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Short notice
Kratko saopštenje

Differences in Functional Abilities in Junior Karates in the Pre-Competition and Competition Period

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Abstract: *The sample of respondents on whom this research was conducted consists of 14 male junior athletes (karatists), potential representatives from the Republic of Kosovo. The research was conducted within the framework of the preparatory and pre-competitive period for participation in the Karate World Championship. The potential representatives who entered the sample of respondents were active competitors who participated in the national championship and premier leagues organized by the World Karate Federation WKF (World Karate Federation). The main goal of this research is to monitor and determine the differences that appear in the functional abilities of karate players after ten weeks of programmed training. The obtained results were processed and analyzed with a statistical package of programs appropriate for the research. According to the applied ANOVA and MANOVA tests, out of a total of six analyzed variables, only two (Beep - test and VO2max.) were found to have a statistically significant difference between the three measurements.*
Keywords: *karate, competitors, juniors, potential national team players, preparatory and pre-competition period*

Introduction

Karate, seen from the perspective of sport and martial art, develops great self-discipline, dedication and awareness among practitioners (Kostovski, Ž.et all.2014). Karate, nowadays, is included in the group of the most popular martial arts, practiced all over the world, which attracts an increasing number of participants, practitioners and supporters. During the competitions organized by the WKF (World Karate Federation), two equally important disciplines are present: sports fighting (kumite) and kata (kata). Both disciplines are increasingly relevant among a growing number of researchers, scientists, trainers, practitioners, who research this area on a daily basis.

As a condition for talking about diagnosis in the training process, the existing modalities of fitness training that are used in the training processes of karatekas should first be defined. A relatively large number of studies have been conducted in karate sport, which discuss the dominance of high-intensity structural activities that prevail during a karate fight. During the fight, anaerobic metabolism is used as a source of energy, which according to the physiological classification and dominance of energy processes, karate fight is classified as lactate-glycolytic anaerobic sports (Lehman I Jedliczka 1998; Shmidt I Perry 1976). On the other hand, Beneke R.,et al. (2004), investigating the energy systems and metabolic consumption of aerobic and anaerobic energy in karate fights, came to the conclusion that the dominant source of energy is aerobic metabolism, but there is anaerobic supplementation mainly with high-energy phosphates. Karate as a physical activity belongs to the group of polystructural acyclic sports with a complex and dynamically expressed structure. The dynamism and high frequency of movements during the fight require karatekas to have a high level of functional and motor skills, with a special emphasis on coordination, speed and strength skills (Blaževič i sor, 2006). Karate training and diagnostic procedures aim to develop and analyze the specifics of the sport, such as: the specific structure of movements, the specific situations arising from the structure of karate technique and the levels and needs of specific energy capacities.

For all athletes and sports workers who are professionally involved in this sport, it is of primary importance to have validly confirmed and summarized knowledge about the main functional, motor and psychological factors related to the structuring and modeling of karate training. Oxygen consumption is considered one of the most important estimators for determining the level of intensity of physical activity. The precise measurement of maximal oxygen consumption (VO2max) is carried out by subjecting karatekas to physical exertion, which should be long enough to

achieve complete exhaustion of the aerobic energy system. Both laboratory and field tests are used in testing athletes. In the context of the above, several authors (Najmi, N., et al. (2018); Martínez, Q., Ó.,A. & Izquierdo, M., A., C. (2020); Przybylski. P. et al. (2021); Martinez-de-Quel O et al. 2021), suggest that among the various tests for assessing aerobic capacity, the 20m shuttle run test (Shuttle round or Beep test) is the most commonly used test.

Success in any sport, including karate, depends on the joint action of several factors: technique, tactics, decision-making speed and mental abilities. For this entire system to function normally, it largely depends on the physiological characteristics of karatekas (Zaborski et al, 2015). Training, as well as sports combat, requires karatekas to possess a high level of motor and functional abilities, with special emphasis on the speed, strength, and coordination abilities of the karateka (Blaževič et al, 2006).

Diagnostic procedures during the training process in karatekas aim to monitor and analyze the development of the specific structure of movements, in specific situations, specific energy capacities, etc., which in turn arise from the structure of the karate sport. In this context, it can be concluded that physiological characteristics are of high importance in the process of the efficient preparation of karate athletes to achieve top results.

Methods

The sample of respondents on whom the research was conducted consists of 14 male athletes (junior karate fighters), potential representatives from the Republic of Kosovo. The research was conducted within the framework of the preparatory and pre-competitive period for participation in the Karate World Championship. The research was of a longitudinal nature and was conducted with the respondents on three occasions: initial, control and final measurement. The potential representatives who entered the sample of respondents are active competitors who participated in the state championship and premier leagues organized by the World Karate Federation WKF (World Karate Federation). The subject of the research in this study is the functional abilities of junior karate fighters in the preparatory and pre-competitive period.

The research was conducted in order to determine the differences that appear in functional abilities after ten weeks of programmed training. From the aspect of the athlete's functional abilities, changes that occur in: maximum oxygen consumption (VO2max), maximum heart rate (HRmax) and blood lactate concentration were monitored (1. Lactate concentration at rest KLAM, 2. Lactate concentration after exercise KLNO 3. Lactate concentration after recovery KLNR).

The data obtained from the research according to the size and characteristics of the sample of respondents were processed with a statistical package of programs intended for this type of research. In order to present an objective picture of the research, the following statistical parameters were applied: Multivariate analysis of variance (MANOVA) - which will determine the significance of the differences between the three measurements for each group of respondents. Univariate analysis of variance (ANOVA), which will determine the individual differences for each variable according to the given characteristics.

Results

In table no. 1, the results relating to the maximum oxygen consumption (VO2 max) in Junior karatekas in the different time sequences are shown. From the obtained results it can be seen that, in their programmed training process, the karatekas achieved the best results in the arithmetic means of the variables Beep t (Mean= 9.71± 1.77) and the variable VO2 max (Mean= 45.93 ± 6.28), which they achieved in the third time sequence. This difference in the results between the initial, control and final measurements should be attributed to the well-programmed training in the preparatory period of the karatekas and thus indicates the improvement of their physical fitness. These results, compared to results from the available literature, are within similar limits. Thus, according to data obtained from (Ravier, G., et al. 2009), who conducted a study examining the effects of adding high-intensity sessions twice a week for 7 weeks on markers of aerobic and anaerobic metabolism in elite karate athletes, significant improvements in VO2 max and positive physiological changes were obtained, which improved the time in which they could engage in intense physical activity before fatigue occurred.

From the values shown in table 1, which refer to the statistically significant differences between the time sequences of the measurements, it is evident that based on the results obtained from the three measurements of each variable and the values of Raos's F approximation (743.29), a statistically significant difference was determined

between the three time sequences for the variable maximal oxygen consumption (VO2 max) at a level of p=0.00. According to the analysis of the values from Table 1, which relate to the Beep-test variable and the statistically significant differences between the time sequences of the measurements, it can be concluded that based on the results obtained from the three measurements of each variable separately and the values of Raos's F approximation (385.19), a statistically significant difference was found between the three time sequences (measurements) of the Beep-test at a level of p=0.000.

Table 1. *Multivariate differences in variables from Functional Abilities among Junior respondents*

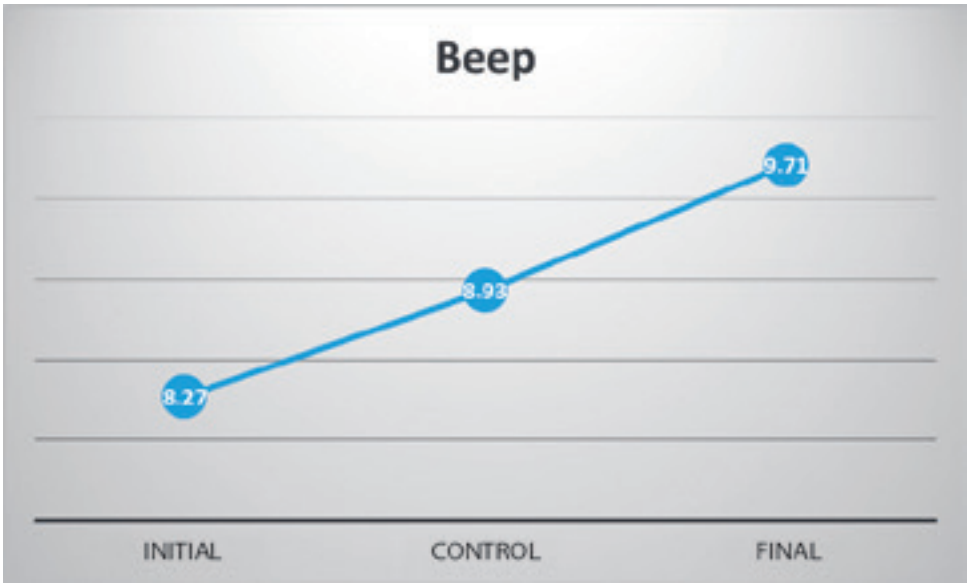
Juniori	Иницијално		Контролно		Финално		F	Sig
	Mean	SD	Mean	SD	Mean	SD		
Beep	8,27	1,82	8,93	1,86	9,71	1,77	385,19	**0,000**
VO2max	40,84	6,23	42,79	6,13	45,93	6,28	743,29	**0,000**
MHRmax	85,29	4,76	83,00	6,19	81,29	6,27	4,41	0,056
HR	98,71	2,20	98,57	2,47	99,07	0,83	0,39	0,542
KLAM			6,57	4,60	6,21	5,01	0,25	0,805
KLNO			15,57	2,24	15,07	1,94	1,34	0,205
KLNR			12,21	5,55	10,86	3,42	1,12	0,285

The differences at the Univariate level are shown in Table 2, i.e. the time sequences that participate in creating the statistically significant difference within the measurements. From the table it can be seen that for the variable Beep test (Beep t), numerical differences between the measurements were determined, which are also statistically significant differences, in all three measurements at the level of p=0.002 to p=0.000. The largest statistically significant difference is determined between the initial measurement and the final measurement at the level of p=0.00.

Table 2. *Univariate differences of the variable Beep-test for the group of respondents Juniors*

Pairwise Comparisons (Beep)						
(I) Time		Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	(.657)*	.26	.02	-1.21	-.10
	3	(1.443)*	.35	.00	-2.19	-.69
2	1	.657*	.26	.02	.10	1.21
	3	(.786)*	.24	.01	-1.30	-.27
3	1	1.443*	.35	.00	.69	2.19
	2	.786*	.24	.01	.27	1.30

The increase in the values of the beep - test variable is also graphically shown in graph no. 1, where a slight continuous increase in the values achieved by the respondents can be observed between the initial (8.27), through the control (8.93) to the final measurement (9.71), which indicates a significant improvement in physical endurance.

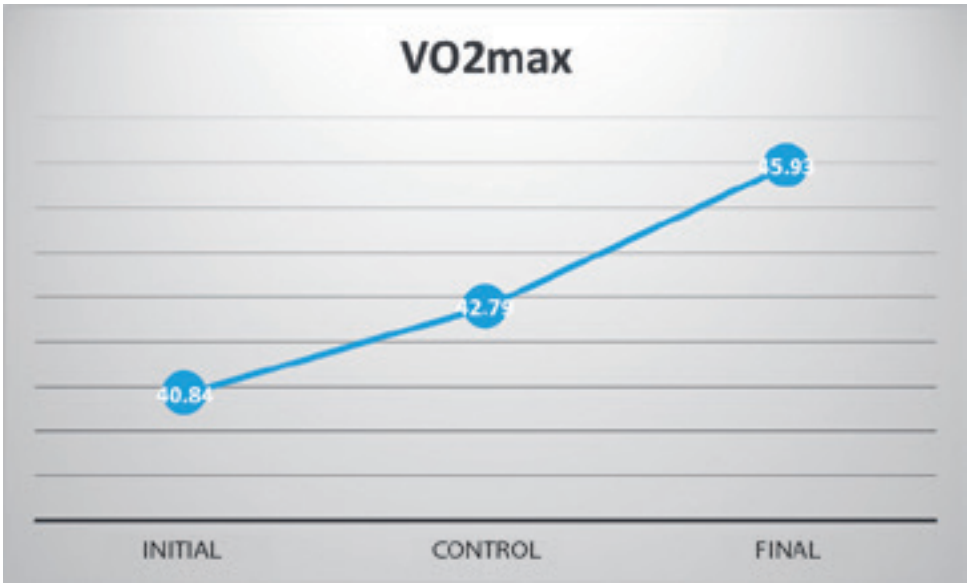


Graph 1. *Beep test*

Table 3 shows the differences at the Univariate level, i.e. the time sequences that contribute to the creation of the statistically significant difference within the measurements. At the same time, it can be seen that for the variable VO2 max, the determined numerical differences are also statistically significant differences, in all three measurements at the level p=0.004 to p=0.000. The largest statistically significant difference is determined between the final measurement and the other two (control and initial) measurements at the level p=0.00. For elite karate athletes to train and compete at a high level, both aerobic and anaerobic metabolic efficiency are important, but aerobic capacity can be a decisive factor. However, it should be taken into account that the level can be variable, depending on age categories and gender-related factors (Gaweł, E., et al.2025)

Table 3. *Univariate differences of the variable VO2max for the Juniors group of respondents*

Pairwise Comparisons (VO2max)						
(I) Time		Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	(1.943)*	.83	.04	-3.74	-.14
	3	(5.086)*	1.06	.00	-7.38	-2.79
2	1	1.943*	.83	.04	.14	3.74
	3	(3.143)*	.65	.00	-4.56	-1.73
3	1	5.086*	1.06	.00	2.79	7.38
	2	3.143*	.65	.00	1.73	4.56



Graph 2. *VO2max*

Graph 2. presents the increase in VO2 max. from the initial to the final measurement, where according to the obtained values, from the initial (40.84) to the control (42.79) measurement there is a smaller increase which then records larger values from the control to the final (45.93) measurement, which indicates a great progress in the values of aerobic capacity among the respondents.

Discussion

In the research of Beneka et al. (2004), the structural profile of the acyclic activity of karate fighting indicates that aerobic metabolism is the dominant source of energy with anaerobic compensation, mainly energy rich in phosphates. The functional basis of karate fighting (according to Beneka et al. 2004) consists of 77.8% aerobic capacity and 22.2% anaerobic capacity, (16% ATP adenosine triphosphate, PC creatine – phosphate, and 6.2% anaerobic glycolytic capacities).

The importance of aerobic and anaerobic endurance is also emphasized by Iide, K., et al. (2008), in their research on the physiological response of the body during simulated karate competitions where karate athletes reached approximately 85-93% of HR max. This can be correlated with the significant results obtained from the Beep test from this research, which suggests that karate athletes can effectively work in zones with high heart rate and high VO2 max., and delay fatigue. Güler et al. (2018), emphasize that a high level of aerobic capacity is essential to avoid fatigue and to enable faster recovery during breaks between fights and between intense periods during a fight.

It is also worth mentioning the results obtained from the research of Arazi, H., and Izadi, M. (2017), in which the authors link body weight to maximum oxygen consumption because karatekas in heavier categories showed lower VO2 max. compared to other weight categories.

Several authors (including Nema, K. et al. 2024), suggest that with such precise data on the impact of aerobic and anaerobic capacity, heart rate, fatigue, lactate levels, etc., it will be possible to qualitatively approach the development of work plans and programs and individualization of training in order to improve sports performance, monitor progress and prevent injuries.

Conclusion

In terms of its structural complexity, karate belongs to polystructural acyclic sports, dominated by acyclic unpredictable movements, and only has symbolic destruction of the opponent. This positive destruction, the karateka tries to achieve by delivering controlled blows to the head and body of the opponent, although the movements represent a combination of maximal and submaximal intensity (Kostovski et al, 2015), and the energy is drawn from both aerobic and anaerobic metabolism. In sports performed indoors (gyms), the physical performance of athletes is generally determined by the duration and pace of the competition. In response to this, training programs aim to slow

down the time for fatigue formation and improve endurance (Ismail Kaya at. all 2013). According to Chaabene, H., et al. (2012), between two consecutive fights or between two periods within a fight, aerobic capacity plays a major role because it ensures the recovery processes between those periods, thus preventing fatigue. All of these above-mentioned findings indicate the need for continuous and comprehensive scientific research to understand the exact physiological and conditioning requirements of elite karate, which will also include other parameters and indicators, such as: research and comparisons by gender, age and weight categories, differences between kata and kumite, etc. The inability to find a statistically significant difference in blood lactate levels between the initial, control and final measurements can be attributed to various other influencing factors (a difference exists, but it is not large enough to be significant). Lactate is not a consistently reliable marker of aerobic adaptation and further studies involving very high-intensity training are definitely needed, as blood lactate indicates anaerobic glycolysis, while VO_2max and the beep test measure aerobic endurance capabilities. Most karate studies focus on post-exercise lactate rather than resting lactate, as resting values are usually low and indistinguishable (e.g., Güler, M., et al. 2018). In this context, according to Chaabène, H., et al. (2014), lactate levels are significantly higher in competitive conditions because official fights cause greater physiological stress (and more lactate is secreted in response) than in training conditions. Therefore, the need to replicate competitive intensity during training is emphasized.

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