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CrossFit Training Impact on the Level of Special Physical Fitness of Young Athletes Practicing Judo

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Abstract

The high level of individual physical fitness of athletes is one of the main factors in achieving sports success in martial arts. This study aimed to assess CrossFit training's impact on the level of physical fitness of young (16-17 years old) athletes practising judo. The athletes' competitive activity data was also assessed. The young athletes (n=33) demonstrated athletic performance at a level approaching that of elite athletes. They were randomly divided into approximately two equal groups. During the training of one of the groups (n=16), CrossFit sessions were used. The obtained data were evaluated using SJFT, the level of lactate concentration in blood and a comparative analysis of the judoists' competitive coefficients (CC). Statistical analysis was performed using the Mann-Whitney U-test. A significant ($p<0.05$) athletic superiority has been revealed among those who used CrossFit training in the coefficient of active combat time (CC-3) in competitive matches. SJFT indicators of both athlete groups show a positive trend. Increased dynamics of blood lactate concentrations after exercises were detected among both groups. Moreover, among the athletes who used CrossFit training, blood lactate level data were significantly ($p<0.05$) higher, averaging 14.54 ± 0.51 mmol/l. The duels percentage won by athletes who used CrossFit training was considerably higher than those athletes who did not use CrossFit training (59% vs 54%).

Key words: martial arts, judo, young athletes, CrossFit training, competitive activity

Introduction

Experts indicate that one of the main factors for achieving significant success is athletes' physical (Podrigalo et al., 2019) and the functional fitness level in martial arts (Volodchenko, Podrigalo, Aghyppo, Romanenko, & Rovnaya, 2017). It is known that athletes' level of physical and functional fitness should be at their best when practising judo since judo is characterised by periodic high-intensity strength exercises (Mohammed & Choi, 2017). Moreover, experts also state that athletes need to develop muscle strength, strength and endurance to achieve significant competitive results (Franchini, Brito, Fukuda, & Artioli, 2014). Unfortunately, scientists have revealed a lack of physical fitness level among some elite Russian judoists (Adolf et al., 2018). Also, experts point out

the lack of relevant data related to the possibility of a significant increase of judo athletes' physical and functional status (Ceylan, Gurses, Akgul, Baydil, & Franchini, 2018).

It should be noted that it is customary to use hypoxic interval training to increase athletes' functional status in the practice of training elite fighters (Rovniy, Pasko, & Galimskiy, 2017). Russian experts point to the need to use exercises that affect the physical fitness of judo, thereby increasing athletes' level of endurance when practising judo. Surkov (2015) recommends using the following exercises: leap over partner while he is bent over and crawl under his legs after his partner stands up. Pashintsev and Surkov (2015) recommend the use of exercises with weights (30 seconds - exercise, 30 seconds - rest) for 5 minutes, followed by 5 minutes of rest.



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Recently CrossFit training has been used to increase the level of athletes' preparedness in the practice of sports. It should be noted that CrossFit training is actively used in the training of police officers and special services in the Russian Federation (Galimova et al., 2018). Some experts recommend CrossFit training for a significant increase in the level of athletes' physical fitness for various types of martial arts (Osipov et al., 2017). Furthermore, there is evidence of using CrossFit trainings effectively in the process of competitive training of elite Russian athletes who practice martial arts: judo, sambo, and combat sambo (Osipov, Kudryavtsev, Koptev, Iermakov, & Bliznevskaya, 2018). However, there is a lack of accurate information about the required number and content of CrossFit training in the training process of elite and sub-elite athletes practising martial arts in the literature. There is a lack of reliable data on the impact of CrossFit training on the level of competitive results of young athletes practising judo.

The purpose of the research: dynamic analysis of competitive activity and competitive results of young (16-17 years old) judoists' using CrossFit trainings during pre-competitive and competitive training periods. Athletes' physical fitness level during the use of CrossFit training was also assessed.

Methods

Research participants: young (16-17 years old) male athletes who have been practising judo for at least 4-5 years. The weight category of judoists is 73 kg. Sports qualifications – athletes who are close to the elite level: candidates for master of sports in judo ($n=33$). All athletes underwent a medical examination and had no contraindications to judo. Moreover, all athletes gave informed consent to participate in the research. The athletes were randomly divided into two approximately equal groups: Group 1 ($n=17$) and Group 2 ($n=16$).

The studies were approved by the ethics committee of the Institute of Physical Culture, Sports and Tourism, Siberian Federal University. The research duration was 10 months (August-May 2018) during which all athletes, in addition to their training, took part in seven judo competitions. During the study period, the training of athletes for competitions was somewhat different. Group 1 ($n=17$) was prepared according to the standard training program operating in many judo schools of the Russian Federation and CIS countries (Koptev et al., 2019). This program has a specific ratio of the volume of training load: physical training (100-120 hours), tactical and technical training (380-400 hours), and Randori (50-55 hours). For the development of endurance, the following were used: Randori and circular training (serial execution of strength and gymnastic exercises in a specific sequence with the same rest intervals between the series). These training sessions were part of athletes' physical training of Group 1 and took about 30-40% of the total time.

The programme of athletes' pre-competition and competitive training of Group 2 ($n=16$) included physical training (120-130 hours); tactical and technical training (380 hours); Randori (50 hours). For the development of endurance, the following were used: Randori and CrossFit training. The latter took about 50% of the total amount of time spent on the physical training of athletes in this group. The training sessions consisted of a serial performance of the following exercises: fast run (60 m); work with weights (16 kg); squats with a barbell (weight 50-60% of the athlete's weight); jumping on pedestals (height - 60-80 cm); carrying the load (40-50% of the athlete's weight) for speed, etc. The duration of each series was 4 minutes (the time of a com-

petitive match in judo). The rest between the series was 4-5 minutes. The duration of each CrossFit workout was 45 minutes.

Special tests were used for qualitative monitoring of athletes' functional status while practising martial arts. Furthermore, lactate data concentration in judoists' blood was used for a qualitative assessment of athletes' condition after intensive training (circular and CrossFit sessions). A glucose and lactate analyser BIOSEN 5030 (Germany) was used for data collection. All athletes' blood was sampled on a monthly basis during training sessions. The level of physical fitness of athletes was assessed using SJFT. Data of Osipov et al. (2018) were used for a qualitative comparison of the obtained data with the results of young and elite judoists.

The level of competitive activity of the studied athletes was assessed using special criteria: competitive coefficients (CC). These coefficients are the average arithmetic indicators values of athletes' actions in competitive duels (Koptev, 2018). In our studies, we used athletes' CC activity: the number of Nage-waza technical actions (CC-1) and Ne-waza (CC-2) as well as the ratio of active combat time and total match time (CC-3). Furthermore, CC was calculated using the structural analysis of athletes' competitive duels. All the matches of both athletes' groups were taken for the analysis of the research period: 422 athletes' competitive duels of Group 1 and 431 athletes' competitive matches of Group 2. Experts were involved ($n=10$): coaches and judges of high qualification for the qualitative determination of CC in judo. Furthermore, the opinion of three experts was taken into account in the analysis of each match. The data of Osipov et al. (2018) were used for comparison of the CC of the studied athletes with the CC indicators of elite athletes from Russia and Kyrgyzstan.

Statistical analysis of the results was performed using SPSS20. Furthermore, a Mann-Whitney U-test is used determining the confidence level of the obtained data.

Results

The improvement dynamics of index assessment of athletes' physical fitness from average classification (13.04-13.94) to good (11.74-13.03) has been revealed in SJFT terms. An insignificant superiority of SJFT data was recorded among athletes of Group 2.

The lactate concentration of studied athletes' blood increased significantly over the study period. Also, an increase of lactate concentration was detected in both groups; however, athletes who used CrossFit during training had significantly ($p<0.05$) higher blood lactate content (14.54 ± 0.51 mmol/l) than athletes who did not use CrossFit (13.79 ± 0.38 mmol/l).

At the beginning of the study, data about athletes' CC had not been collected; determination of athletes' CC values was carried out in the research course. Comparative analysis of the values of CC-1 and CC-2 have not revealed significant differences in the coefficients of competitive activity among the judoists of both groups. Somewhat higher values of these coefficients were found among athletes of Group 2, but the differences between the results of groups are not significant. On average, athletes performed 6.22 ± 0.17 receptions of Nage-waza and 2.47 ± 0.19 receptions of Ne-waza per match. It should be noted that the smaller the value of this coefficient, the higher the level of activity in the match was when evaluating CC-3. A significant difference ($p<0.05$) of the values of this coefficient was found in favour of athletes from Group 2. These studies are presented in Table 1.

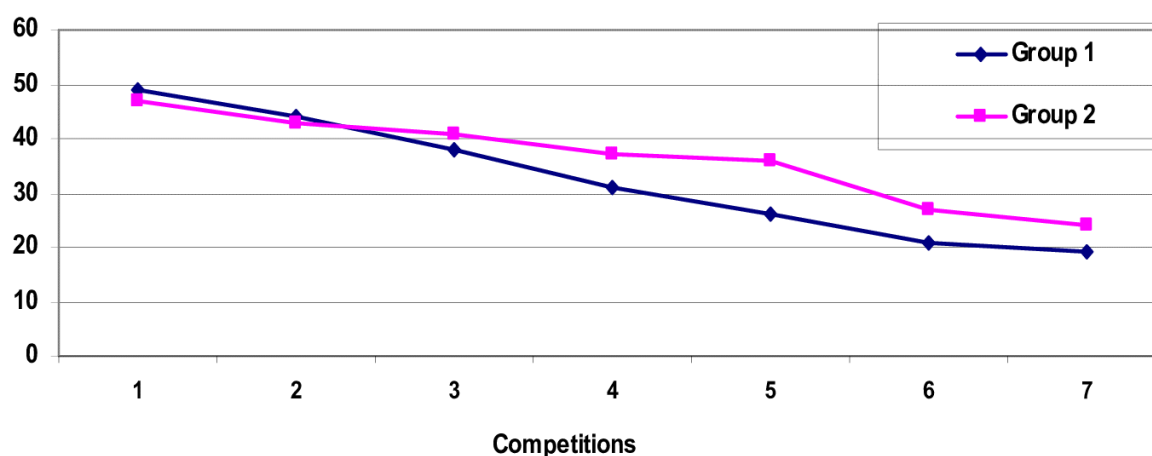
Table 1. Test results and CC values of studied athletes

Criteria	Group 1 (n=17)		Group 2 (n=16)	
	August	May	August	May
SJFT	13.26±0.19	12.94±0.37	13.31±0.14	12.77±0.32
Lactate	13.09±0.44	13.79±0.38	13.21±0.46	14.54±0.51*
CC-1	-	6.18±0.14	-	6.26±0.21
CC-2	-	2.39±0.22	-	2.55±0.16
CC-3	-	3.28±0.09	-	2.89±0.04*

Legend: * (reliability of results differences) – $p < 0.05$.

At the end of the research, some athletic advantage from Group 2 was revealed in the total number of competitive matches for the entire study period (August-May 2018). Athletes of Group 1 held 422 competitive matches and athletes of Group 2 – 431 matches. Competitive activity results of the

studied judoists were also evaluated by the number of duels won at seven competitions. Athletes of Group 1 won 54% of matches, while athletes of Group 2 won 59% of competitive matches. Statistics of won competitive matches of both groups are presented in Figure 1.

**Figure 1.** Ratio of duels won by the studied athletes

Discussion

First, a certain lack of significant scientific research of the use of CrossFit training in practice of pre-competition and competitive training of judoists at various levels should be noted. This is a matter of some concern, since athletes need a high level of endurance to achieve success in judo (Kuvačić, Krstulović, & Đapić Caput, 2017). However, the scientific literature presents data on the benefits of interval training for the development of athletes' endurance when practising martial arts (Rovniy et al., 2017). The effect of high-intensity interval training on the performance indicators of judokas has also been proven by experts (Franchini, Cormack, & Takito, 2019). In judo, interval workouts lasting for 20–60 minutes are used for certain cycles, from 4 to 8 weeks (Magnani Branco et al., 2017; Pashintsev & Surkov, 2015). However, scientists emphasize that the effect of short-term interval training for elite judo wrestlers will be minimal (Magnani Branco et al., 2017). For a significant increase in the level of athletes' physical fitness, regular and sufficiently long training effects of a certain power are necessary. In our studies, CrossFit sessions were used during the entire period of pre-competitive and competitive training of judoists at least two times a week. This made it possible to increase the indices of athletes' physical fitness.

According to expert data, the average lactate concentration in the blood of young athletes after intensive interval training is approximately 12.91±0.47 mmol/l (Pashintsev & Surkov, 2015). There is evidence of increased lactate levels among young judoists after a strenuous load of up to 15 mmol/l and

above (Campos et al., 2018). In our studies, increased dynamics in blood lactate concentrations of both athletes' groups was revealed. Athletes using CrossFit during the training showed an average of 14.54±0.51 mmol/l at the end of the study period. This dynamic shows a higher efficiency of CrossFit workouts compared to circuit training.

It is known that many specialists use Randori on a large scale to increase the fitness levels of judo wrestlers (Franchini, Del Vecchio, Ferreira Julio, Matheus, & Candau, 2015). However, the literature presents data on the insufficient effectiveness of Randori in the development of the physical fitness of judo wrestlers. Moreover, experts point out that the physiological requirements for meeting Randori differ from the requirements for intense competitive effects (Franchini et al., 2014). In our present study, an increase in fitness level was found in both athletes' groups who used Randori in the amount of 50–55 hours for 10 months. We consider a further increase of Randori volume for athletes of this age and qualification to be ineffective.

However, the dynamics of SJFT index changes in both athletes' groups show a significant improvement of indices of judo athletes' special physical fitness regardless of the training program. Scientists point out that the effectiveness of SJFT performance is directly related to the effectiveness of competitive matches (Kons, Ache Dias, & Detanico, 2017). Furthermore, athletes of Group 2 showed better results, which in our opinion indicates a high potential of CrossFit trainings in improving athletes' fitness. It was revealed that the results of studied athletes are somewhat inferior to the SJFT indicators

of junior foreign athletes (Agostinho, Olivio Junior, Stankovic, Escobar-Molina, & Franchini, 2018), but the differences are insignificant. Interestingly, the SJFT index indicators of young (16–17 years old) athletes compared with SJFT data of Russian older athletes (19–23 years old) (Osipov, Kudryavtsev, Iermakov, & Jagiello, 2018) turned out to be higher. In our opinion, a balanced program of CrossFit training (optimal choice of exercises and time interval of load) contributed to a higher result.

Comparison of CC data of the studied athletes with CC indicators of elite judoists from Russia and Kyrgyzstan of this weight category (up to 73 kg) have revealed a significant lag of young athletes of CC–1 (the number of Nage-waza techniques) from elite judoists. If young athletes perform 6.22 ± 0.17 technical actions of Nage-waza on average then elite athletes of this weight category perform 9.25 ± 0.41 judo techniques per duel. However, in terms of CC–2 (Ne-waza technique), young athletes of both groups significantly exceed the elite judo wrestlers. On average per match, the studied athletes perform 2.47 ± 0.19 receptions of Ne-waza, and the elite judo athletes perform only 1.41 ± 0.09 receptions. However, this advantage of young athletes cannot be explained only by CrossFit workouts. A significant advantage of CC–2 data over elite judoists was also found among athletes of Group 1 who have not used CrossFit in their pre-competitive and competitive training. It is possible that these results are explained by the tactical features of preparing athletes for dominance in the stalls.

It should be emphasized that the use of regular cross-trainings in the practice of young judoists seeking to join the competitive elite can significantly increase the combat activity of judo athletes in competitive matches (CC–3). A higher percentage of won matches (an average was more than 5%) was also found among athletes who have used CrossFit during the pre-competition and competitive training periods.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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