studied parameters in the main and control groups after the experiment with the help of Student's parametric criteria (t) with a significance level not lower than 0,05.

The research was carried out based on the secondary schools No. 146 and No. 57 of Kharkiv during the 2017–2018 school years. It was attended by 113 pupils of 16–17 years old, of which 2 main and 2 control groups were formed. The main groups included 59 pupils: the first group – 16-year-old boys and girls (n = 27), the second group – 17-year-old boys and girls (n = 32); control groups included 54 pupils: the first group - 16-year-old boys and girls (n = 21) and the second group – 17-year-old boys and girls (n = 33). All children who took part in the research were almost healthy and were under the supervision of a school doctor.

During the research, the preparedness of the control groups was engaged only in the generally accepted state program on physical culture for the 10^{th}–11^{th} grades of general secondary education institutions, and the educational process on physical education of pupils of the main groups was supplemented by the CrossFit variant module developed by us. CrossFit classes were held twice a week, according to the school schedule. The content of which included theoretical information, special physical training (elements of gymnastics, athletics and weightlifting, kettlebell, general development exercises), and technical training (specially picked up CrossFit exercises "Burpee", "Box Jump", "Farmer's Walk", "Good morning", "Bear crawl", "Floor wipers", "Burpee bench jump"., etc.). At the end of studying the CrossFit module, the pupils carried out a set of exercises in the facilitated conditions which consisted of special and technical elements of CrossFit, for the minimum period and with the specified quantity of rounds ("Cindy", "Annie", "Fran", etc.) [16].

During the classes, the age, sex, and anatomical-physiological features of the pupils were taken into account. The load and dosage increased gradually, taking into account the individual capabilities of pupils. CrossFit exercises were also included in the preparatory part of the lesson of other variable modules, in the system of organized breaks, and were given in the form of homework.

Results of the research

Considering the investigated indicators, reliable differences between the investigated data weren't found ($p>0,05$).

In the age aspect, it is determined mainly the improvement in results with age, both in main and control groups ($p>0,05$).

Comparing the results of the article, a reliable prevarication of the data of boys, over the indicators of girls are revealed, mainly ($p<0,05–0,001$), except the results of a cross split, where there is an opposite trend, that is, the indicators of girls are better than the data of boys and these changes are mainly reliable ($p<0,05–0,01$).

Determining the level of physical preparedness of pupils of senior school age, it was revealed that the results of the stating experiment indicate that in pupils of the study groups it corresponds to a score of 3 points, which indicates the "average" level. So, according to the level of force development, on average, there is a score – 2 points ("below the average" level); endurance – 3 points ("below the average" level); agility – 3 points ("average" level); speed abilities – 2 points ("below the average" level); flexibility – 3 points ("average" level).

After the introduction of the experimental technique, a significant improvement was revealed in all the investigated indicators, both in boys and in girls of the main groups (Table 1), and these differences are statistically significant ($p<0,05–0,001$). So, the increase in results reflecting the level of force development in the 10^{th}-grade boys was – 24,5%, the 11^{th}-grade – 23,7%; girls, 55,3 percent and 43,3 percent respectively; endurance – in the 10^{th}grade boys is 7,8%, in the 11^{th} grade – 6,4%; 25,6 percent and 21,4 percent respectively; dexterity - in the 10^{th}-grade boys is 3,1%, in the 11^{th}-grade – 8,0%; girls had 3,0 percent and 3,5 percent respectively; speed abilities – in the 10^{th}-grade boys is 3,1%, in the 11^{th}-grade – 2,1%; girls 9,5 percent

and 3,0 percent respectively; flexibility – for the 10th-grade boys is 10,6%, for the 11th-grade – 10,2%; for girls, 24,2% and 13,4%, respectively.

Table 1

Indicators of physical preparedness of main group pupils before and after the experiment

Grades / Sex		Groups			t	p
		n	***Before the experiment***	***After the experiment***		
			Indicators $\bar{X}$ ±m			
Hanging straight leg raises (number of times)						
10 grade	Boys	17	14,35±1,74	17,88±2,11	4,07	<0,001
	Girls	12	7,83±1,93	12,17±2,06	6,39	<0,001
11 grade	Boys	10	16,00±2,35	19,80±1,53	2,03	>0,05
	Girls	22	9,86±0,99	14,14±0,93	7,98	<0,001
Running in place with intensity of 70% from maximum to pronounced fatigue (s)						
10 grade	Boys	17	116,08±2,79	125,20±1,00	4,79	<0,001
	Girls	12	34,14±1,98	42,90±1,21	8,89	<0,001
11 grade	Boys	10	131,16±1,83	139,59±0,66	4,90	<0,001
	Girls	22	33,09±1,31	40,17±2,29	4,48	<0,001
"Shuttle" run 4-9 m (s)						
10 grade	Boys	17	9,91±0,19	9,60±0,20	3,43	<0,01
	Girls	12	11,38±0,14	11,03±0,14	3,79	<0,01
11 grade	Boys	10	9,81±0,16	9,02±0,07	5,21	<0,001
	Girls	22	11,14±0,17	10,75±0,20	3,29	<0,01
Run 60 m (s)						
10 grade	Boys	17	9,12±0,10	8,83±0,06	3,97	<0,01
	Girls	12	11,18±0,26	10,12±0,21	8,18	<0,001
11 grade	Boys	10	9,09±0,12	8,90±0,10	3,05	<0,05
	Girls	22	11,00±0,26	10,67±0,23	3,70	<0,001
Cross split (cm)						
10 grade	Boys	17	29,71±2,44	26,53±2,60	2,81	<0,05
	Girls	12	22,33±3,65	16,92±2,89	6,13	<0,001
11 grade	Boys	10	31,10±3,04	27,90±3,14	4,95	<0,001
	Girls	22	20,32±2,23	17,59±1,94	2,47	<0,05

Analyzing the studied indicators in the age and sex aspects obtained after the use of CrossFit exercises, it was found that the trend of differences remained unchanged compared to the initial data in pupils of the main groups, mainly.

Examining the performance of the control group pupils after the experiment, it was found that they also improved slightly, but these changes are not significant and aren't reliable (p>0,05). Thus, the increase in results ranged from 0,3% to 9,4%. It should be noted that there weren't changes from the original data by age and article.

When comparing the repeated data of main and control groups pupils (Table 2), significant primacy of results of main groups over control groups was

established. It should be noted that reliable differences are observed in the indicators of hanging straight leg raises of the 11th-grade pupils (p<0,05); running on the place with the intensity of 70% from maximum to pronounced fatigue of the 10th–11th-grade pupils (p<0,05; 0,001); "shuttle" run 4x9 m of the 11th-grade boys (p<0,001); run 60 m of the 10th-grade girls (p<0,01) and cross split of the 11th-grade girls (p<0,05).

Table 2

Comparison of physical preparedness indicators of pupils of main and control groups after the experiment

Grades	Sex	Groups				t	p
		n	***Main***	n	***Control***		
		Indicators $\bar{x}$ ±m					
Hanging straight leg raises (number of times)							
10 grade	Boys	17	17,88±2,11	10	13,70±1,34	1,67	>0,05
	Girls	12	12,17±2,06	11	7,91±1,31	1,74	>0,05
11 grade	Boys	10	19,80±1,53	17	15,12±0,86	2,67	<0,05
	Girls	22	14,14±0,93	16	10,19±1,25	2,54	<0,05
Running in place with intensity of 70% from maximum to pronounced fatigue (s)							
10 grade	Boys	17	125,20±1,00	10	121,04±1,57	2,23	<0,05
	Girls	12	42,90±1,21	11	33,85±1,24	5,22	<0,001
11 grade	Boys	10	139,59±0,66	17	131,24±1,53	5,01	<0,001
	Girls	22	40,17±2,29	16	34,31±1,70	2,05	<0,05
"Shuttle" run 4-9 m (s)							
10 grade	Boys	17	9,60±0,20	10	9,98±0,11	1,68	>0,05
	Girls	12	11,03±0,14	11	11,31±0,23	1,07	>0,05
11 grade	Boys	10	9,02±0,07	17	9,81±0,12	5,49	<0,001
	Girls	22	10,75±0,20	16	11,29±0,24	1,76	>0,05
Run 60 m (s)							
10 grade	Boys	17	8,83±0,06	10	9,01±0,12	1,35	>0,05
	Girls	12	10,12±0,21	11	11,35±0,37	2,92	<0,01
11 grade	Boys	10	8,90±0,10	17	9,13±0,15	1,30	>0,05
	Girls	22	10,67±0,23	16	11,16±0,34	1,22	>0,05
Cross split (cm)							
10 grade	Boys	17	26,53±2,60	10	28,80±4,72	0,42	>0,05
	Girls	12	16,92±2,89	11	20,55±3,87	0,75	>0,05
11 grade	Boys	10	27,90±3,14	17	31,35±2,92	0,81	>0,05
	Girls	22	17,59±1,94	16	23,38±1,96	2,09	<0,05

Determining the level of physical preparedness of older pupils, after the introduction of the variable module CrossFit into the physical education process, it was revealed that against the background of a significant and reliable improvement in the results, it increased by 1 point and became equal to a score of 4 points, which indicates the "above average" level. So, indicators of the level of development of force, endurance, dexterity, and flexibility on average correspond to a score of 4

points (“above the average” level), speed abilities – 3 points (“average” level). It should be noted that in the study control groups, the indicators remained unchanged, that is, changes weren’t observed on the assessment scale.

Thus, the results of the research indicate positive dynamics in the physical preparedness indicators of 16–17-year-old pupils of main groups, influenced by CrossFit exercises.

Conclusions / Discussion

According to the results of the research, it was established that CrossFit exercises in the process of physical education of the 10^{th}–11^{th} grade pupils contributed to improving the level of physical preparedness. Thus, considering the changes in the level of development of the maximum dynamic muscle strength of the abdominal press, the established mainly significant improvement both in boys and girls of the main groups, and these differences are statistically significant ($p<0,001$). The above is confirmed by the data of I. I. Zemtsova (2019) according to which it was revealed that muscle hypertrophy occurs during physical exertion of the force direction, as a result of adaptation-trophic exposure, characterized by an increase in thickness and a tighter packaging of contractile elements of muscle tissue. So, scientists T. M. Kravchuk, T. V. Karpunets, I. V. Stepanenko (2019), indicate that the introduction of functional exercises into the main part of the lesson contributed to a significant improvement in force abilities of high school pupils.

Analyzing the indicators of the level of endurance development obtained after the use of the variable module CrossFit, it was determined that the data improved significantly and are reliable in nature of differences ($p<0,001$) in pupils of the main groups. So, according to O. M. Khudoliy (2008), this is because the oxygen modes of the body under physical exertion become more economical at the studied age, the ability of the body to work “in debt” significantly increases, that is, anaerobic productivity increases.

Considering the indicators of coordination of movements obtained after the pedagogical experiment, it was revealed that they improved significantly and are reliable in nature of differences in pupils of senior school age in main groups

(p<0,01; 0,001). The above is confirmed by the data of I. I. Zemtsova (2019), according to which it is determined that the improvement of motor coordination to the level of adults continues, and the differentiation of muscle forces reaches the maximum level in 16-17 years. So, according to V. A. Berezovskyi (2016), it was established that under the influence of physical culture lessons with elements of sports orientation, the indicators of agility of high school pupils improved significantly.

Analyzing the level of development of the frequency of movements obtained after the introduction of CrossFit exercises, a significant and reliable improvement in data in pupils of the main groups was revealed (p<0,05–0,001). So, scientists Zh. K. Kholodov, V. S. Kuznetsov (2008) claim that classes in various sports affect positively the development of high-speed abilities.

Analyzing the indicators of the level of motor development in pelvis joints obtained after the experiment, it was determined that, they improved significantly and have a reliable nature of differences in pupils of the main groups (p<0,05; 0,001). According to I. I. Zemtsova (2019), it was determined that ossification of the skeleton hasn't been completed at this age yet, which provides a sufficiently high level of mobility and significant reserves available to improve flexibility, especially under the influence of systematic, dosed physical activity. Thus, our data are consistent with the indicators of V.U. Krendeleva (2015), according to which positive changes in the level of flexibility development in high school boys and girls are observed, under the influence of wellness fitness.

Thus, the conducted researches indicate the positive impact of CrossFit exercises proposed by us on the level of physical preparedness of the 10^{th}–11^{th} grade pupils.

Prospects for further research in this direction can be carried out by determining the level of physical health of high school pupils under the influence of CrossFit exercises.

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