

Author's methodology for the express testing of combat athletes from the Kazakhstan Olympic WKF karate team

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Abstract

The purpose of this study is to develop an effective method of express testing to correct the functionality and to stabilize the performance of member athletes from the national World Karate Federation (WKF) karate team of the Republic of Kazakhstan (RK) during training and competition activities. When forming the author's express testing methodology, to control the functionality of karate athletes using the latest generation of heart rate monitors, the authors for the first time in Kazakhstan developed a methodology for testing combat athletes practicing WKF karate and prepared recommendations for using the sum of heart rate figures as a factor reflecting the objective amount of functional exertion of karate athletes to stabilize athlete performance.

The obtained data show that the innovative method declared by the authors, which describes the functioning of the training process through the creation of digital databases, allows to more objectively coordinate the methods of training athletes to participate in the most important sports events including the Olympics.

Key Words: standard and maximum tests, heart rate sum, diagnostics, correction of the functionality and performance of karate athletes

Introduction

The basic research concepts were analysed after studying physiological, psychological and pedagogical, sociological methods, special literature, regulatory documents, and analytical scientific sources, which were then summarized. Next, the obtained data were interpreted, and scientific research and experiments were conducted. The main methodological sources included theoretical works of well-known high-performance sport scientists.

In modern high-performance sports, training and competition activities of high-performance athletes imply considerable physical exertion. If the training process is arranged improperly, exertion leads to overstraining, chronic and excessive fatigue, which decreases the performance and immunity of athletes. The methodologies of testing athletes when teams are formed and when their competition potential is preliminarily planned are important training factors (Chaabene et al., 2019). The first factor refers to high-performance sports, where the performance of an athlete or the team is not only important for the rating but extends to the development level of the entire country and nation, especially when athletes show their performance in competitions such as the Olympics.

For any country, the major sporting event, which occurs every four years, requires a scientific approach not only from the point of view of tactical training of a team (Zadorozhna et al., 2020). In terms of social and political issues, athlete performance is important in the sphere of national priorities and helps update research in this area. At least one of the reasons for this is that "...global competition in sports will constantly intensify, which requires developing high-tech approaches to the development of high-performance sports that are based on using the latest achievements in science and practice..." (Zakiryaynov, 2013). Beyond that, we conducted research and experiments according to the author's methodology for express testing of combat athletes from the Kazakhstan Olympic World Karate Federation (WKF) karate team. We relied on scientific materials published by various karate scientists and specialists from other countries.

Materials and Methods

This research and performed experiments were aimed at developing author's methodology for the express testing of karate athletes from the RK national Olympic team using innovative practices, modern technologies and devices.

To develop the author's express tests, the materials based on modern theoretical knowledge and physiology, anatomy, and biomechanics were used (Barbeta et al., 2017) in addition to many years of experience of renowned masters, coaches, and researchers of sports karate. The research experiments involved 25 lead athletes from the national and youth team; however, of note, there is a difference in performing specific combat techniques depending on age (Rakita et al., 2018).

The participants were selected on the basis of differences in the anthropometric profile of performance (Koropanovski et al., 2011) and on the well-known fact that professional karate athletes have a higher physical level (Chaabène et al., 2012).

The test group did not include any female athletes. This gender-based division was used because male athletes make more intensive movements compared to female athletes (Tabben et al., 2014, Senturk, 2017).

There are two disciplines in karate, i.e., kata and kumite. Athletes from each category have distinctive features such as metabolic power (Doria et al., 2009).

Kumite representatives participated in the tests.

The research was conducted both during training camps and competition activities, as suggested by the plan of training for international rating tournaments, which are qualifying completions for the Olympics in Tokyo.

Starting from 2016, owing to the changed requirements for the regulations of competition activities, especially with respect to pre-Olympic licensed tournaments, it became necessary for the Republic of Kazakhstan national team karate athletes to develop a special methodology for testing combat athletes.

Specifically, two problems had to be solved:

- first, to accurately monitor the dynamics of athletes' fatigue to take preventive measures to correct and stabilize the performance;
- second, to develop and implement an updated modern methodology for express testing to control not only the functional capabilities but the recovery of combat athletes, which are subject to a considerable increase in the number of pre-Olympic rating competitions in each calendar year.

The approach and work plans were specific for each athlete. New methodologies of the training process were introduced, and complex medical and biological examinations were conducted on a regular basis.

During the analysis, a psychological aspect affecting athlete's condition was taken into account and was an important part of research (Vesković et al., 2019; Zharko et al., 2019).

Research tasks:

1. Developing author's methodology for express testing using the latest generation of heart rate monitors to control the physiological parameters of karate athletes' bodies.
2. Identifying optimum conditions and prospects of ensuring the systems of control over the restoration of physiological functions and stabilization of the performance of athletes' bodies.
3. Correlating the need for high-quality management of scientific experiments with the solution of tasks for the successful participation of the RK national WKF karate-do team in the Olympics.

Research Methods

At the modern stage of development of high-performance sports, achievements in theory and methodology are essential and allow to solve various problems that emerge during sports improvement.

In this study, testing of athletes was organized using modern Polar heart rate monitors, which allow to control and compare the initial and final levels of training of the experiment participants and to transfer data directly to the device. In addition, the data obtained during all training sessions as well as the corresponding places and dates were saved in the created digital database using special applications. Some applications allowed researchers to analyse the data of karate athletes during different cycles and periods of their activities (i.e., training, competition, and transitional).

The main task to be solved during the experiments was the quick and high-quality control of athletes' functional system during training sessions as well as between and after simulated fights. Compared to previous research works (Loturco et al., 2016), this study was conducted during training sessions using the Polar team software program; then, the results were used in practice. When the data of study participants (age, weight, and height) were entered, the software identified the limit heart beats per minute.

Then, depending on the training exertion experienced by a combat athlete, the software automatically determined the impulse zone that the condition of athlete's body corresponded to at a particular training stage.

Based on the obtained information, the coaches of the RK national WKF karate team were able to plan the scope of training for all its participants and at the same time coordinate the functional capabilities of each athlete individually. Based on the time of stabilization of the heart rate, which ranged from increased to normal, the training effectiveness was assessed in real-time.

According to WKF, the test time corresponds to the official time, i.e., 3 min. The length of one exercise is 15 s, and the rest time in between is 10 s. Because the minimum time for active actions is 0.3 s (Ates, 2018), the total time of the test exercise is 15 s.

Standard and maximum express tests were used that are inherent in the sports qualification of the athletes and the level of their preparedness. The information value of tests and their interrelation with the proficiency of the athletes was observed. The studies showed that the qualification of an athlete and his/her performance were directly related to the speed of recovery reactions of the body. Before the research experiments started, standard and maximum express tests for national team karate athletes were developed, which facilitated the involvement of a large muscle bulk in exercising. In addition, the parameters, length, and contents of such tests were determined (Table 1).

Table 1. Parameters of the developed standard and maximum tests

Exercise No.	Brief description of the test exercise	Standard test		Maximum test	
		Q-ty (times)	Rest (s)	Time (s)	Rest (s)
1	Loop Starting position (SP) – Front support position. Alternately pull your legs with the knees to the chest and return them to the starting position.	20	10	15	10
2	High knee running SP – Main stance. Alternately raise your right and left hips. The arms are bent at the elbows and move opposite to the movement of the legs.	60	10	15	10
3	Left hand punches SP – Right-hand stance. The arms bent at the elbows are raised at shoulder level. Make short punches with your left hand in front.	35	10	15	10
4	Crunches SP– Lying on the back. The feet are shoulder-width apart and bent at the knees. The hands are extended above the head. Raise your body and touch the floor between the legs with your hands.	15	10	15	10
5	Push-ups SP – Front support position. Bend and stretch your arms until your chest touches the floor and back.	20	10	15	10
6	Right hand punches SP – Left-hand stance. The arms bent at the elbows are raised at shoulder level. Make short punches with your right hand in front.	35	10	15	10
7	Burpees SP – From the standing position, sit down and rest your hands on the floor, while moving your legs back and taking the plank position with straight arms. From the plank position, quickly pull your legs to your arms in a jump. Stand up and quickly jump as high as possible, while clapping your hands above your head. Return to the starting position.	8	10	15	10
8	Jumping out of the half-squat position SP – The legs are shoulder-width apart. The back is straight. Make a half-squat while inhaling; then, make a powerful jump as high as possible while exhaling. The hips should be as springy as possible. After your feet touch the floor, take the starting position.	20	10	15	10

Results

In WKF karate, which has been recently qualified for the Olympics, the success of attacking actions depends on how quickly they are performed subject to compliance with the required amplitude and speed of attacking movements as well as the target accuracy of finishing hitting movements. All of the abovementioned qualities mostly depend on the capabilities of the functional condition of an athlete's body. In sports science, the heart rate is most often expressed in conditional points. However, in practice, the best expression of practice intensity is the real heart rate value (which is measured immediately after the training task is performed), the lactate concentration in blood, heart rate beat, ventilation, and oxygen consumption (Güler et al., 2018). Similar data were obtained during the express testing of athletes of the RK national team in 2019–2020 using a Polar heart rate monitor.

As part of the standard test, all heart rate data were summed up during practice because they objectively reflected the functionality of an athlete. If an athlete showed a low heart rate sum, it was easy for him/her to practice. If the heart rate sum for 3 min was 500 beats and after some time decreased to 450 beats, this indicated the increased capabilities of the oxygen transport system, and anaerobic capabilities of the body were mostly involved in practice; thus, the training process was beneficial. The recovery process of combat athletes was also tested according to the heart rate.

Below is an example of calculating the heart rate sum in the express test; the test lasts 3 min; the recovery time is 5 min; the total time is 8 min. Let us assume that the initial heart rate before the test is 80 beats per minute; then, the initial heart rate sum (80×8) is 640 beats. During the test (3 min), the heart rate figures corresponded to 140, 180, and 190 beats per minute. Thus, the heart rate sum is 510 beats.

During the recovery process (5 min), the heart rate per minute was as follows: 180, 160, 140, 120, and 100. The final sum during the recovery period is 700 beats. The total heart rate during the test and recovery is 1210 beats. Then, let us deduct the initial sum of 640 from this sum. The result (i.e., 570) correlated with the oxygen debt, lactate concentration, and cardiac output of blood. If the heart rate figures started to grow, we changed the focus of training, switched to technical practice and to practice to improve coordination and flexibility, which reduced the overall functional exertion. After one week, we again conducted tests and, as a rule, observed the decreased heart rate, which indicated the recovery of the functional mechanisms of an athlete's body. Therefore, the heart rate sum of heart beats is an important informative figure, which is used to assess the functional capabilities of an athlete.

Athletes who achieved higher results are known to have certain characteristics (Chaabene et al., 2012).

When we offered large training programs, even high-performance athletes felt an accumulated fatigue. If the fatigue was visible, decreased performance was noted; signs of excessive fatigue appeared, and the sleep and general wellbeing became worse. The initial signs of excessive fatigue are rather latent. The methodology for express testing developed by the author allowed to catch decreased performance 2–3 weeks before the first signs of excessive fatigue are obvious and to prevent it thereafter by changing the focus of practice or decreasing exertion. Therefore, the control over the bodies of karate athletes using express tests is essential. In this combat sport, there are no simple mechanisms of control over athletes. Owing to such mechanisms, we can see that an athlete is not able to practice to the full extent. Thus, the focus of exertion on the transport system of the heart and on everything related to the disposal of waste products of muscle activities should be changed. The theoretical and psychological make-up, studying of main rivals, watching of videos to view technical elements, and compensatory qualities should be also employed (Table 2).

Table 2. Results of the tests conducted using modern heart rate monitors when studying the RK national WKF karate team athletes in 2020

Sequence number	Figures of express tests using heart rate monitors (heart rate sum)							
	Experiment I		Experiment II		Experiment III		Experiment IV	
	08.01.2020	15.01.2020	17.01.2020	23.01.2020	28.01.2020	12.02.2020	18.02.2020	27.02.2020
1	542	556	521	516	497	481	489	473
2	551	563	560	573	567	543	524	496
3	607	620	624	631	628	619	603	585
4	549	558	537	559	540	543	536	520
5	630	652	546	532	534	509	528	539
6	590	601	578	565	571	569	577	594
7	534	547	542	548	545	552	541	565
8	628	639	619	624	623	617	611	597
9	632	645	635	620	629	637	623	609
10	640	659	662	677	663	650	637	647
11	619	634	632	631	637	645	641	623
12	625	643	639	644	641	627	619	604
13	637	646	636	640	635	621	624	618
14	650	672	668	661	653	641	635	614
15	629	641	625	633	617	594	612	636
16	646	527	674	679	661	642	652	668
17	639	652	645	653	642	637	610	644
18	642	661	650	638	645	673	656	641
19	634	658	662	675	670	668	658	643
20	623	640	631	626	621	602	615	638

21	652	669	682	697	687	664	674	665
22	651	676	673	662	658	635	629	647
23	654	673	668	682	677	692	667	675
24	669	682	674	665	692	686	673	664
25	651	673	692	684	697	665	653	686

Conclusions

Practical studies showed that the author's standard and maximum express tests were short-term but objective. Their advantage over other research methods is the use of simple tools, which do not prevent athletes from moving and allow to obtain data on several participants at a time. At the same time, obtaining data on the minute volume of blood, maximum oxygen consumption, and lactate concentrate requires more complicated and bulky tools.

This is the reason why a rather simple mechanism of testing the functional capabilities of karate athletes was offered. Conducting such tests for a long period of time allows to continuously correct the heart rate sum and, thus, the heart rate during both practice and recovery.

The express testing methodology developed by the research authors allowed to rather reliably manage the mechanism of athletes' performance and to correct the training process in the context of both the amount of exertion and change in energy supply systems of the karate athletes' body. According to the heart rate monitor readings, we managed to monitor the figures of body's energy supply system and, if needed, to change the focus of the training process.

This, in turn, considerably extended the range of using the new generation of heart rate monitors in high-performance sports.

The experiments confirmed that to prevent the athletes' body from getting used to the tests, we should:

- Offer exercises that are specific but customary and do not require additional training.
- Apply motor actions that achieve a given standard and maximum exertion (e.g., high-tempo squats or jumping up, general basic strikes on makiwara or a bag; these actions are generally well mastered and do not require an athlete to show high technical qualities).

- Only one rule should be followed, i.e., to ensure the standard nature of the offered tests that identify the level of performance using a heart rate monitor as well as emerging fatigue and adaptation of recovery reactions.

Thus, the author's tests allow to record the heart rate itself as a mechanism to control the performance, recovery reactions and prevention of such conditions as overtraining and excessive fatigue.

This test can be tied to all structures of training and competition processes, to any period, and to any training stage. Moreover, there is an opportunity to knowingly load an athlete by creating additional stress to adapt his/her body to recovery. However, the level of exertion should be reduced before competitions and brought to the initial level. This approach allows karate athletes to be best-trained for competitions.

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