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## IMPROVEMENT AND CONTROL OF THE DEVELOPMENT LEVEL OF SPECIAL ENDURANCE IN ATHLETES OF HIGH QUALIFICATION IN KYOKUSHIN KAIKAN KARATE

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### Abstract

This article investigates and deals with the characteristics that are most informative in the process of saving of muscular activity of sportsmen to fight by the rules of kyokushin kaikan karate. The optimal intensity of training load for athletes of high qualification specializing in kyokushin kaikan karate is proved in different structural formations (introductory, striking, intermediate, competition and recovery microcycles) of a single training period. The systematic improvement of the special endurance level of sportsmen of high qualification is determined before the big competition in the process of implementation of the training load intensity. A number of partial indices and the total characteristics that describe the level of special endurance (creatine phosphate efficiency index, glycolytic efficiency index, integrated power of impact work, integral index of speed-power preparedness) in karatekas of high qualification is recorded on modern digital equipment – chrono-dynamometer "Spuderg". The dynamics of the special endurance level in athletes of high qualification of the kyokushin kaikan karate is analyzed in a single training period of five months. The efficiency of wide application of this device is proven for control and correction of sportsmen' training process of high qualification specializing in striking martial arts. Practical recommendations are provided for the development of special endurance in athletes of high qualification specializing in kyokushin kaikan karate.

**Keywords:** Karate, Kyokushin, sportsman, high qualification, improvement, control, level, special endurance, parameters, energy supply, micro cycle, creatine phosphate, glycogen, fight, punch, intensity, load.

### 1. Introduction

Sports shape in person a complete system of theoretical and methodological knowledge, practical skills, foster the pursuit of excellence by improving personal morphological and physiological features, contribute to obtaining moral

satisfaction when demonstrating athletic performance of a certain level or achieving victory, it also suggests active participation in public and cultural life of the community. Along with sports that have a long history, a relatively young sport receives more and more development in society and the recognition of sports organizations. On the basis of the classical theory [12, 14], at the early stages of young sports development, the popularization events take place to increase the number of people involved in a specific sport. The purpose of mass sports gives people access to improve their motor qualities and capabilities, to strengthen health and increase creative longevity. At subsequent stages of sports perfection, a higher quality level is achieved in the readiness of the person, allowing him/her to get higher achievements in sports, i.e. to prepare his/her body for functioning in the zone of an absolute human limits. The purpose of sport is a demonstration of the greatest possible sports results or victories at major sporting events. Kyokushin kaikan karate, which is the object of this study, is a relatively young sport that has been developing since 1947, after the victory of the founder species of Masutatsu Oyama in the first post-war championship of the Japan karate in Kyoto. Becoming the champion of Japan karate, the founder of Kyokushin proved the advantages of his developed martial art over other martial art schools. In the modern sports, the rules of the bout in kyokushin kaikan karate can be reduced to the confrontation between two opponents without weapons through the contact techniques to be performed with maximum power and speed. As a mass sport, the kyokushin kaikan karate was developed in 1990. By that time, the official representatives - Federations, have worked in 105 countries. In the last 25 years, the kyokushin kaikan karate focuses on high performance sports: annual championship of countries and continents, once in four years – the world Cup in weight categories on different continents and every four years – the absolute world championship in Japan without taking into account the weight of the athletes. In 2015, a conference was held of the organizing Committee of the Olympic Games in 2020, which are planned in the Tokyo city, where the host proposed to include five additional sports, including karate in the Olympic program of competition. Thus, for the next four years, every country needs to prepare a national karatekas team of high qualification who can be competitive in the fight for the victory. The success of the sports result demonstration in kyokushin kaikan karate depends on the effective manifestations of the various technical arsenal of the athlete. It requires optimal parameters of motor qualities development in karatekas. However, there is still no consensus on how to plan the sequence of different structural formations in the training process. In what proportions sportsmen of high qualification should perform the special and auxiliary physical exercises? How to agree on the training exercises of various kinds? Therefore, it is difficult to plan and control the training process in kyokushin kaikan karate. Thus, the research in this direction is

relevant. The practical value of this research includes the wide use of recorded quantitative data on the level of special endurance development in different structural formations in the training process by sportsmen of high qualification from different countries in order to prepare for important competitions. Compliance with methodical recommendations on the implementation of special training exercises in a specific microcycle and in a certain mode of intensity will allow the karateka to improve the existing level of special endurance.

**2. Methods**

1. Theoretical analysis and generalization of data of scientific and methodical literature.
2. Pedagogical supervision.
3. Pedagogical testing (method of chronodynamics).
4. Pedagogical experiment.
5. Methods of mathematical statistics (Student’s t-test).

The rules of competitive bouts under the rules of the kyokushin kaikan karate provide major rounds lasting three minutes for athletes over the age of 18 year. As in other sports, the competition means are the sports karate techniques. According to the statement [14, p. 622]: "the sports equipment should implicate the set of techniques and activities to ensure the most effective solution of motor tasks, due to the specifics of a particular sport, his discipline, type of competition". In kyokushin kaikan karate, the technical arsenal for 80% consists of strikes. To win bouts in senior competitions, it is necessary to use complex combinations of striking techniques, which require a manifestation of special endurance karate. According to the development of the Fox-Haskell [5, 20, 21] given in *table 1*, most of the fights by the rules of kyokushin kaikan karate between athletes with approximately equal level, are conducted in the intensity range of 80-100% and even more (to 100% of intensity equals the heart rate at 200 beats/min.) with short periods of 70-80% (heart rate 140-160 beats/min.). Thus, karatekas need to perform training load in this range when preparing for the competition.

**Table 1: The Fox-Haskell gradation of aerobic and anaerobic loads and heart rate.**

		Zones of exercises									
		age									
		20	25	30	35	40	45	50	55	65	70
beats/min. intensity	100%	200	195	190	185	180	175	170	165	155	150
	VO2 Max (maximum effort)										
	90%	180	176	171	167	162	158	153	149	140	135
	Anaerobic (intensive training)										
	80%	160	156	152	148	144	140	136	132	124	120
Aerobic (cardio training / endurance)											
70%	140	137	133	130	126	123	119	116	109	105	

Weight control (fitness / fat loss)										
60%	120	117	114	111	108	105	102	99	93	90
Moderate activity (rehabilitation / workout)										
50%	100	98	95	93	90	88	85	83	78	75

Guided by the data of physiologists [8, 9, 15, 31], at different intensities of muscle activity of athletes according to table 2, different energy systems become active. The most important characteristics of the energy supply of muscle activity of athletes in an intense fight in kyokushin kaikan karate are creatine phosphate and glycogen.

**Table 2: The energy assurance systems of muscle activity in athletes of different intensity.**

The intensity – bioenergy criterion				
Effort time	Intensity	Energy system	Anaerobic processes	Aerobic processes
under 6 s (10 s)	maximum	ATP-creatine phosphate	100-95 %	0 (1)-5 %
6 (10) – 30 s	high	ATP-creatine phosphate and rapid glycogen	95-80 %	5-20 %
30 c – 2 min.	moderately high	rapid and free glycogen	80-50 %	20-50 %
2 – 3 min.	average	free glycogen and Oxygen	50-40 %	50-60 %
3 – 30 min.	moderately low	Oxygen	40-5 %	60-95 %
over 30 min.	low	Oxygen	5-2 %	95-98 %

Control of the level of special endurance karate is a complex procedure that requires sophisticated scientific equipment. Among the most modern devices, providing informative features are highlighted in specialized striking ergometers of "Spuderg" series. This device is based on the method of chromodynamics [16], which allows continuous measurement of various parameters of the striking work in combat sports. Special striking endurance karatekas of high qualification were assessed using tests of continuous application of direct punches to torque the punching bag for 8 s. and for 40 s. at maximum intensity.

"Test 8 s." allows measuring creatine phosphate health of karateka. This device measures the partial indicators: number of strokes inflicted by karate for 8 s. (K8) and their tonnage (F8), separately for the first (K4, F4) and the second half of the test (K4, F4). Power of karateka strike work (W8), the coefficient of "explosive" endurance (CEE), the index of "explosive" endurance (IEE) – on the basis of which, the index of creatine phosphate performance (ICFP) is calculated.

Similar calculations of glycolytic performance index (GPI) are in the "Test 40 s.". After establishing the number of punches inflicted by karateka for 40 s. (K40) and their tonnage (F40) separately for the first (K20, F20) and the second half of the test (K20, F20), power of karateka striking work (W40), the coefficient of "speed" endurance

(CSE), index of "speed" endurance (ISE), additionally, such indicators are calculated: integral power of striking work

–  $IPW = 2 \times IEE \times ISE$  (constant "2" is designed to align the contributions of both indexes into an integrated indicator of IPW), and integrated index of speed-power preparedness of IISPP =  $ICFP \times GPI$ . The interpretation of these indices and coefficients is associated with the determination of their value – the higher it is, the better.

The procedure of pedagogical testing according to the method of chronodynamics included the following. Each karateka was asked to run "Test 8 s.", and after a long break, "Test 40 s.". To take punches, the subject karateka chose a convenient distance to a dynamometric punching bag and began to apply straight punches of the left and right hand alternately at maximum intensity. Pedagogical experiment was carried out for single-cycle period of training of the Ukraine national team in kyokushin kaikan karate during 5 months. Training of athletes was carried out for two important events, namely: Qualifying Championship for the subsequent formation of the national team for international competitions of a various rank and the Absolute World Championships in Japan 2015.

16 karatekas of high qualification were included in the group of subjects. Age of athletes was from 24 to 30 years, experience of continuous kyokushin kaikan karate employment – 15-20 years, and the qualification was higher than 1st Dan (Dan – level of skill in karate). Karatekas' weight ranged from 78 to 98 kg. Control measurements of the special endurance level of sportsmen of high qualification were carried out at the beginning and at the end of striking microcycle and intermediate microcycle before the national Championship and before the World Cup.

### **3. Literature Review**

Analysis of scientific papers and publications shows that not enough attention is paid to the problem of special endurance development in the athletes. Primarily, the philosophical perception of different types of martial arts [10, 29, 36] are highlighted, or the analysis of psychological qualities of a karateka and motivational factors affecting the duration of studies [33, 41]. In recent years, the development regarding the application of IT technologies in the training process of the martial arts became known [1, 46]. The material is dedicated to the increase in power and strength in martial arts [43], and the author [23] highlights a set of exercises for recovery of athletes after training loads.

In science, there is also a lot of information on the organization of training process in karate. The basic tenets of karate training are provided by the authors [32, 30, 34, 35]. Researchers [39, 42] have determined the characteristics of neuromuscular reactions, and in the sources [27-28, 37, 44-45] – physiological functional indicators that can be guided in the process of karatekas training. However, studies of the characteristics of athletes' special endurance

(striking performance) and recommendations for their improvement were carried out only in boxing [11, 13, 16], kickboxing [26], Muay Thai [3] and certain types of karate [4, 7, 40]. In kyokushin kaikan karate, specialists [2, 6] only carried out the analysis of formation in the optimum technical arsenal.

The author's research of the system of martial arts like kyokushin kaikan karate, was originally dedicated to the training process and the rationale of its structure [17-19]. This work includes material research for the improvement and control of special endurance in sportsmen of high qualification specializing in kyokushin kaikan karate in a single period of training that fills this gap.

#### **4. Results**

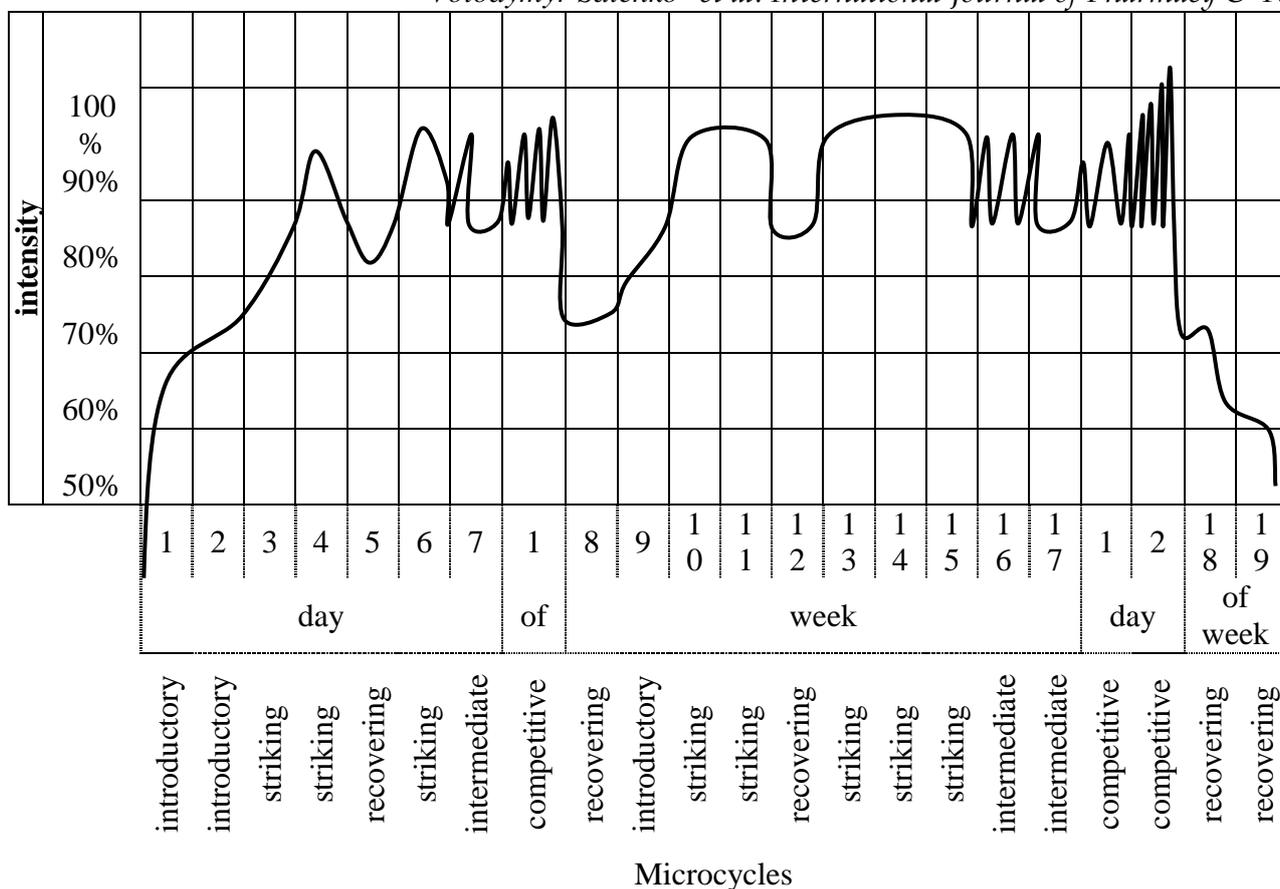
The purpose of the study is to justify the processes of improvement and control of the level of development of special endurance in athletes of high qualification specializing in kyokushin kaikan karate in a single training period.

Objectives of the study:

1. To justify the optimal intensity run training load of athletes of high qualification specializing in kyokushin kaikan karate in a single training period.
2. To control the level of development of the special endurance of sportsmen of high qualification before responsible competitions.
3. To analyze the dynamics of the level of special endurance in athletes of high qualification specializing in kyokushin kaikan karate in a single training period.

Despite the fact that the form of kyokushin kaikan karate today has gained wide popularity, the demonstration of technical and tactical skills in competitive bouts in different countries is different. It depends on national traditions of a specific region, anthropometric parameters and individual psychophysiological features of athletes. On this basis, the Slavic karatekas should not copy the training program of the Asian or American schools. Especially in recent years, more and more Russian athletes took part in the final of the world championship in Kyokushin, training methodologies that need to be analysed and widely applied.

Therefore, researchers from the Russian Federation [22, 25, 38] have substantiated theoretical and methodological foundations of long-term preparation in this kind of karate and effective management of the bout. Based on the work of scientists in this field, it is possible to carry out pilot planning training loads aimed at improving the level of special endurance in separate training period of karatekas of high qualification.



**Figure 1. Graph of intensity of training load in the single period of training of karatekas of high qualification.**

According to the developed optimum intensity of a training load for a single period of training (5 months) to each competition was scheduled introductory, striking, intermediate, competitive, and recovering microcycles in the sequence shown in *Figure 1*. Therefore, despite the high skills of karate, the beginning was supported by the two-week introductory microcycle, as after a long active leisure functional performance of the athletes received a natural decline. The first week included the load of aerobic training with the intensity of exercise at 50-70% (heart rate at the level of 100-140 beats/min), in the second week, the impact load was carried out in the range of 70-80% (heart rate at the level of 140-160 beats/min). In subsequent striking microcycle of two weeks, performed exercises are primarily anaerobic: third week – with an intensity of 80-90% (heart rate at the level of 160-180 beats/min), fourth week with the intensity of 90-95% (heart rate at 180-190 beats/min). In the fifth week, the recovery microcycle was performed with a slight decrease in intensity to 85-90% (heart rate at the level of 170-180 beats/min.) for a short rest and improving precise karate techniques. On the sixth week of training, a striking microcycle was performed with the intensity of the training load 90-100% (heart rate at the level of 180-200 beats/min.). In the seventh week of training, karatekas of high qualification (intermediate microcycle) conducted a one-day control test. At the same day, they improved techniques in anaerobic mode with an intensity of about 100% (heart rate in the range of 200 beats/min). In the remaining training sessions during the week, the load was executed to the intensity of about 90% (heart rate up to

180 beats/min). After seven weeks of training, subject karatekas competed in the qualifying championship to be included in the national team at the Absolute World Championship in kyokushin kaikan karate. The national Championships in kyokushin kaikan karate were held in one day, where there are from three to four or five bouts depending on the number of participants. In a one-day microcycle, the intensity of the fights carried out in the maximum-high range (80-100% and even more), but the first bout is often not with the most powerful enemy (therefore its intensity can vary at the level of 60-90%) as the leaders are usually dispersed in the drawing. After the competition, the duration of the recovery microcycle was only one week since the main purpose of single five-month period of training was the absolute world championship. The intensity of the preferential load in the recovery microcycle (week 8) was at the level of 75-80% (heart rate 170-180 beats/min.). Subsequent introductory microcycle included a regime of training exercises with higher intensity of 85-90% (heart rate at the level of 170-180 beats/min) than the first single training period and proceeded during one week (9 week). The tenth and eleventh weeks of karatekas training included striking microcycle. As in the same period of preparation for the national championship, exercises were carried out in a predominantly anaerobic mode with an intensity of 90-100% (heart rate at the level of 180-200 beats/min.). At the twelfth week (recovery microcycle), the intensity slightly decreased to 85% (heart rate around 170 beats/min) for karatekas to take a short rest karate and improve their arsenal of precise techniques. At the 13-15 weeks (striking microcycle), they performed a training load of extreme nature with a rate of 100-110% (heart rate at the level of 200-210 beats/min). Intermediate microcycle (week 16) with the intensity of the training was carried out at 90% with the increase to 95-100% (heart rate 195-200 beats/min). In the early 17th week, the teacher held a one-day testing and execution anaerobic load with an intensity of 95-100% (heart rate 195-200 beats/min), in other days, the load was maintained at 90% (with heart rate up to 180 beats/min). The competitive microcycle in the absolute world championship in kyokushin kaikan karate lasted for two days. According to the program of competitions, in the first day, one or two bouts are usually held on a similar principle to the dispersion of the leaders, in this regard, the intensity of performing technical-tactical methods varies between 70-100% (heart rate of 140-200 beats/min.). On the second day, 32 best karatekas of the same level of sportsmanship are competing. During these fights, the intensity increases to more than 90-120% (when heart rate is at the level of 180-220 beats/min. or more). After the end of the competition in the recovery microcycle (week 18), the aerobic rehabilitation program starts with the intensity of 70-80% (heart rate at the level of 140-160 beats/min). 19 week – 50-70% (heart rate 100-140 beats/min), and further the intensity of the training load is gradually reduced.

Control measurements of the level of special endurance in sportsmen of high qualification were carried out before the national championship at the beginning and at the end of striking microcycle (3 and 6 weeks) and intermediate microcycle (week 7), and then by analogy, before the World Cup at 10 and 15 weeks (striking microcycle) and 17 week (intermediate microcycle). Before the implementation of the anaerobic training program, at the third week of training, sportsmen of high qualification had the following functional characteristics of anaerobic performance (see table 3): ICFP – 429,79 c.u., GPI – 563,77 c.u., IPW – 12,47 c.u., IISPP – 993,56. At the beginning of the sixth week, apparent indicators of karatekas got some improvement: ICFP – 516,64 c.u., GPI – 649,29 c.u., IPW – 13,78 c.u., IISPP – 1165,93 c.u., however, this was carried out without statistically significant reliability ( $p > 0.05$ ) between the first and second measurements ( $\bar{X}_1 \leftrightarrow \bar{X}_2$ ). Pedagogical testing of the characteristics of karatekas special performance in intermediate microcycle has identified higher rates: ICFP – 563,79 c.u., GPI – 751,85 c.u., IPW – 14,79 c.u., IISPP – 1315,64 c.u. Statistically significant reliability is determined between the first and third measurement ( $\bar{X}_1 \leftrightarrow \bar{X}_3$ ) of ICFP, GPI and IPW characteristics – at  $p < 0.05$ , and IISPP – at  $p < 0.01$ .

**Table 3: Indicators of special endurance (indexes of striking efficiency) in the karatekas of high qualification (n=16) in preparation for the national championship.**

indexes of striking efficiency	beginning of striking microcycle (3 week)		$\bar{X}_1 \leftrightarrow \bar{X}_2$	end of striking microcycle (6 week)		$\bar{X}_1 \leftrightarrow \bar{X}_3$	Intermediate microcycle for the national championship (week 7)	
	$\bar{X}_1$	m		$\bar{X}_2$	m		$\bar{X}_3$	m
	ICFP, c.u.	429,79	23,35	$p > 0,05$	516,64	30,65	$p < 0,05$	563,79
GPI, c.u.	563,77	20,01	$p > 0,05$	649,29	40,44	$p < 0,05$	751,85	50,68
IPW, c.u.	12,47	0,36	$p > 0,05$	13,78	0,51	$p < 0,05$	14,79	0,48
IISPP, c.u.	993,56	30,76	$p > 0,05$	1165,93	59,45	$p < 0,01$	1315,64	66,32

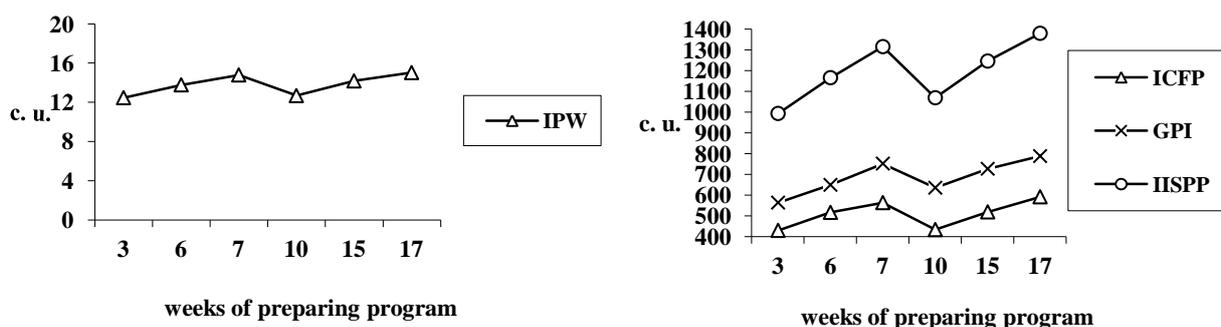
After a week-long recovery microcycle after the national championship, at the beginning of striking microcycle (10 week), the control testing of anaerobic characteristics of performance has established the following average results (table 4): ICFP – 433,79 c.u., GPI – 635,42 c.u., IPW – of 12.68 c.u., IISPP – 1069,20 c.u. After conducting pedagogical testing on the 15 week of karatekas training program, there was a slight improvement in average indicators: ICFP – 519,18 c.u., GPI – 726,91 c.u., IPW – 14,18 c.u., IISPP – 1246,09 c.u., however, between the first and second measurement ( $\bar{X}_1 \leftrightarrow \bar{X}_2$ ) we did not reveal statistically significant reliability ( $p > 0.05$ ). In the intermediate microcycle to the absolute world championship, we determined the following results: ICFP – 591, 82

between the first and third measurement ( $\bar{x}_1 \leftrightarrow \bar{x}_3$ ) of ICFP, GPI and IPW characteristics – at  $p < 0.05$ , and IISPP – at  $p < 0.01$ .

**Table 4: Indicators of special endurance (indexes of striking efficiency) in the karatekas of high qualification (n=16) in preparation for the absolute world championship.**

indexes of striking efficiency	beginning of striking microcycle (10 week)		$\bar{x}_1 \leftrightarrow \bar{x}_2$	end of striking microcycle (15 week)		$\bar{x}_1 \leftrightarrow \bar{x}_3$	Intermediate microcycle for the World Cup (17 week)	
	$\bar{x}_1$	m		$\bar{x}_2$	m		$\bar{x}_3$	m
	ICFP, c.u.	433,79	32,51	$p > 0,05$	519,18	32,65	$p < 0,05$	591,82
GPI, c.u.	635,42	19,49	$p > 0,05$	726,91	48,68	$p < 0,05$	788,05	35,21
IPW, c.u.	12,68	0,46	$p > 0,05$	14,18	0,41	$p < 0,05$	15,03	0,48
IISPP, c.u.	1069,20	45,62	$p > 0,05$	1246,09	48,13	$p < 0,01$	1379,87	57,02

In the process of training load with specified intensity in each microcycle, the dynamics of characteristics (ICFP, GPI, IPW, IISPP) of special endurance level in sportsmen of high qualification in a single training period shows a systematic improvement before the important competition (Figure 2). After completing the first stage of preparation for the national championship, indicators reduce in the recovery microcycle and at 10<sup>th</sup> week remain below the level of the second measurement – at the end of striking microcycle (week 6), followed by further rapid improvement to maximum performance in the beginning of 17<sup>th</sup> week – 6 days before the absolute world championship.



**Figure 2. Dynamics of characteristics of the special endurance level in athletes of high qualification (n=16), specializing in kyokushin kaikan karate in a single-cycle period of training.**

Positive indicators of the studied characteristics were confirmed by sport results of karatekas of high qualification in responsible competitions. Therefore, on the championship of the 16 subject karatekas, prize-winning places in various weight categories were taken by eight athletes, five of which were selected for the absolute world championship in kyokushin kaikan karate 2015. Athletes who were not included in the country's national team, continued to carry out

training with a given load in each microcycle, together with leaders with the aim of subsequent participation in another competition – a prestigious international tournament.

Conducting the analysis of the study results, the following can be stated. While preparing for the qualifying championship, highly skilled athletes specializing in kyokushin kaikan karate should demonstrate the following ranges of special endurance characteristics: ICFP –  $563,79 \pm 27,22$  c.u., GPI –  $751,85 \pm 50,68$  c.u., IPW –  $14,79 \pm 0,48$  c.u., IISPP –  $1315,64 \pm 66,32$  c.u.

For competitive fighting of karatekas in the World Cup, the same indicators should be increased to: ICFP –  $591,82 \pm 32,21$  c.u., GPI –  $788,05 \pm 35,21$  c.u., IPW –  $15,03 \pm 0,48$  c.u., IISPP –  $1379,87 \pm 57,02$  c.u. To achieve the karatekas' high qualification level of the stated indicators, the training load should be planned according to the intensity dynamics, shown in Figure 1.

## **5. Discussions**

Evaluating the results of the study, it can be argued that the planning of the training loads in different structural formations in accordance with the law of super compensation (based on the resynthesis of glycogen in the human body) in the range of optimal intensity improves the level of karatekas' preparedness without causing imbalance in the physiological processes in operation and the subsequent recovery. However, the literature discussion contains the question, how to ensure objective control of the training process in striking types of martial arts, and how to carry out the optimal planning and correction of programs in different structural formations based on the received data. The specifics of the competitive activity does not provide opportunities in the process of the bout in the contact types of martial arts to quantitatively capture the performance of competitive actions of athletes, such as is possible in other sports with units of time, distance, weight, etc. On this basis, greater attention trainers and researchers is the identification and correction of various characteristics in preparatory and precompetitive period of training of the athletes. In recent years, to improve the reliability of research in sport actively applies IT technology.

Let us conduct the analysis of foreign experience of the countries in which martial arts are widespread. One such country is Russia, where, as you know, different types of martial arts have a long history. Scientific developments in this field have the following potential [24]. As you can see, from 1994 to 2014, a number of different specialized simulators and training devices, devices for control informative for martial arts performance were created and patented. It definitely has a positive impact on the performance of athletes using such equipment in the training process. However, only some of the patented devices allow examining the strength, sharpness (speed), the rate and

efficiency of punches or series of punch combinations. In turn, the characteristics of special endurance (striking performance) these devices do not allow fixing. It is difficult to plan the training load for athletes, in the absence of information on functional training of karate in a separate structural education: the potential of a particular athlete in the development of special endurance and performance level of creatine phosphate and glycogen health at the moment.

A device that allows capturing such indicators is a digital chrono-dynamometer "Spuderg". For comparative analysis, the data are taken different impact characteristics of athletes recorded by the researchers on this device, from Boxing [11, 13, 16], kickboxing [26], and Thai Boxing [3]. Therefore, we compare selected indicators boxers of high qualification with the results of our study. According to the data [3] collected from the candidates for the master of sports on Thai Boxing, the results of ICFP are about 269,10 c.u.. According to the research [16] of ICFP in members of the national teams in Boxing, this indicator varies in the range of 550-650 c.u. The maximum result was recorded by scientists in the boxer of the Olympic team of Ukraine in light weight class – 683 c.u. As can be seen from tables 3-4, similar to the average performance of karatekas of high qualification are fixed before national championship level 563, 79 c.u., and in front of the absolute world championship kyokushin kaikan karate – 591,82 c.u.

According to [16], the GPI feature for skilled martial artists should exceed 400 c.u. The maximum recorded result of this characteristic in boxers of light weight was 700 c.u. In our studies, the results obtained from karatekas of high qualification reached 751, 85 c.u. – before the national championship and 788,05 c.u. – before the absolute world championship in kyokushin kaikan karate.

Before the Olympic games of 1996, in boxers of a national team of Ukraine, the IPW indicators were recorded in the range from 12, 94 to 15,66 c.u., and IISPP – 820-899 c.u. (according to the authors [11, 16]). Four years later, before the Olympic games in 2000, a researcher [16] made similar measurements to the characteristics of Ukrainian national team and got the results of 13.59-20.73 c.u. (IPW) and 950-1329 c.u. (IISP). The karatekas of high qualification had the IPW result before national championship equal to 14,79 c.u., and IISPP – 1315,64 c.u., and before the absolute world championship, these figures improved to 15.03 c.u. and 1379,87 c.u.

Despite the differences in the specific study of the martial arts, skill level of subjects of athletes and their weight categories, the stages of preparation and other factors, comparative analysis of the results revealed a homogeneous dependence in the numerical data of scientists who used the "Spuderg" device in the control of the training process. Thus, it is possible to conclude about the information content for widespread use in striking types of martial arts of

this device. This allows increasing the efficiency of control and correction of training process of sportsmen of high qualification specializing in striking martial arts.

Focusing on the world sports practice in the field of martial arts, it can be stated that the level of preparedness of the karatekas in international competitions reaches the limit of human capabilities. In this regard, athletes representing their country at the world Championships should be versatile. Thus, the possibility of achieving victory can be realized at the expense of maximum manifestation of personal endurance that is recognised as a striking performance in the specificity of competitive activities of kyokushin kaikan karate. In coaching, you should focus on the data recorded in our study and implement the calculation of the optimal energy supply for the body of subject karateka – both in training process and in upcoming bouts.

## **6. Conclusions**

1. In this work, the authors highlighted the optimal intensity of training load for athletes of high qualification specializing in kyokushin kaikan karate in a single training period. Planning the intensity of training load is determined in microcycles in a five-month period of preparation for the national Championship and the absolute world championship for karatekas of high qualification.

2. The authors have conducted the monitoring of the level of the special endurance development in karatekas of high qualification before important competitions. On modern digital equipment, we recorded a number of partial indicators – the number and strength of punches of karateka in first and second half of the test, their total number and tonnage, power of striking work, the coefficients and indexes of special striking toughness, and the overall performance of ICFP, GPI, IPW, and IISP. It is established that highly skilled athletes specializing in kyokushin kaikan karate should demonstrate the following ranges of special endurance characteristics: ICFP –  $563,79 \pm 27,22$  c.u., GPI –  $751,85 \pm 50,68$  c.u., IPW –  $14,79 \pm 0,48$  c.u., IISPP –  $1315,64 \pm 66,32$  c.u. in preparing for the qualifying national Championship, and ICFP –  $591,82 \pm 32,21$  c.u., GPI –  $788,05 \pm 35,21$  c.u., IPW –  $15,03 \pm 0,48$  c.u., IISPP –  $1379,87 \pm 57,02$  c.u. for competitive struggle at the World Cup.

3. The authors have conducted the analysis of the dynamics of the special endurance level in athletes of high qualification specializing in kyokushin kaikan karate in a single training period. Dynamics displays statistically significant improvement in the level of special endurance of sportsmen of high qualification before the important competition through the implementation of the training load intensity.

To develop the special endurance in athletes of high qualification specializing in kyokushin kaikan karate, the following practical recommendations should be considered. At the beginning of the one-cycle preparing period, the training load of introductory microcycle should include exercises aimed at developing the general endurance (aerobic mode): 1-week – at an intensity of 60-75% (heart rate 120-155 beats/min); 2nd week at an intensity of 75-80% (heart rate 155-160 beats/min). Exercises can serve both as an additional training tool – motocross running, swimming, cycling, skiing, etc.; and as a basic one – implementation of technical-tactical actions, exercises with a partner, working with special equipment and gears for martial arts, etc.

In the period of the striking and intermediate microcycles, there is a need to execute training load intensity in the range of 90-100% (heart rate 180-200 beats/min), i.e. mainly in the anaerobic mode, aimed at improving personal endurance in karatekas. Training load should contain special exercises, which are close to competitive. Therefore, the duration of training exercises should not exceed three minutes, similar to the rules of one round in a bout in kyokushin kaikan karate.

For further research, it is planned to conduct analysis of energy supply of muscle activity in the qualified athletes in each round of intensive competitive bout in kyokushin kaikan karate.

## **References**

1. Ashanin V. S., Romanenko V. V. The use of computer technologies in the assessment of sensorimotor responses in the martial arts. *Sloboda science and sport bulletin*; 2015; 4(48), 15-18 p.
2. Boychenko N. V., Pashkov I. M., Ananchenko K. V. Improving the combinative technique of the karatekas in the "Kyokushin" style. *Sloboda science and sport bulletin*; 2015; 1(45), 29-33 p.
3. Vachev S. M. Comparative analysis of the level of specialized “exploding” work in striking techniques of thaiboxers of high-mass categories and athletes of high qualification. *Problems and prospects of sports development and martial arts in higher educational institutions* 2006, 31-34 p.
4. Vovkanich L. S., Dunets-Lesko A. V. Factor analysis of the structure of the special preparedness of sportsmen. *Theory and methodology of physical education* 2012; Volume 3, 36-40 p.
5. Volkov N. I., Osipenko A. A., Nessen E. N., Korsun S. N. *Biochemistry of muscle activity*. Kyiv, Olimpijskaia literatura 2000, 498 p.
6. Galimski V. A. The influence of the karate technique elements on the functional state and physical preparedness of cadets of Flight Academy. *Sloboda science and sport bulletin*; 2015; Issue 1(45), 43-47 p.

7. Dunets-Lesko A. V., Vovkanich L. S., Bohdan I., Ostrovskiy M. Special performance of sportsmen and its improvement by modifying training loads. *Young sport science of Ukraine* 2012; V. 1, P. 75-79.
8. Zemtsova I. I. *Sports physiology*. Kyiv, Olimpijskaia literatura; 2010, P. 219.
9. Zimkin N. V. *Physiological characteristics of strength, speed and endurance*. – Moscow, FiS; 2006, P. 205.
10. Katanskiy S. A., Kasianov T. R. *Theory and practice of martial arts*. In 4 volumes. Moscow, Sovetskiy sport; 2013, P. 1897.
11. Klichko V. V., Savchin M. P. System of tests for assessing special fitness of the boxers of high qualification. *Science in Olympic sport*; 2000; Volume 2, P. 23-30.
12. Matveev L. P. *The general theory of sport and its applied aspects*, Saint Petersburg, “Lan” press; 2005, P. 384.
13. Nikitenko A. O., Nikitenko S. A., Busol V. V., Nikitenko A. A., Velichkovich M. R., Martsiv V. P. The relations of indicators of speed and power qualities of combat athletes at the stage of specialized basic training. *Pedagogy, psychology, and medical-biological problems of physical training and sports*; 2013; Volume 1, P. 49-55.
14. Platonov V. N. *The system of sportsmen preparation in Olympic sport. The general theory and its practical applications*. Kyiv, Olimpijskaia literatura 2015, Volume 1, P. 680.
15. Rovniy A. S., Rovniy V. A., Rovna O. O. *Physiology of motor activity*. Kharkiv, Kharkiv National Automobile and Highway University; 2014, P. 343.
16. Savchin M. P. *Fitness of the boxer and its diagnostics*. Kyiv, Nora-print; 2003, P. 220.
17. Saenko V. G. *kyokushin kaikan karate: the system of physical training of the student monography*. Nikopol, Nikopol Economic University; Lugansk, SEP Reznikov V. S., 2010, P. 228.
18. Saenko V. G. *The system of Kyokushinkai karate: basics of scientific knowledge of sports skills, military crafts, martial arts, monography*. Lugansk, SEP Reznikov V. S., 2010, P. 300.
19. Saenko V. G. *Development and control of training process of athletes in kyokushin kaikan karate, monography*. Lugansk, SEP Reznikov V. S., 2012, P. 404.
20. Smirnov V. M., Dubrovskiy V. I. *Physiology of physical education and sport*. Moscow, VLADOS-PRESS; 2002, P. 608.
21. Solodkov A. S., Sologub E. B. *Human physiology. General. Sports. Age-specific*. Moscow, Soviet sport; 2012, P. 618.

22. Stepanov S. V., Dvorkin L. S. Theoretical and methodological foundations of long-term preparation of sportsmen. Moscow, Theory and practice of physical culture; 2004, P. 380.
23. Tolcheva A. V. A complex of Hatha yoga exercises for recovery of athletes after training loads. Problems and prospects of sports and martial arts development in higher educational institutions; 2015, P. 153-155.
24. Training devices and facilities for exercises in the special sport arts: training equipment for boxing or football – A63B 69/34 [Electronic source]. – Retrieved from:
25. Shorshorov S. A. The content of the manners training of combat conduct in kyokushin kaikan karate: synopsis of a thesis by PhD, Associate professor: 13.00.04. Moscow, RUSSIAN STATE ACADEMY OF PHYSICAL EDUCATION; 2002, P. 23.
26. Yaremko M. O. Experimental substantiation for the improving method of power performance of kickboxers' leg kicks at the stage of preliminary basic training. Theory and methodology of physical education 2003; Volume 3, P. 21-25.
27. Chaabene H., Franchini E., Sterkowicz S., Tabben M., Hachana Y., Chamari K. Physiological responses to karate specific activities. Science & Sports, Elsevier Masson 2015; Issue 30 (4), P. 179-187.
28. Chaabene H., Hachana Y., Franchini E., Tabben M., Mkaouer B., Negra Y., Hammami M., Chamari K. Criterion Related Validity of Karate Specific Aerobic Test (KSAT). Asian journal of sports medicine 2015; Vol. 6 Issue 3, P. 1-7.
29. Filho B.J., Frosi T.O., Lima C.S. Análise cinesiológica do movimento chūdan gyaku zuki. Conexões: revista da Faculdade de Educação Física da UNICAMP, Campinas, 2013; Issue 11(3), P. 36-49.
30. Górski J. Fizjologia wysiłku i treningu fizycznego. Warszawa, Lekarskie PZWL 2011; P. 293.
31. Grigorian M. Karate-do: A basic manual of karate. Empire books 2009; P. 262.
32. Kavoura A., Ryba T.V., Kekkonen M. Psychological Research on Martial Artists: A Critical View from a Cultural Praxis Framework. Scand Sport Stud Forum 2012; Volume 3, P. 1-23.
33. Knapik J., Darakjy S., Scott S.J., Hauret K.G., Canada S., Marin R., Rieger W., Jones B. H. Evaluation of a standardized physical training program for basic combat training. Journal of Strength & Conditioning Research 2005; Volume 19(2), P. 246-253.
34. Kuśnierz C. Values associated with practicing modern karate as a form of cultivating old Japanese Bushido patterns. Ido Mov Cult 2011; Volume 11, P. 1-5.

35. Martial arts of the world: An Encyclopedia of History and innovation / by edit. T.A. Green, J.R. Svinth. USA, ABC-CLIO 2010, P. 833.
36. Nunan D. Development of a sports specific aerobic capacity test for karate: a pilot study. *Journal of Sports Science and Medicine*, 2006; Volume 5, P. 47-53.
37. Olin S.V., Struihin I.A. Eganov V.A. Defensive technical and tactical actions in the structure of preparedness in karate kiokusinkay. *Martial arts & combat sports : status and prospects of development 2011*, P. 214-216.
38. Padulo J., Chaabene H., Tabben M., Haddad M., Gevat C., Vando S., Maurino L., Chaouachi A., Chamari K. The construct validity of session RPE during an intensive camp in young male Karate athletes. *Muscles, ligaments and tendons journal* 2014; Issue 4(2), P. 121-126.
39. Ralph B. Energetics of karate kumite. *Eur J Physiologyh* 2004, P. 518-523.
40. Roschel H., Batista M., Monteiro R., Bertuzzi R.C., Barroso R., Loturco I., et al. Association between neuromuscular tests and kumite performance on the Brazilian Karate National Team. *Journal sport scientific medicine* 2012; Volume 21, P. 23.
41. Sprague M. Strength and power training for martial arts. Turtle press 2005, P. 240.
42. Tabben M., Coquart J., Chaabene H., Franchini E., Ghoul N., Tourny C. Time-motion, tactical and technical analysis in top-level karatekas according to gender, bout outcome and weight categories. *Journal sport scientific* 2015; Issue 33(8), P. 841-849.
43. Rogowska A., Kuśnierz C. Determinants of the attitude towards combat sports and martial arts. *Journal of Combat Sports and Martial Arts. MEDSPORTPRESS* 2013; Issue 2(2); Vol. 4, P. 185-190.
44. Tabben M., Sioud R., Haddad M., Franchini E., Chaouachi A., Coquart J., et al. Physiological and perceived exertion responses during international karate kumite competition. *Asian journal of sports medicine* 2013; Issue 4(4), P. 263-271.
45. Tsui F., Pain M.T.G. Utilising human performance criteria and computer simulation to design a martial arts kicking robot with increased biofidelity. *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology* 2012; P. 244-252.

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