CHANGES IN THE MAXIMUM OXYGEN CONSUMPTION IN KARATE ATHLETES IN THE PREPARATORY AND PRE-COMPETITIVE PERIOD

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Abstract

Karate training, as well as training in other martial arts, promotes positive adaptations to health-related physical fitness components. Among these components, maximum oxygen consumption (VO2max) is an important indicator of cardio-respiratory condition, as well as a strong and independent predictor of the risk of death from cardiovascular disease. Regular assessment of aerobic fitness is important to monitor the effectiveness of training processes and the willingness of karate fighters to compete. The need to determine the specific aerobic capacity of karate requires more specific tests and training protocols, so some studies have focused on physiological and temporal analysis of karate competitions. The aim of this study was to assess the level and differences of maximum oxygen consumption (VO2max) in karate athletes during training in the preparatory and pre-competition period, calculated using the (Beep t) test until dismissal. The research was conducted on a stratified sample of 16 male karate fighters, potential members of the national team from the Republic of Kosovo, in the period of preparations before participating in the World Cup for U21, juniors and cadets in Chile 2019. For each variable the basic descriptive statistical parameters were calculated separately: Arithmetic mean (Mean), standard deviation (SD), lower (min) and upper (max) result limit. One-Way Repeated-Measures ANOVA was used to determine the intergroup differences in the arithmetic means. To determine the special impact of each variable in creating group differences, the LSD test post hoc analysis was used.

Keywords: VO2 max, Beep test, U21

INTRODUCTION

Karate, in its development, has evolved from traditional military skill to modern global martial arts. Karate combat consists of a number of repetitions of percussion and defense techniques, separated by high-intensity rhythmic jumping movements during a 3-minute fight in men (Beneke R, et al. 2004). Thus, karate fights are clearly characterized by an intermittent pattern of activities (Chaabene H, Hachana Y, Franchini E, et al. 2012). From the analysis of karate competitions at the national level, it is noted that the stages of activity contain 16 ± 5 actions with high intensity after the fight, which last 1–3 seconds, each of them (Beneke R, et al. 2004), and on international level, karate athlete performs 17 ± 7 high-intensity actions lasting 1-5 seconds each, each using predominantly specific techniques of the upper extremities (76.19% of all applied techniques) (Chaabene H, Franchini E, Miarka B, et al 2013). Previous research has shown that the overall metabolic profile of karate athlete is predominantly aerobic, although anaerobic processes allow it to perform crucial actions (Beneke R, et al. 2004; Doria C, Veicsteinas A, Limonta E, et al. 2009). As a result, regular assessment of aerobic fitness is important to monitor the effectiveness of the training process and the willingness of karate athletes to compete (Chaabene H, Hachana Y, Franchini E, et al. 2012). Laboratory tests for maximal oxygen consumption (VO2max) have traditionally been used to assess the aerobic condition of karate practitioners. The need to determine the specific aerobic capacity of karate athletes requires more specific tests and training protocols, so some studies have focused on physiological and temporal analysis of karate competitions (Chaabene H, Franchini E, Miarka B, et al 2013. lide K, Imamura H, Yoshimura Y, et al. 2008). Karate training, as in other martial arts, promotes beneficial adaptations to health-related physical fitness components (Douris P, Chinan A, Gomez M, Aw A, Steffens D, Weiss S. 2004, McClellan T, Anderson W. 2002). Among these components, maximum oxygen consumption (O2max) is an important indicator of cardio-respiratory condition, as well as a strong and independent predictor of risk of death from cardiovascular disease (Duncan GE, Li SM, Zhou XH. 1999-2000 and 2001-2002). ., Kodama S, Saito K, Tanaka S, Maki M, Yachi Y, Asumi M, et al. 2009). Athletes, trainers and scientists in the area of sports have a great interest in monitoring and measuring the adaptations of the organism, produced as a consequence of training. For this reason, methods are used that provide reliable information about the athlete's

performance during a match or training, intensive training is applied to achieve the desired metabolic, cardiovascular and neuromuscular adaptations, in order to increase their physical capacity (Hughson and Shoemaker, 2015; Stanley, Peake and Buchheit, 2013). The research focused on changes in maximum oxygen consumption (VO2max) during the maximum load during the preparatory and pre-competition period in karate athletes. The need to assess these parameters is due to the fact that fatigue, as a psycho physiological condition, exists on two levels: 1) peripheral - metabolic changes in the performance of muscles that limit the performance 2) central - changes in the central nervous system that affects the motor and perceptual processing (Fitts 1994).

METHODS

Participants

The research was conducted on a stratified sample of 16 male karate athletes, potential national team members in the U21 category, from the Republic of Kosovo, in the period of preparations before participating in the World Cup for U21, juniors and cadets in Chile 2019. The measuring was realized in three time sequences in the preparatory period (Initial, Control and Final).

Instruments

The assessment of the level and differences of maximum oxygen consumption (VO2max) in karate during training in the preparation and competition period was calculated using the Beep test (Beep t) until dismissal.

Statistical Analysis

For each variable, the basic descriptive statistical parameters were calculated separately; Arithmetic mean (Mean), standard deviation (SD), lower (min) and upper (max) result limit. One-Way Repeated-Measures ANOVA was used to determine the intergroup differences in the arithmetic means. Influence of each variable on the creation of group differences was determined by applying the LSD test post hoc analysis. The research was conducted without a control group, due to the fact that we are talking about top athletes, junior seniors with an average age of 20 years, which indicates the fact that the curve of human development turns into a stage of stagnation, and in this period there were no physical exercises other than training activities. These data are sufficient confirmation that the changes in athletes are the result of the training process.

RESULTS

The results of this study, which refer to the maximum oxygen consumption (VO2 max) in karate athletes in different time sequences, are shown in Table No. 1. From these it can be concluded that the karate athletes in their programmed training process achieved the best results of the arithmetic means in the variable VO2 max (Mean = 51.45 ± 4.41) in the third time sequence. Analogous to this result, the values of Beep t (Mean = 11.30 ± 1.35) are the highest. The obvious difference in results between the initial, control and final measurements is due to well-programmed training in the preparatory period of the karate athletes and indicates the improvement of their physical fitness. If these results are compared with the results of the available literature, it can be said that they are moving in similar frameworks.

Table 1. Descriptive statistics of maximum oxygen consumption

	Variables	Mean	Min	Max	SD
Initial measurement (n=16)	VO2 max	45,63	35,1	55,7	6,89
	Beep t	9,59	6,8	12,7	2,18
Control measurement (n=16)	VO2 max	49,49	42,9	57,7	5,24
	Beep t	10,60	8,9	13,2	1,43
Final measurement (n=16)	VO2 max	51,45	44,9	58,3	4,41
	Beep t	11,30	9,5	13,4	1,35

Table 2. Multivariate Tests of Significance Sigma-restricted parameterization Effective hypothesis decomposition

Multivariate Tests [VO2]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
factor1	Wilks' Lambda	,387	11,092[b]	2,000	14,000	,001	,613

Table 3. Analysis of Variance Marked effects are significant at p < ,05000

Measure: MEASURE_1

(I) factor1	(J) factor1	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-3,862)*	,799	,000	-5,565)	-2,160)
	3	-5,825)*	1,290	,000	-8,574)	-3,076)
2	1	3,862*	,799	,000	2,160	5,565
	3	-1,962)*	,712	,015	-3,481)	-,444)
3	1	5,825*	1,290	,000	3,076	8,574
	2	1,962*	,712	,015	,444	3,481

From the values shown in Table 2, referring to the statistically significant differences between the time sequences of the measurements, it can be concluded that: based on Wilks' Lambda (0.387) and Raos F-approximation (11,401), there is a statistically significant difference between the three time sequences (measurements) of the maximum oxygen consumption (VO2 max) at the level of p = 0.001.

Table 3 represents the differences at the Univariate level, ie the time sequences that contribute to the creation of the statistically significant difference within the measurements. From the same it can be seen that in the variable VO2 max, the determined numerical differences are statistically significant differences, in all three measurements at the of level p = 0.000 to p = 0.015. The largest stylistically significant difference is determined between the initial measurement with the other two (control and final) measurements at level of p = 0.000.

The Figure 1 shows the growth curve of the maximum oxygen consumption values (VO2 max), according to the time sequences. From the same it can be seen that the biggest increase of VO2 max, occurs in the preparatory period, where the emphasis is on improving this functional ability. In the next (pre-competition) period, the curve is slightly but upwards decent, due to the changes (specifics) of the training process that occur at that stage. This indicates a well-programmed training process in karate athletes and achieving a good fitness form.

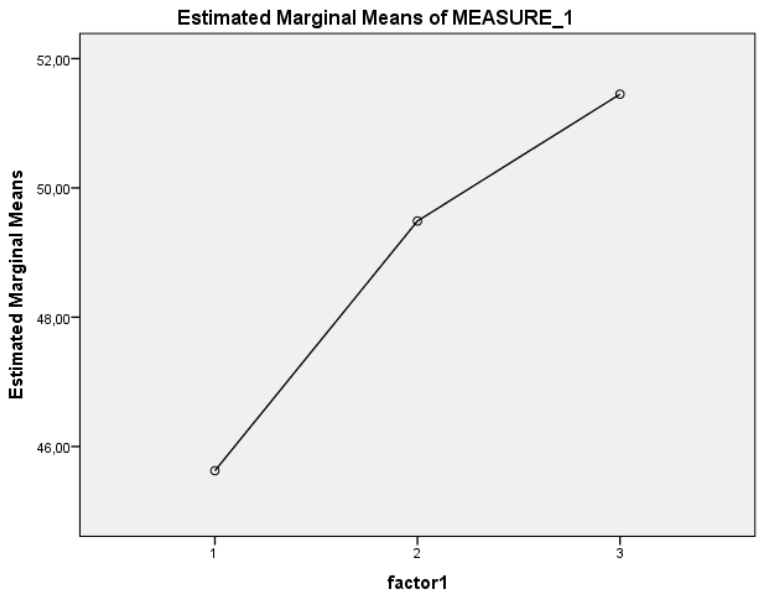

Figure 1. The growth curve of VO2 max

In table 4, the statistically significant differences between the time sequences of the Beep test (Beep t) variable measurements are shown. Analyzing the obtained values, it can be concluded that: based on Wilks' Lambda (0.507) and Raos F approximation (6.804), there is a statistically significant difference between the three measurements of the Beep test (Beep t) at the level of p = 0.009.

Table 4. Multivariate Tests of Significance Sigma-restricted parameterization Effective hypothesis decomposition

Multivariate Tests[Beep test]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
factor1	Wilks' Lambda	,507	6,804[b]	2,000	14,000	,009	,493

Table 5 represents the differences at the Univariate level, i.e. the time sequences that contribute to the creation of the statistically significant difference within the measurements. From the same it can be seen that in the variable Beep test (Beep t), numerical differences between the measurements have been determined, which are statistically significant differences, in all three measurements at the level of p = 0.002 to p = 0.005. The largest stylistically significant difference is determined between the initial measurement with the other two (control and final) measurements at the level of p = 0.004 or p = 0.002.

Table 5. Analysis of Variance Marked effects are significant at p < ,05000

(I) factor1	(J) factor1	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-1,013)*	,296	,004	-1,644)	-,382)
	3	-1,707)*	,448	,002	-2,662)	-,752)
2	1	1,013*	,296	,004	,382	1,644
	3	-,694)*	,209	,005	-1,139)	-,248)
3	1	1,707*	,448	,002	,752	2,662
	2	,694*	,209	,005	,248	1,139

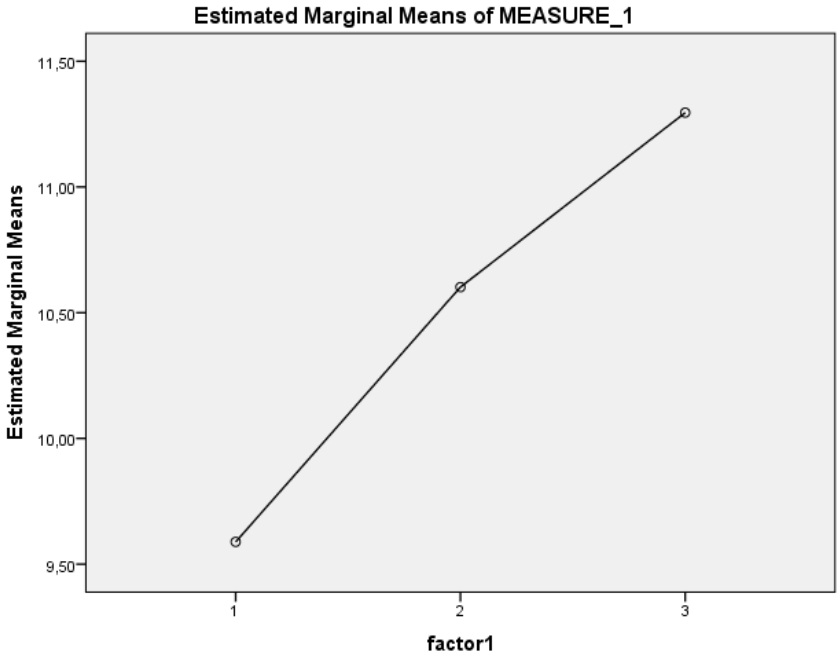

Figure 2. The curve of the increase in the values of Beep t

Figure 2 shows the Beep test (Beep t) value growth curve, according to time sequences. From this it can be concluded that the largest increase in Beep t occurs in the preparatory period, where the arithmetic mean of the repetitive cycles increases from 9.59 to 10.60. In the next (pre-competition) period, the curve is slightly but upwards decent, due to the changes (specificity) of the training process that occur at that stage, with an increase in the arithmetic means of the repeating cycles from 10.60 to 11.30.

From the analysis of the achieved values of the Beep test in the final measurement, it can be noticed that relatively high test levels have been measured. A maximum of fourteen level (Beep t 13.4) and a minimum of tenth level (Beep t 9.5) or a mean value of twelve (Beep t 11.30) were reached. Based on these indicators, the relative maximum oxygen consumption of 58.3 ml / kg / min, or the average VO2max 51.45 ml / kg / min, is estimated, which are relatively high values for this population of respondents.

DISCUSSION

Due to its structural complexity, karate belongs to polystructural acyclic sports, which are dominated by acyclic unpredictable movements, and there is only a symbolic destruction of the opponent. This positive destruction, the karate athlete strives to achieve by giving controlled kicks to the opponent's head and body, although the movements are a combination of maximum and sub maximal intensity (Kostovski et al, 2015), and the energy is drawn from both aerobic and anaerobic metabolism. In indoor sports (gyms), the physical performance of athletes is generally determined by the duration and pace of the competition. In response, training programs aim to slow down the time it takes to form fatigue and improve endurance (Ismail KAYA at. Alll 2013).
Maximum oxygen consumption (VO2max) is one of the most used parameters when it comes to assessing the aerobic capacity of athletes. This parameter has been accepted as one of the best demonstrator of the functional limits of cardiovascular systems in athletes. To assess this parameter, there are a number of direct laboratory tests as well as indirect methods or field tests used in research.

When comparing the results of the research, with previous research on male and international karate athletes, it can be concluded that they move in similar frameworks. Chaabčne et al. (2012) in their study obtained values for the relative maximum oxygen consumption (VO2max), from 47.8 ± 4.4 to 61.4 ± 2.6 ml / kg / min in males, while in women lower values were obtained 32.75 ± 4.1 to 42.9 ± 1.6 ml / kg / min. It should also be noted that (VO2max) is a parameter that can be affected in terms of improvement, as shown by Ravier et al. (2008), in his research conducted by top French karate athletes. They studied the effects of markers on aerobic and anaerobic metabolism after seven weeks of experimental treatment. The study added two intermittent high-intensity workouts during the week and received improvements in total values of (VO2max), from 58.7 ± 3.1 to 61.4 ± 2.6 ml / kg / min. In the laboratory research of treadmill track (M.Tabban 2014), conducted with male and female karate athletes, average values of HRmax 200 ± 5 and VO2max 52.00 ± 6.10 mL / kg / min were achieved for the whole group, ie for males 56.25 ± 3.83 mL / kg / min, and in females, 47.00 ± 4.00 mL / kg / min.

From the study (Chaabčne et al. 2013), the authors concluded that maximum oxygen consumption (VO2max) is considered an important marker of cardiovascular and respiratory integration, although its measurement was conducted in only two studies using simulated combats. These authors observed values ranging between 34.9 ± 3.0 ml.kg-1.min-1 (72% of VO2max) 41.3 ± 13.1 ml.kg-1.min-1, confirming the high aerobic participation in this combat sport.

CONCLUSION

Athletes' functional abilities can play a crucial role in achieving top form, and thus achieving ultimate sports success. That was more of a reason to conduct research with 16 male karate athletes, potential national team members of the Republic of Kosovo. Heart rate and blood lactate concentration are appropriate parameters for assessing the intensity of the effort that karate athletes must endure during the competition. Heart rate is an indicator of the intensity of an athlete's activity in any sport because it is directly related to the quantity of the oxygen that the athlete consumes. According to the linear relationship between V02 and heart rate, oxygen consumption increases when heart rate increases (McArdle et al, 1986). This link was also used in this study to determine the level of oxygen consumption. Because direct measurement of maximum oxygen consumption involves sophisticated and expensive equipment, it is generally not measured frequently during the preparatory training process, but field tests with high measurement characteristics are used to estimate maximum oxygen consumption (V02max).

If we take into account that our study was about karate athletes, and that the karate federation of Kosovo is a member of the European and World Federation, more recently, it can be said that the results achieved by a part of the karate athletes are of satisfactory value in terms of comparative results from the literature. Based on the results shown, karate athletes potential members of the national team have a satisfactory level of aerobic ability, and they use less oxygen during the competition compared to measuring the maximum load. During the competition, karate athlete do not reach the maximum level of load, and in one tournament the karate athlete can have 4-5 combats during the day, which requires energy resources to be able to withstand at least 5 combats during the day.

The main limitation of our study is the relatively small number of participants, which reduces the power of statistics. However, it should be borne in mind that this is mainly due to the specificity of the discipline, because the number of karate athletes who make up the core of the national team and who train under the supervision of one coach and in the same conditions, is always limited and rarely any national team from countries like Kosovo (in terms of population) has a larger number

of potential members of this age group. Therefore, it is advisable to conduct other research that will include karate practitioners from other age categories, and that will be conducted according to our research methodology. This type of research is desirable to do, by expanding the segments of the research, and in other macro cycles of the training process.

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