

The use of functional training – crossfit methods to improve the level of special training of athletes who specialize in combat sambo.

ALEKSANDER OSIPOV^{1,2}, MIKHAIL KUDRYAVTSEV^{1,3,4,5}, KONSTANTIN GATILOV¹, TATYANA ZHAVNER^{1,4}, YULYA KLIMUK¹, EKATERINA PONOMAREVA¹, ANNA VAPAEVA¹, POLINA FEDOROVA¹, EVGENY GAPPEL⁴, ALEKSANDER KARNAUKHOV⁴

¹Siberian Federal University, RUSSIA

²Krasnoyarsk State Medical University, RUSSIA

³Reshetnev Siberian State Aerospace University, RUSSIA

⁴Krasnoyarsk State Pedagogical University, RUSSIA

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Abstract:

The article is devoted to the search for effective methods of training effects on athletes specializing in combat sambo. It was revealed that the main criterion determining the success of combat sambo wrestlers in the competitive activity will be the level of their special training. Moreover, this training includes special endurance of athletes, active dynamics of competitive contests and the speed of recovery of fighters after intense training and competitive loads. Besides, to increase the level of special endurance combat sambo wrestlers significantly it was suggested to include in the training process of combat athletes the method of intensive functional training - crossfit. In a year of studies the tests on the evaluation of the level of recovery of combat athletes after a specific load showed that the athletes using the training method - crossfit in their training sessions demonstrated significantly ($P < 0.05$) the best recovery time after the load than the wrestlers who did not use this technique. These results allow us to recommend the methods of intensive functional training - crossfit to increase the level of functional fitness (special endurance) of athletes practicing mixed martial arts including combat sambo.

Key words: mixed martial arts; combat sambo; special endurance; methods of training; recovery speed; crossfit.

Introduction

Different types of martial arts are very popular among the population of different countries primarily youth (children, adolescents and boys). Today, many young people choose the lessons of mixed martial arts, the synthesis of shock and throw technique, painful and suffocating techniques for themselves. According to the experts opinion they refer to mixed martial arts: various types of hand-to-hand combat, kudo, combat sambo, wushu Sanda, pankration, jujitsu, etc. (Ashkinazi, & Bavykin, 2014). Many of these types of martial arts are used by specialists not only for the purpose of teaching martial arts but also as effective means of increasing the level of health and physical fitness of various groups of the population (Chyu, 2010). However, it should be recognized that these types of martial arts have only been developed recently and have not yet a significant scientific and methodological base for training and training athletes. E. Cherepov argues that modern mixed martial arts need an effective scientific and methodological base for conducting training sessions which includes all significant achievements in the field of sports science (Cherepov, & Shaikhetdinov, 2016). Since the technical actions of athletes in mixed martial arts represent receptions from various martial arts (boxing, wrestling, jujitsu, etc.) and there are significant difficulties in developing educational training programs for athletes (Lahti, 2016). Despite the growing popularity of mixed martial arts in the world there is a significant lack of research devoted to the physiological requirements for practicing such sports (Dopico-Calvo, Morenilla, et al., 2016). Practical activities of specialists and coaches in mixed martial arts are based mainly on their subjective preferences and existing teaching traditions (Lenetsky, & Harris, 2012). Completely this statement can be attributed to combat sambo. Consequently, combat sambo is a relatively young sport and the technique of training qualified athletes has not yet been fully explored. Specialists point out that there are quite significant differences in the technical and tactical arsenal of wrestlers specializing in sambo and combat sambo (Dadelo, Mečkovskis, & Štarevičius, 2013). There are many problems impeding the way of sports perfection of athletes specializing in combat sambo. For example, the imperfection of the current training program for officers and employees in the law enforcement agencies of the Russian Federation is described as a fascination with striking action in the rack and inadequate possession of effective protection methods lying on the ground (Osipov, Kudryavtsev, Galimova, et al., 2017).

According to scientists, one of the main problems facing specialists in the field of modern sports science is the search for effective ways to achieve meaningful sports results provided to preserve their health by athletes

(Osipov, Kudryavtsev, Iermakov, et al., 2017; Tropin, Romanenko, & Ponomaryov, 2016). Indeed, a significant obstacle to the successful solution of this problem is the constant increase in the volume and intensity of training and competitive loads of athletes. In full, the processes of a significant increase in the amount of training activities can be observed in sports and mixed martial arts including combat sambo. At present analysis of scientific research shows that specialists and trainers have concentrated their main efforts on organizing the training process in single combat in such a way as to maximize the level of functional fitness for athletes to compete (Zhang, Ashkinazi, et al., 2016). The scientists note the importance of constant monitoring and operational control over the level of physical activity received by athletes in various types of martial arts including sambo and judo (Osipov, Kudryavtsev, Fedorova, et al., 2017; Zebzeev, & Zdanovich, 2013). In the current conditions of sports development of athletes the process of their preparation should be based on prompt and accurate information about the level of physical condition of martial artists which makes it necessary to provide quality control over the effectiveness of training exercises (Tron, Ilyin, & Bitsyura, 2013). The lack of such control over the level of load received by wrestlers during intensive training leads to fatigue and impairment of the athletes' functional state in a short time (Osipov, Kudryavtsev, Kuzmin, et al., 2016). Monitoring the functional state of athletes is a very important aspect of their preparation for successful competitive activity as S. Iermakov says (Iermakov, Podrigalo, et al., 2016). Unfortunately, the systems used for assessing the functional reserves of combat athletes today are in need of improvement in order to optimize the loads of sportsmen specializing in mixed martial arts (Pryimakov, Iermakov, et al., 2016).

Thus, the research of the authors of the article is devoted to the search for effective ways to increase the level of special preparedness of athletes specializing in combat sambo. To the special preparedness of combat sambo-wrestlers, the specialists include the level of special endurance of the martial artists, the ability to actively (saturated with various technical actions) conducting competitive fights, the speed of recovery of athletes after intensive training and fights. The speed of recovery of an athlete after an extremely intense training is one of the main parameters for assessing the level of preparedness of a single combatant as E. Bavykin says (Bavykin, 2014). The ability to maximize the number of moves in a competitive match is one of the important indicators which are necessary for predicting the success of athletes in mixed martial arts (Podrigalo, Iermakov, et al., 2017). Undoubtedly, in order to increase these indicators combat athletes need to use modern methods of intensive functional training in the training process. The authors of the article consider the possibility of using the functional training methodology - crossfit in the training process of combat athletes practicing combat sambo. It's not a secret that crossfitting today is one of the most popular training programs for the physically active population of our planet (Sprey, J., Ferreira, T., et al., 2016; Osipov, Kudryavtsev, Kramida, et al., 2016). Originally this type of functional training was developed for the needs of military units and gradually spread to the civilian population. The training is based on the implementation of complexes of various exercises, including running, weightlifting, gymnastics and ballistic exercises (Glassman, 2007). We must admit that the experts say that all exercises are performed quickly, in certain series with a time limit or without any recovery time between the series. Specialists report quite significant improvements in the level of functional readiness of people using crossfit in their training sessions (Waryasz, et al., 2016). In view of the above, good indicators of muscle mass gain, increased bone density, significant myocardial dilatation were also revealed (Eremin, Volkov, & Seluyanov, 2014).

Material & methods

The research was carried out in the Academy of wrestling named after D.G. Mindiashvili (Krasnoyarsk) with two groups of sportsmen practicing in combat sambo. Moreover, the duration of the study was during 1 year. The total number of athletes participating in the research was 60 people. The sports qualification of the candidates is the candidate for master of sports (n = 41) and the master of sports of the Russian Federation (n = 19) in judo, sambo and combat sambo. However, it should be noted that the age of athletes is about 20-21. The experience of wrestling is 7-8 years. For the study all athletes were divided into 2 equal groups: group 1 - experimental (n = 30) and group 2 - control (n = 30). The fighters were trained according to the training program for combat sambo wrestlers operating at the wrestling academy. This program includes daily training sessions lasting for 2-2.5 hours including the study and improvement of techniques for punching and kicking, techniques of standing and lying fighting techniques, training fights (sparring) and physical preparation for competitive activities. Physical training includes training in the gym (2 days a week for 1.5 hours) aimed at developing the maximum muscle strength of combat athletes and training aimed at developing special endurance athletes to intense competition fights: circular and interval training (2 days per week for 1 hour). These exercises are a set of different tasks (power or gymnastic exercises) performed by athletes for a certain time (10 minutes) with equal rest intervals (5 minutes) between series of exercises. The control group of martial artists continued training on this program. By the way, the experimental group of athletes was asked to replace the circular and interval training with the functional training method - crossfit. This type of training included the most effective exercises for athletes specializing in mixed martial arts. Specialists attribute such exercises to jerking and jerking (16, 24 and 32 kg) squats with a bar on their shoulders (from 80% of their own body weight), squats on one leg,

jumps on stands (from 50 to 120 cm), Sprinting, weight lifting (running with a partner on the shoulders), rope climbing on speed, etc. (Galimova, et al., 2017). The exercises were performed in series (the duration of each series was 5 minutes - the time of the competitive duel in combat sambo) with rest intervals between each series which are not more than 5 minutes. According to the rules of the Sambo and Combat Sambo competitions the rest interval between competitive fights is at least 5 minutes and during this time the wrestler must have time to regain his strength. It should be noted that the rest interval between the series of exercises is gradually decreased by 10-15 seconds every month. Thus, in 6 months of exercise interval between the series of exercises was 4 minutes and at the end of the study was 3 minutes.

Assessment of the level of adaptation of athletes to training and competitive loads should occur through informative, reliable and accurate assessment methods: tests, indices and functional samples (Podrigalo, Iermakov, & Jagiełło, 2017). Both Russian and foreign experts propose to use special tests which are the fulfillment of throws both wrestling mannequins and one or several wrestlers for a qualitative assessment of the level of special endurance of combat athletes for a certain time (Zebzeev, & Zdanovich, 2013, Drid, Trivic, & Tabakov, 2012). In our studies, a special judo fitness test was used by S. Sterkowicz (Sterkowicz, & Franchini, 2001). The assessment of the athletes' special endurance level was carried out using a classification table developed by E. Franchini (Franchini, Del Vecchio, & Sterkowicz, 2009). A test was also used to determine the level of special endurance of athletes specializing in percussion technique (boxing, kickboxing, etc.) (Osipov, Nizhegorodtsev, Ostanin, et al., 2013). The given test consisted in performance by sportsmen of the greatest quantity of power impacts on a boxing bag within 3 minutes (Gaskov, & Kuzmin, 2011). The tested athletes recorded heart rate both before the test and during the recovery period before the heart rate returned to normal. The frequency of heart rate (pulse dynamics) according to many experts is quite informative and accessible characteristic of assessing the level of the functional state of athletes and the body's response to physical stress of varying intensity (Qiang, 2015; Romanov, Vasil'kov, et al., 2015).

Conducting studies on the control over the level of the functional state of combat athletes through the registration and subsequent evaluation of the electrocardiogram are recommended by many experts. A. Zavyalov recommends the use of ECG control in free and Greco-Roman wrestling (Zavyalov, et al., 2007) and A. Osipov controlled the dynamics of functional changes with the help of an electrocardiogram in sambo and judo wrestlers (Osipov, Kudryavtsev, Kuzmin, et al., 2016). In our studies, all the athletes underwent a standard test of assessing the level of the functional state and the body's response to physical stress. This test is the performance of the test run in place for duration of 3 minutes with a running speed of at least 180 per minute. All the examined athletes registered an electrocardiogram during the rest immediately after exercise by the wrestlers and during every minute of the entire recovery period (5 minutes). This test is widely used to assess the level of functional status of athletes specializing in different sports (Osipov, 2007). Periodic monitoring of the cardiovascular system allows to prevent the development of pathological conditions and to objectively assess the level of myocardial adaptation to physical stress by electrocardiography (Podrigalo, Volodchenko, Rovnaya, et al., 2017).

Statistical analysis of the results of the study was carried out using the program SPSS20. The reliability of differences in the results of the mean values in two interrelated samples was determined using Student's t-test.

Results

It turned out that the results of tests indicate a certain increase in the level of special endurance in martial artists both the control group and the experimental group. The recovery time of athletes after specific loads decreased in all tests.

The recovery intervals after the performance by athletes of both groups of special judo fitness tests at the initiation of the studies averaged: 2.06 ± 0.04 minutes in the wrestlers of the control group and 2.08 ± 0.06 minutes in the wrestlers of the experimental group. At the end of the study the recovery intervals were: 1.47 ± 0.03 minutes for the control group athletes and 1.44 ± 0.05 minutes for the fighters of the experimental group. Statistical analysis of the results of this test did not allow the authors to reveal statistically significant differences.

Moreover, the recovery time of the athletes of both groups after performing the test with applying the maximum number of power strikes at the boxing bag at the beginning of the study was: 2.29 ± 0.05 minutes for the athletes of the control group and 2.24 ± 0.08 minutes for the combat athletes of the experimental group. At the end of the study the results slightly decreased in the control group - 2.17 ± 0.08 minutes and significantly improved in the athletes of the experimental group - 2.03 ± 0.06 minutes. The difference between the mean values of the recovery intervals in the Sambo wrestlers of both groups was statistically significant ($P < 0.05$).

However, the recovery intervals of the athletes after the standard test of assessing the body's reaction to physical activity (running on the spot for 3 minutes with a certain frequency of running steps) at the beginning of the studies were: 3.41 ± 0.06 minutes for the wrestlers of the control group and 3.49 ± 0.08 minutes for the athletes of the experimental group. At the end of the study, the recovery intervals for the athletes decreased: 3.32 ± 0.05 minutes for the wrestlers of the control group and 3.12 ± 0.04 minutes for the combat athletes of the

experimental group. Analysis of the results allowed to reveal a statistically significant difference ($P < 0.05$) between the data of athletes of the experimental and control groups.

An important point is that the main results of the authors' studies are presented in Table 1.

Table 1. The recovery time after the control tests of the examined combat athletes at the initiation and at the end of the studies.

Combat athlete (n=60)	Judo fitness test		Test with punching		Standart test	
	Initiation of study	End of study	Initiation of study	End of study	Initiation of study	End of study
Group №1 (n=30)	2.08±0.06	1.44±0.05*	2.24±0.08	2.03±0.06**	3.49±0.08	3.12±0.04**
Group №2 (n=30)	2.06±0.04	1.47±0.03	2.29±0.05	2.17±0.08	3.41±0.06	3.32±0.05

Note. * - Inaccurately, ** - accuracy- $P < 0,05$

Discussion

According to the results of the research prove how important it is to use the techniques of intensive functional training of sport-martial arts practitioners and the need for qualitative changes in the scientific and methodological base of the existing training process in mixed martial arts in particular in combat sambo. The speed of recovery of athletes after intense training and competitive loads is one of the most important factors for achieving success in competitive activities (Osipov, Kudryavtsev, Kuzmin, et al., 2016; Bavykin, 2014). Unfortunately, the research data show that athletes training in sports programs for combatants in the sports schools did not demonstrate significant improvements in the recovery rates of the cardiovascular system after specific test loads. Similar results of the wrestlers of the control group clearly indicate the need to make changes in the training program for athletes in order to improve their level of functional preparedness. However, many trainers ignore the data of the latest scientific research and create a training process either on the basis of traditional methods of teaching some kind of martial arts (boxing, wrestling, judo, karate, etc.) or guided by one's own preferences or skills. It is important to remember that the those specialists, who have experience of practicing various types of wrestling, conduct training guided by the basic training of wrestlers and experts with experience in boxing or Thai boxing train athletes using the training base for fighters. An analysis of the level of technical preparedness of Russian police officers for the successful counteraction to armed criminals has shown that there is a clear separation in the training programs for police officers for shock and throwing equipment with a clear predominance of percussion techniques in the performance of combat techniques. This is because most specialists training police officers themselves specialized in various types of shock martial arts (Osipov, Kudryavtsev, Galimova, et al., 2017).

Actually, if we carefully consider the organization of the process of training and training athletes specializing in combat sambo in the Russian Federation it can be found that most athletes and combat sambo trainers come from sports sambo and judo. Naturally, these specialists organize the training process taking into account their own experience of practicing judo or sambo. But experts say that the process of competitive training of wrestlers of sambo and judo has significant differences from the training of combat sambo wrestlers (Dadelo, Mečkovskis, & Štarevičius, 2013).

In fact, it is recognized that one of the significant differences, according to the authors of the article, will be a different style of conducting competitive fights in sports and combat sambo. If in a sport sambo a duel is a match of two wrestlers performing only certain fighting techniques so then in combat sambo the shock equipment is added to the throws and techniques. The intensity of combat in combat sambo significantly increases and the level of stress on the cardiovascular system of athletes is also increasing. Accordingly, the method of training athletes specializing in combat sambo must differ somewhat in the direction of purposeful development of martial arts at the level of special endurance to intense competitive influences. Unfortunately, most trainers practice the methods of training influence which are for the preparation of classical wrestlers - athletes using only the technique of throws and restraints of an opponent. The level of special training (functional readiness and recovery after performing throws) in these athletes is quite high. At the same time, the results of the tests show that the level of recovery in martial artists both experimental and control groups after performing a special judo fitness test is approximately the same.

By the way, quite a different dynamics of the recovery of martial artists of both groups is observed when the athletes perform tests with blows on the boxing bag and running on the spot with high intensity. Since these loads are not typical for the wrestling match athletes training in the training program for sports combatants show significantly lower recovery rates after loads than athletes using intensive functional training techniques - crossfit. According to experts, a significant shortage of modern and effective functional training techniques can be observed today in many martial artists (Osipov, Kudryavtsev, Struchkov, et al., 2016). It should be noted that the use of methods of functional training - crossfit will allow fighters not only to increase the level of functional readiness but also to increase the level of development of other physical qualities, for example, strength.

Indicators of muscle strength are of great importance for athletes practicing different types of mixed martial arts as L. Podrigalo argues (Podrigalo, Iermakov, et al., 2016).

At the same time, there are scientific studies that do not recommend the use of intensive functional training methods - crossfit in daily training. It is advisable to allocate special days for such training (Mullins, 2015). In addition, studies show that targeted training influences using the training method – crossfit and they have a positive effect in two 60-minute sessions per week. The ECG test readings indicate an improvement in the level of recovery of athletes using cross-training after they perform a test load without impairing their functional state.

Conclusions

However, analysis of the scientific literature shows that there is a contradiction associated with the rapid growth of the popularity of mixed martial arts including combat sambo and the lack of a scientific and methodological base on effective training activities of athletes. Specialists point out that the activity of many coaches in mixed martial arts is not based on significant scientific and methodological material but on subjective preferences and existing traditions of different schools. Further research is needed to find ways to improve the effectiveness of the training process and the competitive activity of athletes practicing various mixed martial arts. It should be noted that particular attention should be paid to the development of quality and effective methods to improve the level of special preparedness of martial artists for competitive activities. According to the authors opinion a significant increase in this level is possible only with the competent use of intensive functional training techniques in the training process. Studies show that the functional training methods - crossfit allow athletes to increase the level of special endurance significantly to the loads specific for athletes who practice mixed martial arts.

References

- Ashkinazi, S., & Bavykin, E. (2014). Improvement of system of special physical training of athletes of complex (mixed) martial arts. *Teoriya I Praktika Fizicheskoy Kultury*, 6. 94-98.
- Bavykin, E. (2014). Speed and strength training as a base of special physical training in complex martial arts. *Teoriya I Praktika Fizicheskoy Kultury*, 2. 20-22.
- Cherepov, E., & Shaikhetdinov, R. (2016). Effectiveness of functional training during physical conditioning of students practicing martial arts. *Journal of Physical Education and Sport*, 2. 510-512. DOI:10.7752/jpes.2016.02079
- Chyu, M. (2010). A non-competitive martial arts exercise program for health and fitness in the general population. *Journal of Human Sport and Exercise*, 5(3). 430-443. DOI:10.4100/jhse.2010.53.13
- Dadelo, S., Mečkovskis, A., & Štarevičius, E. (2013). Sports and combat sambo exposure and differences in stage-activity. *Education. Physical Training. Sport*. 89(2). 12-18.
- Dopico-Calvo, X., Iglesias-Soler, E., Morenilla, L. et al. (2016). Laterality and performance in combat sports. *Archives of Budo*, 12. 167-177.
- Drid, P., Trivic, T., & Tabakov, S. (2012). Special judo fitness test – a review. *Serbian Journal of Sport Science*, 6(4). 117-125.
- Eremin, S., Volkov, V., & Seluyanov, V. (2014). Test of physical working capacity in crossfit. *Teoriya I Praktika Fizicheskoy Kultury*, 6. 24-26.
- Franchini, E., Del Vecchio, F., Sterkowicz, S. (2009). A special judo fitness test classificatory table. *Archives of Budo*, 5(1). 127-129.
- Galimova, A., Kudryavtsev, M., Glubokiy, V., et al. (2017). Rationale for the content of crossfit as high-intensity multifunctional training. *Vestnik Buryatskogo gosudarstvennogo universiteta*, 1. 143-148. [In Russian] DOI:10.18101/1994-0866-2017-1-143-148
- Gaskov, A., & Kuzmin, V. (2011). Modeling the structure of the overall training facilities and training of skilled boxers. *Physical education of students*, 6. 22-26.
- Glassman, G. (2007). Understanding CrossFit. *Crossfit Journal*, 56. 1-2.
- Iermakov, S., Podrigalo, L., Romanenko, V., et al. (2016). Psycho-physiological features of sportsmen in impact and throwing martial arts. *Journal of Physical Education and Sport*, 2. 433-441. DOI:10.7752/jpes.2016.02067
- Lahti, J. (2016). Sports analysis, training considerations and applied methods for Mixed Martial Arts. Coaching seminar LBIA028. Department of Biology of Physical Activity, University of Jyväskylä. 92 p. <https://jyx.jyu.fi/dspace/bitstream/handle/123456789/49013/Lahti%20Johan.pdf;sequence=1>
- Lenetsky, S., & Harris, N. (2012). The mixed martial arts athlete: A physiological profile. *Strength & Conditioning Journal*, 34(1). 32-47. DOI:10.1519/SSC.0b013e3182389f00
- Mullins, N. (2015). CrossFit: Remember what you have learned; apply what you know. *Journal of Exercise Physiology*, 18(6). 32-44.

- Osipov, A., Kudryavtsev, M., Galimova, A., et al., (2017). Analysis level of the special proficiency of cadets and officers of the Internal Affairs authorities of the Russian Federation to the physical interdictory effort by criminals. *Journal of Physical Education and Sport*, 2. 602-607. DOI:10.7752/jpes.2017.02091
- Osipov, A., Kudryavtsev, M., Iermakov, S., et al. (2017). Topics of doctoral and postdoctoral dissertations devoted to judo in period 2000-2016 – the overall analysis of works of Russian experts. *Archives of Budo*, 13. 1-10.
- Osipov, A., Kudryavtsev, M., Fedorova, P., et al. (2017). Comparative analysis of the scientific views of Russian and foreign scientists on the problem of training skilled judo wrestlers. *Journal of Physical Education and Sport*, 1. 288-293. DOI:10.7752/jpes.2017.01043
- Osipov, A., Kudryavtsev, M., Kramida, I., et al. (2016). Modern methodic of power cardio training in students' physical education. *Physical education of students*, 6. 34-39. DOI:10.15561/20755279.2016.0604
- Osipov, A., Kudryavtsev, M., Struchkov, V., et al. (2016). Expert analysis of the competitive level of young Russian judo athletes who train for active attack fighting. *Journal of Physical Education and Sport*, 4. 1153-1158. DOI:10.7752/jpes.2016.04185
- Osipov, A., Kudryavtsev, M., Kuzmin, V., et al. (2016). Methods of operative and informative control of the muscle loading level used during the training of sambo wrestlers. *Journal of Physical Education and Sport*, 4. 1247-1252. DOI:10.7752/jpes.2016.04198
- Osipov, A., Nizhegorodtsev, D., Ostanin, Yu., et al. (2013). Research of the efficiency of various methods of endurance development at young boxers. *V mire nauchnykh otkrytiy*, 7.1(43). 111-123. [In Russian]
- Osipov, A.Yu. (2007). Estimation of athletes' condition on basis of ECG-control. *Teoriya I Praktika Fizicheskoy Kultury*, 7. 46-49.
- Podrigalo, L., Iermakov, S., & Jagiełło, W. (2017). Special indices of body composition as a criterion of somatic development of martial arts practitioners. *Archives of Budo Science of Martial Arts and Extreme Sports*, 13. 5-12.
- Podrigalo, L., Iermakov, S., Potop, V., et al. (2017). Special aspects of psycho-physiological reactions of different skillfulness athletes, practicing martial arts. *Journal of Physical Education and Sport*, 2 (Supplement issue). 519-526. DOI:10.7752/jpes.2017.s2078
- Podrigalo, L., Volodchenko, A., Rovnaya, O., et al. (2017). Analysis of adaptation potentials of kick boxers' cardio-vascular system. *Pedagogics, psychology, medico-biological problems of physical training and sports*, 21(4). 185-191. DOI:10.15561/18189172.2017.0407
- Podrigalo, L., Iermakov, S., Alekseev, A., et al. (2016). Studying of interconnections of morphological functional indicators of students, who practice martial arts. *Physical education of students*, 1. 64-70. doi:10.15561/20755279.2016.0109
- Pryimakov, O., Iermakov, S., Kolenkov, O., et al. (2016). Monitoring of functional fitness of combat athletes during the precompetitive preparation stage. *Journal of Physical Education and Sport*, 2. 551-561. DOI:10.7752/jpes.2016.02087
- Qiang, L.Y. (2015). Operative correction of judoists' training loads on the base of on-line monitoring of heart beats rate. *Physical Education of Students*, 2. 13-21. <http://dx.doi.org/10.15561/20755279.2015.0203>
- Romanov, V., Vasil'kov, I., Vasil'kov, A., et al. (2015). Ways to determine intensity of exercise in competitive matches of combat sambo wrestlers. *Teoriya I Praktika Fizicheskoy Kultury*, 6. 69-70.
- Sprey, J., Ferreira, T., de Lima, M., et al. (2016). An epidemiological profile of crossfit athletes in Brazil. *Orthopedic Journal of Sports Medicine*, 4. 2325967116663706. DOI:10.1177/2325967116663706
- Sterkowicz, S., & Franchini, E. (2001). Specific fitness of elite and novice judoists. *Journal of Human Kinetics*, 6. 81-98.
- Tron, R.A., Ilyin, V.N., & Bitsyura, R.V. (2013). Control of physical fitness of athletes specializing in combat sambo. *Pedagogics, psychology, medico-biological problems of physical training and sports*, 10. 80-83. DOI: 10.6084/m9.figshare.775334
- Tropin, Yu., Romanenko, V., & Ponomaryov, V. (2016). Model characteristics of sensory-motor reactions and perceptions of specific wrestlers of different styles of confrontation. *Slobozhanskyi Herald of Science and Sport*, 3(53). 70-73.
- Waryasz, G., Suric, V., Daniels, A., et al. (2016). CrossFit® instructor demographics and practice trends. *Orthopedic Reviews (Pavia)*, 8(4). 6571 eCollection. DOI:10.4081/or.2016.6571
- Zavyalov, A.I., Zavyalov, D.A., & Zavyalov, A.A. (2007). Biopedagogics - Base of Sports Training. *Teoriya I Praktika Fizicheskoy Kultury*, 7. 56-58.
- Zebzeev, V.V., & Zdanovich, O.S. (2013). Analysis of special fitness of junior judokas. *Teoriya I Praktika Fizicheskoy Kultury*, 2. 13.
- Zhang, X., Ashkinazi, S., Bavykin, E., et al. (2016). Effects of interval training modes on development of special physical qualities of athletes involved in hand-to-hand fighting. *Archives of Budo Science of Martial Arts and Extreme Sports*, 12. 131-138.