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Original Article

Optimization of judoist training process at a stage of gradual decline of sporting achievements

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Abstract.
Purpose: to determine the possibility of increasing the level of physical preparedness for competitive judoist activity by means of hypoxic influences at the stage of gradual reduction of sport achievements. **Result:** after ten sessions of hypoxic effect during recurrent respiration in confined space and circular special training, a significant increase in the level of physical fitness and competitive activity of judo athletes is observed. The research materials are based on the laws of adaptation of the organism to a gradual decrease in the volume of oxygen (O_2) in the respiratory air. In the process of integrated hypoxic training (IHT) cardiovascular (respiratory system) and respiratory systems (pulmonary ventilation (RMV), respiratory rate (RR), oxygen utilization factor (OUF_2) were recorded, in addition, the percentage of carbon dioxide ($FeCO_2$) and oxygen (FeO_2) in the exhaled air were determined. To determine the dependence of the level of athletes 'preparedness on hypoxic stability, the linear multiple regression coefficient was used, which determines the level of each factor in the development of the level of physical qualities and indicators of athletes' competitive activity. Calculation of the coefficient of reverse step regression makes it possible to establish the most important factors in hypoxic productivity. **Materials of the study:** indicate the need to include in the training process hypoxic effects. The competition activity of judoists is carried out under the influence of complex hypoxic influences and therefore the inclusion of IHT and special physical hypoxic influences contributes to an increase in the level of anaerobic performance and special competitive activity. **Conclusions:** results of the conducted studies determined the adaptive patterns of the oxygen transport system of judoists to hypoxic influences at the stage of gradual reduction of sport achievements. Inclusion in the training process of interval hypoxic training and special sports hypoxic exercises contributed to an increase in the level of physical fitness and competitive activity, which gives grounds for the introduction of hypoxic means in practice.
Keywords: adaptation, judo, hypoxia, interval normobaric hypoxic training.

Introduction.

The current level of sporting achievements, according to the leading scientists of physical culture and sports (Rovniy, 2008; Platonov, 2015; Tsos, et al., 2018; Rovniy, et al., 2018;) has exacerbated the sport competition of competitive activities at various levels (Rovniy, Pasko, Galimskyi, 2017; Rovniy, Pasko, Stepanenko, Grebeniuk, 2017; Ashanin, et al., 2018; Nesen, et al., 2018). This puts forward great demands on the system of training athletes at different stages of sports training. It has been established that with an increase in the age of athletes, the physical preparedness and level of the functional state of the athlete's body are significantly reduced (Perevoznik, 2004; Rovniy, 2008; Platonov, 2013), which makes it necessary to improve the training process for the continuation of sports activities. The rationality of the training process makes it possible to successfully use the adaptive reserves of the organism, without applying extreme loads, however, to maintain a highly effective competitive activity (Platonov, 2015). Thus, despite the huge loads of modern sports, the most intense competition in the largest international competitions, many athletes of considerable age are performing at the highest level.

Modern studies have shown that increasing the effectiveness of the training process is carried out in the presence of a systematic approach (Ananchenko, & Grin, 2006; Kashuba, Khmelnitska, & Krupenya, 2012).

The study of literary sources shows that the system of training in combat sports is based on subjective approaches, rather than on objective information about the functional systems of the body and the level of special preparedness of athletes (Rovnaya, & Ilyn, 2010; Pasko, 2014).

However, research materials already exist (Jagiello, Kalina, Klimczak, Ananczenko, Ashkinazi, & Kalina, 2015), which show that the management of the training process must be carried out in conditions as close to competitive and on the basis of quantitative characteristics of physical preparedness for competitive activities (Bailey, Davies, & Baker, 2000; Pasko, 2014).

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The current level of judo development places high demands on the level of physical qualities and functional capabilities that are carried out under hypoxic conditions.

The motor activity of judoists is characterized by a great variety of techniques that are performed with a constant change in the situation in the static and dynamic modes (Ananchenko, & Grin, 2006; Mulyk, & Kiyko, 2017; Ananchenko, Perebeynos, Pakulin, & Franken, 2018).

Continuous motor activity is 70-150 s, which is provided by anaerobic capacity (Ashanin, Pasko, Podolyaka, Rovnyy, & Yermolaiev, 2015; Ananchenko, Perebeynos, Makhankov, & Pakulin, 2018).

The lack of objective data on the technology of hypoxic training of judoist, the role of optimization of hypoxic effects, and determined the direction of these studies.

Materials and methods.

Participants. In the study, judo athletes from the middle group (73-78 kg) aged 35-40 took part. The level of readiness corresponded to the master of sports and the master of sports of the international class. A total of 18 athletes took part.

Design of the study suggested the development of a method for hypoxic training based on research materials Kolchinskaya A.Z. (2003), which included a method of recurrent respiration in a confined space (Douglas bag with a volume of 20 liters). The session consisted of 10 series of recurrent respiration, each of which lasted up to an independent cessation of breathing for well-being. The air collected in a Douglas bag was passed through the gas clock and the parameters of the cardiovascular and respiratory systems. The course of hypoxic normobaric training consisted of 10 sessions, which were conducted for 10 series with short breaks at the end of each training session.

Second hypoxic task was a circular training, including 5 tasks, which were performed at the maximum tempo lasting 15 seconds. The transition from one exercise to another passed without rest. Circuit training included such assignments: 1. Jumping in place with the pulling of the knees to the chest (number of times); 2. Lifting rod weighing 30 kg to the chest (the number of times); 3. Tackles of the partner (number of times); 4. Lifting the trunk from the rest lying on the hips on the gymnastic horse (number of times); 5. Shuttle run 5x10 m (number of times). Circular training was conducted immediately after the warm-up.

Statistical analysis. Generalization of the studied characteristics was assessed by mean arithmetic value, standard deviation and error of mean arithmetic. Confidence of differences between mean values was stated by Student's t-criterion. Assessment of statistical hypothesizes based on 5% significance level. For statistical processing of data we used licensed program Microsoft Excel (2010). Statistical analysis of the received results was conducted, considering recommendations on Microsoft Excel tables' usage for computer data analysis.

To establish the role of hypoxic training in increasing anaerobic productivity, the method of multiple regression analysis was used, which makes it possible to determine the role of each factor in the adaptation mechanism, as well as in the indicators of competitive activity.

Results of the study and their discussion.

During the study of recurrent respiration, its duration in each series was recorded. An explicit linear relationship between the indices of the duration of respiration, the increase in $FeCO_2$, and the decrease in FeO_2 in the exhaled air was established (Table 1).

Table 1

Indicators of the oxygen-transport system of judo at the beginning of hypoxic training (n=17)

T, min	$FeCO_2$, %	FeO_2, %	BC, l	RR	RMV, l/min	HR beats/min	OUF_2, ml/min
7,50±0,03	2,80±0,02	190,3±0,07	0,66±0,01	12,50±0,09	8,64±0,02	65,00±0,70	32,30±1,40
7,30±0,07	5,21±0,01	17,21±0,04	0,62±0,03	19,30±0,08	9,89±0,01	71±0,78	33,72±0,91
5,65±0,03	9,45±0,02	15,12±0,01	0,63±0,07	19,85±0,04	10,97±0,03	71,21±0,17	33,30±0,70
4,12±0,06	6,11±0,03	14,11±0,04	0,60±0,03	18,80±0,04	11,40±0,05	70,05±0,91	31,40±0,04
3,10±0,02	6,30±0,01	13,81±0,01	0,56±0,01	17,20±0,03	12,38±0,07	74,31±1,11	29,71±1,10
2,62±0,01	6,71±0,02	13,85±0,04	0,68±0,08	19,81±0,04	11,55±0,03	82,51±1,03	30,41±0,71
2,20±0,03	7,28±0,02	12,98±0,08	0,62±0,04	20,88±0,07	12,75±0,02	94,53±1,01	29,11±0,91
1,85±0,03	7,48±0,01	11,95±0,08	0,58±0,05	28,31±0,04	13,45±0,05	109,15±1,41	26,61±0,75
1,75±0,03	7,80±0,01	11,25±0,03	0,54±0,07	28,30±0,05	13,68±0,07	115,00±1,121	27,37±0,09
0,70±0,04	7,92±0,02	10,83±0,06	0,55±0,04	29,75±0,07	14,15±0,06	117,55±1,35	26,00±1,05

Analysis of the results of hypoxic effects indicates a significant change in the parameters of the oxygen-transport system in the first session. The total respiration time in the confined space was 36.79 minutes. There is an increase in respiratory function due to increased hypoxic effects. This is primarily due to the increase in $FeCO_2$ in the exhaled air by 28.4% and the decrease in FeO_2 by 89.4%. The increase in pulmonary ventilation (RMV) by 25.0% was due to an increase in respiratory rate (RR) by 22.8%. Significantly increased the function of blood supply. Thus, the HR (heart rate) increased on 20.0% and the oxygen utilization factor (OUF_2) decreased by 18,8%.

To determine the mechanisms of adaptation in ensuring maximum anaerobic productivity, a regression analysis method was used that determines the role of each factor in providing hypoxic performance.

Mathematical models of regression analysis show the interaction of intersystem and intrasystemic connections in the regulation of the duration of recurrent respiration (formula 1):

$$T_{min1}=3,75\times RR+5,87\times BC+2,19\times HR+2,78\times RMV-1,25\times OUF_2+0,93\times FeCO_2+3,05\times FeO_2 \quad (1)$$

where T_{min1} – duration of recurrent respiration in the first session; RR – respiratory rate; BC – breathing capacity; HR – heart rate; RMV – respiratory minute volume; OUF_2 –oxygen utilization coefficient; $FeCO_2$ – concentration of carbon dioxide in the exhaled air; FeO_2 – oxygen concentration in the exhaled air.

Thus, the multiple regression equation determined the main factor in ensuring an urgent adaptation to the conditions of hypoxia are respiratory rate, respiratory volume and heart rate. This confirms the inverse step regression equation (formula 2):

$$T_{1min} =7,58\times RR+4,57\times BC+3,75\times HR \quad (2)$$

where T_{1min} – duration of recurrent respiration in the first session; RR – respiratory rate; BC – breathing capacity; HR – heart rate.

Thus, the mechanism of urgent adaptation is limited by the level of functionality of the respiratory and circulatory system.

During the experiment after the tenth series of recurrent respiration in a confined space, adaptation reactions to hypoxic effects changed. The multiple regression equation has this kind of interrelation of providing factors (formula 3):

$$T_{2min} =6,32\times OUF_2+5,48\times FeO_2+3,12\times RR+2,85\times RMV+2,58\times BC-2,81\times HR+3,15\times FeCO_2 \quad (3)$$

where T_{2min} – duration of return breathing in the tenth session; OUF_2 –oxygen utilization coefficient; FeO_2 – oxygen concentration in the exhaled air; RR – respiratory rate; RMV – respiratory minute volume; BC – breathing capacity; HR – heart rate; ; $FeCO_2$ – concentration of carbon dioxide in the exhaled air.

The multiple regression equation indicates that at the end of the tenth session, the oxygen utilization factor is the most important in providing hypoxic adaptation. The inverse step regression equation defines three main factors in ensuring the duration of recurrent respiration in an enclosed space (formula 4):

$$T_{2min} =5,72\times OUF_2+4,37\times RMV +3,74\times FeO_2 \quad (4)$$

where T_{2min} – duration of return breathing in the tenth session; OUF_2 –oxygen utilization coefficient RMV – respiratory minute volume; FeO_2 – oxygen concentration in the exhaled air.

Normobaric hypoxic training of judo athletes continued 10 sessions, each of which was 10 series. The presented research materials after 10 sessions (Table 2) indicate a significant increase in the duration of recurrent respiration in each series.

Table 2

Dynamics of the duration of recurrent respiration and functional state of the oxygen transport system of judoists after the tenth session (n=17)

T_2, min	$FeCO_2$, %	FeO_2, %	BC, l	RR	RMV, l/min	HR beats/min	OUF_2, ml/min
8,71±0,03	1,80±0,01	19,30±0,07	0,72±0,01	12,50±0,90	8,46±0,02	65,50±0,70	39,50±0,40
7,12±0,07	4,00±0,03	17,50±0,10	0,76±0,03	13,30±0,08	9,88±0,03	72,30±0,71	38,30±0,50
6,63±0,02	5,40±0,02	15,50±0,06	0,78±0,02	14,20±0,07	10,90±0,01	73,00±0,60	35,40±0,70
4,51±0,04	6,30±0,01	14,30±0,02	0,75±0,04	15,40±0,09	11,40±0,02	81,70±1,01	33,10±0,60
3,62±0,01	6,50±0,04	14,10±0,01	0,70±0,03	16,00±0,07	11,36±0,90	94,40±1,11	30,70±0,40
2,81±0,02	6,90±0,07	13,80±0,06	0,66±0,01	17,40±0,02	11,38±0,04	99,50±1,05	30,90±0,60
2,60±0,01	7,40±0,02	13,00±0,18	0,63±0,07	18,60±0,08	11,48±0,03	102,70±1,50	29,90±0,70
1,83±0,03	7,60±0,03	12,40±0,05	0,62±0,03	19,30±0,04	12,16±0,02	104,30±1,20	28,50±0,50
1,77±0,02	7,80±0,02	12,30±0,04	0,63±0,03	20,50±0,10	13,40±0,05	106,40±1,01	27,80±0,30
1,71±0,03	8,10±0,04	11,80±0,09	0,63±0,02	21,30±0,07	13,44±0,03	108,50±1,21	27,00±0,70

Analysis of the results of the study after the tenth session of normobaric hypoxia indicates significant changes in the duration of the respiration of judoists and the functional activity of the oxygen transport system. Thus, the duration of recurrent respiration in confined space was 44.01 min, which is 12.8% more than in the first session ($p<0,01$). In this adaptation mechanism, a significant change in the functions of the oxygen transport system is observed. Thus, the $FeCO_2$ index decreased in the tenth series at the end of the session by 28.2%, and the FeO_2 index increased by 35,4%. Therefore, a decrease in the breathing capacity by 12.5% is observed, but the respiratory rate is increased by 52.3%, which increased the RMV by 61.5%. The heart rate in the tenth series decreased compared to the baseline data by 10.4%, and the OUF_2 increased from the first session after the tenth session 27,3%. Thus, ten sessions of recurrent respiration contributed to a decrease in $FeCO_2$, which caused an increase in RMV due to an increase in respiratory rate and by increasing the oxygen utilization factor.

After the tenth session of recurrent respiration in a confined space, adaptation reactions to hypoxia changed significantly. The multiple regression equation shows this kind of interrelation of the supporting factors (formula 5):

$$T_{2min}=6{,}32\times OUF_2+5{,}48\times FeO_2+3{,}12\times RR+2{,}58\times BC—2{,}81\times HR–1{,}25\times RMV+1{,}15\times FeCO_2 \quad (5)$$

where T_{2min} – duration of return breathing in the tenth session; OUF_2 –oxygen utilization coefficient; RR – respiratory rate; BC – breathing capacity; HR – heart rate; RMV – respiratory minute volume; $FeCO_2$ – concentration of carbon dioxide in the exhaled air; FeO_2 – oxygen concentration in the exhaled air.

With the help of the inverse step regression equation, the two most important factors in ensuring the duration of recurrent respiration are defined (formula 6):

$$T_{2min} =5{,}72\times OUF_2+4{,}37\times FeO_2 \quad (6)$$

where T_{2min} – duration of return breathing in the tenth session; OUF_2 –oxygen utilization coefficient; FeO_2 - oxygen concentration in the exhaled air.

The problem of optimizing the training of judoists at the age of 35-40 years at the stage of gradual reduction of sports achievements is characterized by the fact that the manifestation of physical qualities in competitive activity is hampered by hypoxic effects (Bernardi, Passino, & Wilmerding, 2001; Rovniy, Pasko, & Grebeniuk, 2016).

Physical qualities contribute to the mastering of complexly coordinated technical elements that ensure the ability of athletes to manifest specific motor functions: static and dynamic equilibrium; accuracy of movements (hack, throws); restructuring of motor activity and coordination of movements (Hochachka, Rupert, & Monge C. 1999; Jagiello, Kalina, Klimczak, Ananczenko, Ashkinazi, & Kalina, 2015).

To study the manifestation of physical qualities, general training and special exercises of judoists were used in the number of 17 people who were engaged 3 times a week and took part in competitions corresponding to the stage of gradual reduction of sports results. Materials of the study are presented in Table 3.

Table 3

Indicators of physical readiness of judoists 35-40 years before and after hypoxic effects (n=17)

Tests	Before the experiment	After the experimen	p
	$\bar{x} \pm m$	$\bar{x} \pm m$	
Cooper test, m	2621,17±18,16	2788,23±19,34	<0,05
Running at 30 m from a high start, s	4,59±0,08	4,45±0,07	<0,05
Standing long jump, cm	234,21±1,11	243,14±0,71	<0,05
Vertical jump, cm	36,87±0,09	43,92±0,16	<0,05
Fivefold jump, m	12,31±0,14	12,77±0,11	<0,05
Shuttle run (4x10 m), s	11,18±0,05	10,30±0,07	<0,05
Running at 200 m, s	32,17±0,28	30,57±0,48	<0,05
Pulling on the crossbar, number of times	16,68±0,07	22,16±0,03	<0,01
Time for 10 pull-ups on the crossbar, s	12,43±0,16	9,41±0,07	<0,05
Time for 18 throws, s	42,19±0,16	36,51±0,12	<0,01
Group of throws, number of times	4,12±0,03	6,81±0,07	<0,01

The presented research materials testify that hypoxic influence contributes to increasing the level of physical fitness of judoists. Especially it concerns different types of endurance. Thus, the Cooper test score increased by 4.4% ($p<0{,}05$), which was facilitated by an increase in the total duration of respiration in an enclosed space and the establishment of a reliable correlation between them ($r=0{,}674$; $p<0{,}01$). Normobaric hypoxic training caused a significant change in all indicators. However, it is necessary to note first of all the changes in the indicators with the manifestation of speed and speed-strength endurance. So, the result of running at 200 m improved by 8.5% ($p<0{,}01$) at the level of correlation with the respiration rate in the confined space ($r=0{,}684$; $p<0{,}001$).

One of the indicators of competitive activity is the number of evaluated special techniques (pick-ups, throws, hooks, coups). After the impact of ten sessions of recurrent respiration in a confined space, the number of special receptions increased by 29,5% ($p<0{,}001$).

One of the indicators of competitive activity is the number of evaluated special techniques (pick-ups, throws, hooks, coups). After the impact of ten sessions of recurrent respiration in confined space and the conduct of circular training of special techniques increased by 29,5% ($p<0{,}001$).

With the purpose of establishing the mechanism of increasing the level of competitive activity (the number of performed procedures that are estimated in points), we performed the calculation of the equation of regression analysis, which objectively shows the role of each factor (physical and hypoxic) in ensuring the performance of technical methods (formula 7):

$$NH=5{,}47\times TT_{18}+7{,}42\times TP_{10}+3{,}57\times R_{30}–2{,}75\times SR–2{,}73\times R_{200}–1{,}73\times PP_n+2{,}71\times VJ+1{,}75\times SJ+0{,}57\times F_5 \quad (7)$$

where NH – number of performed hold; TT_{18} – time for 18 throws; TP_{10} – time for 10 pull-ups on the crossbar; R_{30} – running at 30 m; SR – shuttle run; R_{200} – running at 200 m; PP_n – pulling on the crossbar; VJ – vertical jump; SJ – standing long jump; F_5 – fivefold jump.

The presented equation shows that the most important factor in the implementation of technical techniques is the time of completion of 18 throws.

The calculation of reverse step regression and determines three important factors (formula 8):

$$NH=5,32\times TT_{18}+3,73\times TP_{10}+2,88\times\times R_{200} \quad (8)$$

where NH – number of performed hold; TT_{18} – time for 18 throws; TP_{10} – time for 10 pull-ups on the crossbar; R_{200} – running at 200 m.

Determination of the degree of influence of interval hypoxic training (IHT) on the indicators of competitive activity (number of estimated executed techniques) of judoists was made by the degree of change in the parameters of the oxygen transport system when calculating the multiple regression equation (formula 9):

$$NH=5,72\times T_{2min}+7,12\times RMV+2,85\times BC+3,05\times RR–$$
$$–2,35\times OUF_2–2,25\times HR+3,12\times FeO_2+1,12\times FeCO_2 \quad (9)$$

where NH – number of performed hold; T_{2min} – duration of return breathing; RMV – respiratory minute volume; BC – breathing capacity; RR – respiratory rate; OUF_2 –oxygen utilization coefficient; HR – heart rate; FeO_2 – oxygen concentration in the exhaled air; $FeCO_2$ – concentration of carbon dioxide in the exhaled air.

The equation of multiple regression indicates that at the end of the tenth session, the total time of breathing in a closed space and the minute volume of breathing have the most important value in achieving the number of indicators of competitive judo activity. The inverse step regression equation determines the three main factors in achieving the indicators of competitive activity (formula 10):

$$NH=6,27\times RMV+7,32\times OUF_2+4,78\times T_{2min} \quad (10)$$

where NH – number of perfomed and evaluated hold; RMV – respiratory minute volume; OUF_2 – oxygen utilization coefficient; T_{2min} – duration of return breathing.

Thus, the conducted studies in determining the optimization of the training process of judo athletes at the stage of a gradual decrease in athletic performance of hypoxic effects confirm our assumption that IHT contribute to an increase in the special working capacity and level of sports activity and does not cause excessive stresses of the oxygen transport system.

Discussion.

Modern professionalism in sports causes a lot of problems, one of which is a significant extension of sports activities. Despite the established factors for reducing physical performance and competitive performance, scientists in many countries are trying to find ways to optimize the training process to extend the competitive activity of athletes (Khudolii, Iermakov, & Ananchenko, 2015; Olivier Girard, Frank Brocherie, Jean-Benoit Morin ,& Gregory P. Millet, 2016).

At present, there are significant research materials that show that the management of the training process must be based on the definition of optimization of training loads in conditions close to the competitive (Pasko, 2010). It is the application of such training conditions that contributes to the formation of adaptive mechanisms of the body's functional systems to ensure special performance (Rovniy, et al., 2018).

At present, normobaric hypoxic effects are widely used in the training process, which are one of the effective means of increasing specific performance.

Heikki Rusko, Heikki Tikkanen, & Juha Peltonen (2004) deserve special attention, where it is shown that increasing the efficiency of adaptation of functional systems due to the alternation of hypoxic and normobaric loads leads to a minimum of harmful effects in chronic hypoxia.

In a study by Jagiello, Kalina, Klimczak, Ananczenko, Ashkinazi, & Kalina (2015) and Rovniy, Pasko, & Martyrosyan (2017) it was shown that a significant increase in the adaptive capacity of the organism is due to the preservation of biochemical equilibrium. The presented research materials determine the prospects for the introduction of hypoxic influences in the training process of judoists, which determine the objective indicators of special training in maintaining long-term sports activities of athletes.

Adaptation of the body's systems to the conditions of normobaric hypoxia is a complex integral reaction in which intrasystemic and intersystem rebuilding of the organism is manifested, which determines the special efficiency of judoists (Bailey, Davies, & Baker, 2000; Rovniy, Pasko, Dzhym, & Yefremenko, 2017).

This scientific position is confirmed in our studies when optimizing the training process of judoists due to the influence of normobaric interval hypoxia. After the tenth session, the main factors of adaptation to the effects of hypoxia are the respiratory minute volume (RMV), the oxygen utilization factor (OUF_2), the total respiration time (T_{2min}). The materials of our studies are confirmed by the data of Rovnaya, & Ilyn (2010), Ashanin, Pasko, Podolyaka, Rovnyy, & Yermolaiev, (2015) and Rovniy, Pasko, & Martyrosyan (2017) that the main factors of special working capacity are the functionality of the oxygen transport system.

In the studies Ananchenko, Perebeynos, 2012, Rovniy, Pasko, & Martyrosyan (2017) and Ananchenko, Perebeynos, Pakulin, & Franken (2018) showed that to achieve results in martial arts is the level of consumption and use of oxygen, the energy cost of physical loads and the level of adaptive reserves of the body.

Acknowledgment of our research is the research data (Kashuba, Khmelnitska, & Krupenya, 2012; Jagiello, Kalina, Klimczak, Ananczenko, Ashkinazi, & Kalina, 2015; Olivier Girard, Frank Brocherie, Jean-Benoit Morin, & Gregory P. Millet, 2016), which show that in martial arts at the initial stages of hypoxic preparation, the increase in FeO_2 is a stimulator of increased ventilation of the lungs, which is due to the respiratory rate with a slight decrease in the depth of breathing. One of the mechanisms of adaptation to hypoxia is the rate of gas exchange in the lungs and the delivery of O_2 by blood to the working muscles (Hochachka, Rupert, & Monge, 1999; Bernardi, Passino, & Wilmerding, 2001; Kolchinskaya, Tsiganova, & Ostapenko, 2003).

Conclusion. The conducted researches have established specific adaptation regularities of optimizing the training process of judoists.

Hypoxic normobaric training is a similar condition for competitive judoists activities and does not cause a significant strain on the oxygen transportation system, contributes to a significant increase in general and special physical preparedness.

The application of regression analysis allowed to establish the leading factors in the implementation of the mechanisms of hypoxic adaptation.

To optimize the training process, it is necessary to combine the interval normobaric hypoxia with special training tests which brings the training process closer to competitive conditions.

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