

Application of the Crossfit system in the training of young taekwondo athletes

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Abstract:

Improving the educational and training process of people involved in taekwondo continues to be an urgent problem. The issues of the influence of CrossFit training on the cardiorespiratory system, physical development and physical fitness of young taekwondo athletes remain unresolved. *Research aim:* Use CrossFit training to increase the reserve capacity of the cardio-respiratory system and motor skills in young taekwondo athletes. *Materials and methods.* The pilot project involved 56 young taekwondo athletes. Of these: 28 boys and 28 girls aged 10-12. 2 experimental groups (EG) and 2 control groups (CG) were formed. In the training program for the training of taekwondo athletes of the experimental groups, complexes of physical exercises from the CrossFit system ("CrossFit for younger teenagers") were introduced. These CrossFit exercises were aimed at improving the functional state of the cardiovascular system, respiratory system and physical performance. These indicators directly influenced physical fitness. The control groups of athletes were engaged in accordance with the generally accepted taekwondo program. Conducted boundary testing of performance indicators of the cardiovascular, respiratory and muscular systems. The boundary state of the athletes' physical fitness was assessed. *Results.* The effectiveness of the proposed experimental CrossFit training complexes for increasing the reserve capabilities of the cardiorespiratory, muscular system, power, speed-strength, coordination qualities and general endurance in comparison with athletes who used the traditional training program for this sport has been reliably proven. *Conclusions.* The data obtained during the pilot project can be used in the program of the training process for preparing beginner taekwondo athletes.

Key Words: taekwondo athletes, CrossFit training, functional indicators, physical qualities, physical education

Introduction

The great popularity of taekwondo among the population in many countries is due to the effective health-improving result in maintaining and strengthening health. This type of sports activity became especially attractive for young people after the inclusion of taekwondo in the program of the XXVII Summer Olympic Games. This fact causes the need among specialists in the field of sports to search for and improve methods of improving training sessions in this type of martial arts (Koshcheyev, & Dolbysheva, 2021; Vorozheikin et al., 2022).

Scientists and experts in the field of taekwondo note that in order to achieve high sports results, it is important to develop and improve an athlete's speed and strength qualities and his/her technical and tactical training (Hendarto et al., 2018; Simakov et al., 2018). It is believed that for taekwondo athletes, the most important motor quality is speed and strength ability (Losik, 2018). To improve strength and speed qualities, various means and methods of sports training are used, which involve the use of different volumes and intensity of physical loads (Bubka, & Platonov, 2018; Koshcheyev, 2020; Guillermo et al., 2020). The modern literature presents materials on the successful use of high-intensity interval training Tabata to increase the overall endurance of athletes engaged in taekwondo (Mischenko et al., 2021).

Registration in 2000 by CrossFit Corporation, Inc. as a trademark of CrossFit training attracted scientists' and specialists' attention in the field of physical culture and sports of the possibility to use this branded system in the athletes' training. It is known that CrossFit training is an intensive functional training of speed,

strength and coordination orientation (Klimek et al., 2018). Using the method of circular physical work at the appropriate stations in such training allows a person to get a significant increase in strength, speed, coordination and other motor qualities in a short time. Due to the athlete performing significant CrossFit loads in terms of volume and intensity, it is necessary to regularly monitor functional indicators (Nagovitsyn et al., 2019). In addition to using CrossFit training as a fitness program, it is one of the means of athletes' physical training in some sports, including martial arts (Khomichev, & Tarakanov, 2018; Osipov et al., 2020). It is known that CrossFit training is used for the professional training of various specialists (Poston et al., 2016).

However, despite the great interest of specialists in this problem, there is a limited number of publications on the possible impact of CrossFit loads over the indicators of physical development, physical fitness of the growing body of young athletes engaged in taekwondo and on the activity of their functional respiratory and circulatory systems. Meanwhile, such data are necessary for the scientific substantiation of taekwondo training sessions effective forms in order to improve the athletes' physical performance. We believe that studying this issue will make it possible to make adjustments to the training process of novice taekwondo athletes. It should increase the effectiveness of the martial artists' training as a result of increasing the reserve capabilities of the cardiorespiratory system.

Research aim. To increase young taekwondo athletes' reserve capabilities of the cardiorespiratory system and motor qualities using CrossFit training.

Material & methods

The study was carried out at the sports base of the taekwondo school of the Ural Federal District (Russia). In the 2021-2022 academic year, 56 athletes in 10-12-years-old (boys, n = 28, girls, n = 28) were under observation, doing taekwondo at the initial stage of sports training. Randomized distribution of all participants in the control (CG) and experimental groups (EG) of 14 boys and girls.

Control groups (CG1 and CG2) and experimental (EG1 and EG2) groups of boys and girls were assigned to athletes of the initial stage of training. They practiced taekwondo for 3 weeks for 120 minutes, according to the Federal standard of taekwondo (Federal standard of sports training in the sport «taekwondo ITF», 2019). The written consent of the parents of the children participating in the experiment was obtained. The project carried out does not contradict the principles of the Helsinki Declaration of 2008 concerning biomedical research.

Complexes of intensive, interval physical exercises of the CrossFit system («CrossFit for younger teenagers») were introduced into the young taekwondo athletes' training sessions of both EG, which were aimed at developing and improving all the basic physical qualities, physical development and activity of the cardiorespiratory system. CrossFit training was conducted in the main part of the training session for 20-22 minutes. The regulation of training loads was carried out in accordance with the level of physical and functional fitness of a particular athlete.

The innovative direction of CrossFit training for novice taekwondo practitioners was that the training program was based on three proposed training modules, Table 1.

Table 1. Vector of modules of the CrossFit training system for taekwondo athletes

Module I	Module II	Module III
Training No1	Training No2	Training No3
Development and improvement of all novice taekwondo athletes' basic functional, motor qualities and skills	An anaerobic-aerobic mechanism development for ensuring physical activity to increase the reserve capabilities of all morphofunctional systems of the athlete's body	Preparation of an athlete for solving motor tasks of sports duration with different types of motor movements, their volume and intensity

The corresponding training modules were used at each training session. On Monday we used training No.1, on Wednesday - training No.2, and on Friday – training No.3. The developed crossfit training complexes included from 4-6 to 11-12 various exercises of strength, speed, coordination orientation and cardio training. Every month, the training content and orientation was corrected, the volume and intensity dosage of motor loads was increased, and the training equipment type was changed.

The complication of movements was carried out by increasing the structure, sequence and interrelation of the performed motor actions. A variety of training devices were used in crossfit training: weighted ball (medball) of different weights, rubber shock absorber, BOSU universal balancing platform, TRX training loops and other sports equipment and inventory.

An approximate set of strength and speed-strength exercises of CrossFit training («CrossFit for younger teenagers») is presented in Table 2.

Table 2. Strength and speed-strength exercises crossfit training («Crossfit for younger teenagers»)

Name of the exercise	Content, number of times
Jasmine	Perform 10 push-ups from the floor, 10 pull-ups on the crossbar and 10 deep squats.
North-South	Perform 10 burpees, 10 body twists and 10 jump squats.
Triple 9	Perform 10 jumps on a pedestal, 10 push-ups in a handstand and 10 3x8 m shuttle runs.

At the beginning and at the end of the project, the values of the following indicators were evaluated: body length (cm), body weight (kg) and chest circumference at rest (cm). The functional state of the cardiovascular system of athletes was assessed by the following indicators: the value of the heart rate (bpm) at rest and the Ruffier-Dixon index (arbitrary units). The hypoxic resistance of the organism was assessed by the value of the parameters of the Stange (s) and Genchi (s) samples. The strength of the muscles of the hand of the left and right hands was determined with a dynamometer (kg) with subsequent calculation of the strength index. Conducted milestone testing of the development of the basic motor qualities of young athletes. The following tests were used: running 60 m from a high start, s; running 800 m, m., s; shuttle run 3x8 m, s; pull-ups on a high bar (boys), number of times; hanging pull-ups on the low bar (girls), number of times; lifting the torso from a supine position in 30 s, number of times; long jump with a run, cm; jumping rope in 15 seconds, the number of times.

Statistical processing of the data obtained was carried out by parametric methods with the determination of the values of the arithmetic mean indicators and their errors. Reliability was determined using the Student's coefficient. We used STATISTICA 10.0 and MS Excel 2010 software packages.

Results

At the beginning of the experiment, there were no significant differences between the values of anthropometric and functional indicators in CG and EG athletes among both boys and girls, $p > 0.05$, which may indicate the uniformity of the observation groups composition.

Table 3 presents the results of the morphofunctional parameters values analysis at the end of the experiment in young athletes engaged in taekwondo.

Table 3. The morphofunctional parameters value in athletes at the end of the experiment, $M \pm m$

Indicators	Boys (n=28)		Girls (n=28)		
	CG (n=14)	EG (n=14)	CG (n=14)	EG (n=14)	
Anthropometry					
Standing height, cm	142.7±5.52	143.4±5.84	138.9±2.43	139.3±2.51	
Weight, kg	36.3±1.37	37.7±1.92	32.8±1.57	33.7±2.11	
Chest circumference, cm	66.5±2.41	68.3±2.64	63.8±2.61	63.9±2.39	
Cardiorespiratory system					
Heart rate, bpm	77.0±3.22	68.0±3.27*	69.0±2.89	63.1±2.14*	
Ruffier index, cu	12.9±0.45	9.9±0.57*	11.9±0.43	9.4±0.54*	
Shtange sample, s	54.8±2.68	61.8±2.95*	53.8±2.47	59.5±2.61*	
Genche sample, s	27.3±2.82	36.9±2.93	29.6±1.35	36.9±2.31	
Muscular system					
Hand muscles strength, k	Right	24.4±1.59	28.7±1.63*	21.1±1.21	24.9±1.78*
	Left	23.2±1.44	26.8±1.61*	18.2±1.45	21.7±1.68*
Power index, %	Right arm	67.4±3.59	75.9±3.63*	64.1±2.78	74.1±2.61*
	Left arm	64.1±2.44	70.1±2.61*	55.3±2.45	64.5±2.68*

Note. * Reliability of differences in the values of indicators between athletes CG and EG, $p < 0.05$

It was found that at the end of the study, there were no significant differences in all anthropometric parameters between athletes CG and EG, $p > 0.05$. An analysis of the values of functional characteristics of the cardiorespiratory and muscular system indicates that in boys and girls in EG, where CrossFit training was used, they were significantly better than in CG, where the traditional taekwondo training program was used, $p < 0.05$. Table 4 shows the increase in the values of indicators in athletes EG and CG at the end of the study, compared with the beginning of work.

Table 4. Increase in physical development and respiratory and circulatory systems indicators values of athletes engaged in taekwondo by the end of the project, %

Indicators	Boys (n=28)		Girls (n=28)		
	CG (n=14)	EG (n=14)	CG (n=14)	EG (n=14)	
Anthropometry					
Standing height, cm	2.8	2.8	1.8	2.3	
Weight, kg	9.7	8.8	4.1	4.8	
Chest circumference, cm	1.8	3.4	2.0	2.4	
Cardiorespiratory system					
Heart rate, bpm	3.2	12.1	3.2	8.8	
Rufier index, cu	3.8	32.2	5.7	31.2	
Shtange sample, s	6.0	16.8	6.2	17.5	
Genche sample, s	24.7	47.2	34.5	55.6	
Muscular system					
Hand muscles strength	Right	10.6	18.0	7.4	18.8
	Left	7.1	19.4	6.9	15.3
Power index, %	Right arm	7.2	12.5	8.2	13.4
	Left arm	8.4	14.8	9.4	16.8

At the end of the project, a slight increase in indicators characterizing the CG and EG athletes' physical development was established. The increase in indicators characterizing the functional state of the cardiovascular and respiratory system was significantly higher in the experimental group of both boys and girls, Table 4. The greatest increase was found in boys of the experimental group in the Genche sample (47.2%) and the Rufier index – 32.2%. The greatest increase in girls of the experimental group was found in the Genche sample – 55.6% and the Rufier index – 31.2%.

At the beginning of the experimental project, there were no significant differences between the values of indicators in motor tests for athletes in the boys' group and in the girls' group CG and EG, $p > 0.05$, which may indicate approximately the same level of their motor qualities development.

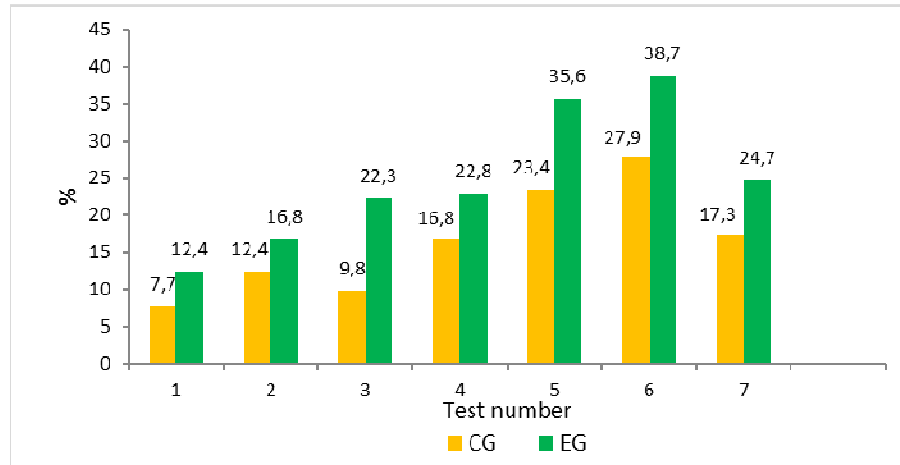
The use of the CrossFit training program in EG boys and girls led to a more significant increase in the values of motor test indicators, compared with the control groups where the traditional program of the training process was used, Table 5.

Table 5. The value of indicators in motor tests in young athletes at the end of the experiment, $M \pm m$

Test No	Tests	Boys (n=28)		Girls (n=28)	
		CG (n=14)	EG (n=14)	CG (n=14)	EG (n=14)
1	Running 60 m from a high start, s	12.2±0.23	10.5±0.20*	12.8±0.25	11.2±0.22*
2	Running 800 m, m, s	6:20±0:13	4:2±0:10*	6:5±0:20	6:12±0:14*
3	Shuttle running 3x8 m, s	10.8±0.35	8.2±0.01*	9.5±0.16	8.8±0.11*
4	Pull-up on a high crossbar (boys), the number of times	3.3±0.81	5.7±0.92*	-	-
5	Pull-up from the hang on a low crossbar (girls), the number of times	-	-	7.6±0.34	15.4±1.43*
6	Lifting the trunk from the supine position in 30 seconds, the number of times	9.2±1.2	16.4±2.23*	5.8±0.45	12.3±1.67*
	Running long jump, cm	292.4±5.56	195.2±5.12*	260.3±4.93	192.4±4.12*
7	Jumping rope in 15 seconds, the number of times	22.2±2.44	26.3±2.3	28.6±2.78	40.2±4.6*

Note. * Reliability of differences in the values of indicators between athletes CG and EG, $p < 0.05$

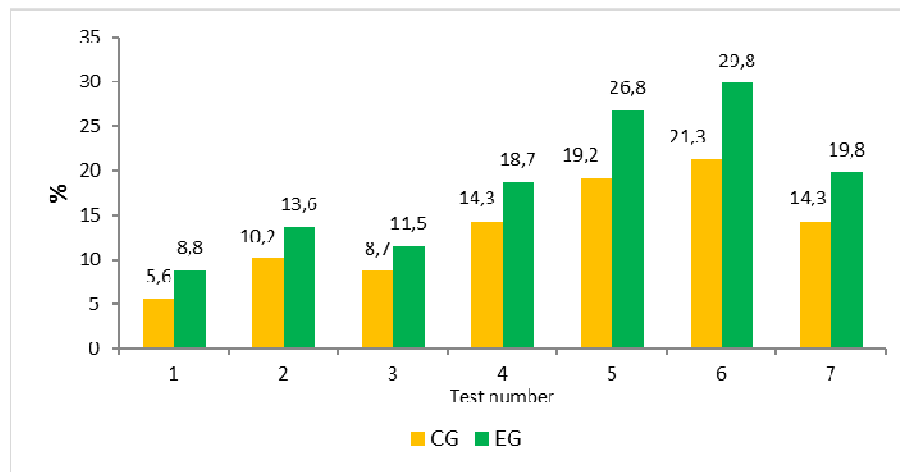
It was found that at the end of the project in the experimental group of boys and girls, the values of indicators in all motor tests were significantly higher than in the corresponding control ones, $p < 0.05$. The increase in the values of motor tests of boys and girls in EG and CG at the end of the experiment, compared with the beginning of the research is shown in Figure 1 and Figure 2.



Note. 1. Running 60 m; 2. Running 800 m; 3. Shuttle running 3x8 m; 4. Pull-up on a high crossbar; 5. Lifting the trunk from the supine position in 30 seconds; 6. Running long jump; 7. Jumping rope in 15 seconds.

Fig. 1. High-stakes increase in values of indicators in motor tests of boys

At the end of the project, the increase in the indicators values in all motor tests of EG boys was greater than in CG. The greatest increase in EG was found in boys in strength (test No. 4 and No. 5) and speed-strength indicators (test No. 6), Figure 1.



Note. 1. Running 60 m; 2. Running 800 m; 3. Shuttle running 3x8 m; 4. Pull-up on a low crossbar; 5. Lifting the trunk from the supine position in 30 seconds; 6. Running long jump; 7. Jumping rope in 15 seconds.

Fig. 2. High-stakes increase in values of indicators in motor tests of girls

At the end of the experimental project, the increase in the indicators values in all motor tests was greater in the girls of the EG than in the CG. The greatest increase in the indicators of EG girls was found in strength (test No. 5) and speed-strength qualities (test No. 6), Figure 2.

Dicussion

Currently, the creation and testing of modern methods of the educational and training process in taekwondo is an urgent direction in the field of theory and practice of sports activities (Abramenkov, 2021). Considerable attention in the training sessions of taekwondo practitioners should be paid to increasing the reserve capabilities of their cardiovascular and respiratory systems (Franchini et al., 2019; Muhamad Syamsul Taufik et al., 2021), this is especially important for novice athletes (Dupuy & Dugué, 2018). An increase in the adaptive potential of the athlete's cardiorespiratory system is the basis for the development and improvement of most motor qualities. First of all, it concerns strength, speed-strength qualities and endurance. It allows getting high athletic results in various sports (Lisenchuk et al., 2019). One of the many methods of developing and improving the taekwondo training program is CrossFit training. It is based on the method of intensive circular training with the direction of developing strength, endurance, flexibility and coordination of movements. With

this type of exercise, there is the cardiovascular system development (Klimek et al., 2018). Insufficient knowledge of the CrossFit training use in increasing the reserve capabilities of the cardiorespiratory system and the general physical fitness of young taekwondo athletes prompted us to study this issue.

The results of the annual experimental project confirmed the opinion of scientists about the positive effect of CrossFit training on increasing the reserve capabilities of the cardiovascular and respiratory systems in athletes engaged in certain types of martial arts (Khomichev, & Tarakanov, 2018; Osipov et al., 2020). According to our data, the heart rate at rest and the Ruffier index were significantly lower in young athletes who were engaged in the program using CrossFit training than in athletes engaged in the traditional curriculum. A similar reaction of the circulatory system was observed by other researchers and sports specialists (Muhamad Syamsul Taufik et al., 2021). Our data indicate that boys and girls of the experimental group had significantly more hypoxic resistance of the body compared to the control group of athletes.

We believe that the increase in the reserve capabilities of the circulatory and respiratory systems allowed us to significantly increase strength abilities. This fact is indicated by significantly large values of the strength of the both hands muscles and strength indices in athletes of the experimental group. A significant increase in the values of the indicators of the cardiorespiratory system adaptation in athletes of the experimental group to physical activity caused a higher increase in such athletes' physical fitness indicators compared with the indicators values of boys and girls in the control group. This fact is consistent with the opinion of Sapto Wibowo et al. (2021) about the increase in special physical fitness of athletes after an increase in the functional parameters of the cardiovascular system. According to our data, in all motor tests of athletes in the experimental group, the increase in the indicators values of speed, strength, coordination, endurance at the end of the project was significantly higher than the values of the indicators in the control one, which indicates the effective preparation of young athletes using crossfit training in the program.

Conclusions

To improve the functionality of the cardiovascular and respiratory systems, the general physical fitness in 10-12-years-old taekwondo athletes, we have tested a program of training sessions using the CrossFit system. The program provides for the inclusion of CrossFit training modules lasting 20-22 minutes in the main part of the taekwondo class.

The experimental program proposed by us for training sessions for taekwondo athletes with the inclusion of CrossFit training modules significantly increased the adaptive abilities of the circulatory, respiratory and muscular systems. The increase in the values of functional indicators, strength, speed-strength, coordination qualities and general endurance in the experimental group of boys and girls was significantly higher compared to the control group of athletes. This allows us to recommend the use of CrossFit training for athletes involved in taekwondo.

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

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