SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

UDK 796.525+796.015.576

ISSN (English ed. Online) 2311-6374
2017, №5(61), pp. 47-50

An influence of interval hypoxic training on physical readiness indicators of trained mountaineers

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Purpose: *determine the influence of interval hypoxic training (IHT) on the indices of physical preparedness at the stage of precompetitive preparation for overcoming Mount Elbrus.*

Material & Methods: *to determine the level of manifestation of physical qualities, the exercises recommended for the training of climbers and methods of mathematical statistics with the calculation of well-known indicators were used to establish the correlation dependence and the reliable difference between the group indices.*

Results: *the conducted studies made it possible to establish that the use of the regime of discontinuous hypoxia 15–15 with breathing through the system into a closed space in the training process of the precompetitive period contribute to an increase in the indices of physical fitness of climbers.*

Conclusion: *the results of the conducted studies indicate that the use of IHT in the 15–15 mode in the period before the ascent to the city of Elbrus allows to significantly increasing the indices of physical preparedness (mainly exercises with a delay in breathing) and the anaerobic and aerobic endurance of skilled climbers in the pre-competition stage.*

Keywords: *climbers, hypoxic training, physical preparedness.*

Introduction

Mountaineering combines the use of two types of sporting activities - mountain tourism (movement with cargo along gentle slopes) and rock climbing (overcoming steep rocky rocks with the use of special equipment) in conditions of increasing hypoxia.

Therefore, in comparison with other types of sports activities', mountaineering has its own specific features associated with staying in the mountainous area [7; 8].

When constructing a summer macrocycle in sports practice, it is recommended to take into account the phenomenon of "transformation is understated", which implies an increase in efficiency and the formation of motor qualities, which decrease somewhat after the athlete fulfills the corresponding loads, and the peak of the increase in results does not coincide with the most significant increase in the volume of the load [2; 5]. In this connection, it is necessary to significantly increase the volume of the load, which will take some time before the volumes of training loads are transformed into an increase in physical performance and the achievement of sports results [3]. Thus, the increase in the volume of loads plays a leading role in the formation of the foundation for the following achievements, and intensification plays a leading role in the realization of sporting achievements on the basis of the fulfilled volume of loads [6; 9].

The preparatory period is of great importance for the successful overcoming of the planned mountain ascents, especially the stage of pre-country walk preparation [4].

The purpose of the research: determine the influence of interval hypoxic training (IHT) on the indices of physical preparedness at the stage of precompetitive preparation for overcoming Mount Elbrus.

Material and Methods of the research

To determine the level of manifestation of physical qualities, the exercises recommended for the training of climbers and methods of mathematical statistics with the calculation of well-known indicators were used to establish the correlation dependence and the reliable difference between the group indices.

Results of the research and their discussion

Our analysis of the content of pre-country walk training (analysis of literature sources and questionnaires) determined the contribution of the types of climbers training in preparation for overcoming mountain peaks (Fig. 1).

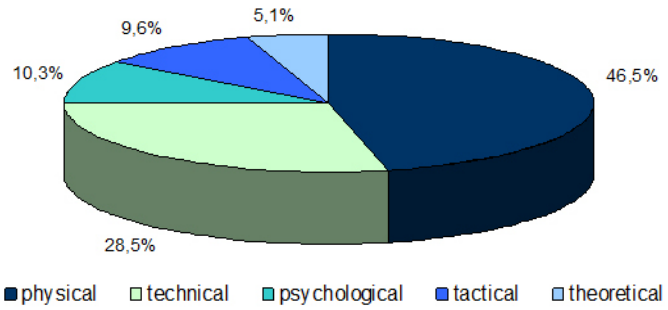

Fig. 1. Contribution of the types of climbers training in preparation for overcoming mountain peaks

As evidenced by the results obtained, the greatest contribution is made by physical training, consisting of general preparatory and special exercises.

The most significant quality is endurance, which is primarily associated with the movement under hypoxic conditions; other motor qualities are less evident (Fig. 2).

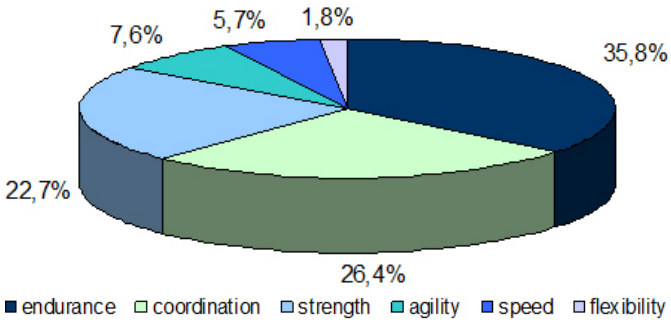

Fig. 2. Motor qualities that make up the physical preparedness of climbers

Correlation analysis that we carried out made it possible to determine the relationship between general preparatory and special-preparatory exercises used in mountaineering (Table 1).

The results of the correlation analysis indicate that the greatest connection is with the exercises connected with pulling-ups – push-ups (r=0,47), arm dynamometry (r=0,44), hang on the bent hands (r=0,48), hang on one bent arm (r=0,52), hang in the block (r=0,50), flexion of the hand with burdening (r=0,57).

Perfoming exercise flexion and extension push-ups interconnected with the hang on the bent hands (r=0,46),), hang on one bent arm (r=0,53), hang in the block (r=0,48) and flexion of the hand with burdening (r=0,61). Arm dynamometry correlates with the hang on the bent hands (r=0,56), hang on one bent arm (r=0,62), hang in the block(r=0,44), flexion of the hand with burdening (r=0,49).

Result of hang on the bent hands requires high indicators in pulling-up (r=0,48), push-ups (r=0,46), arm dynamometry (r=0,56), hang on one bent arm (r=0,64), hang in the block (r=0,51) and flexion of the hand with burdening (r=0,50). In turn, an exercise that requires the greatest manifestation of strength (hang on one bent arm) has significant correlation with pull-ups (r=0,52), push-ups (r=0,53), arm dynamometry (r=0,62) hang on the bent hands (r=0,64).

Performing amount of flexion of the hand with burdening correlated with indicators of exercises carried out at the expense of muscle groups of the upper limbs and trunk: pull-ups (r=0,57), push-ups (r=0,61), arm dynamometry (r=0,49), hang on the bent hands (r=0,50), hang on one bent arm (r=0,58) and hang in the block (r=0,52).

The result of the test determining endurance (interval run 6x1,4 km) has a weak correlation with exercises that are performed due to the muscles of the lower limbs – standing long jump (r=0,41) and squatting on one leg (r=0,40).

Obtained results allow us to take into account the interrelationship and influence of various exercises on the formation of motor qualities in the construction of the training process, using first the general preparatory tools, which are basic, and then the preparatory ones at the preparatory stage, which allowed the development of the contents of the pilot training program for mountaineers in the preparatory period.

Fundamental in the planning of training loads is the development of anaerobic-aerobic endurance, which is the basic basis for the overcoming of mountain peaks and against which the development of other motor qualities takes place.

At the same time, it is determined [1], the quality of endurance depends on the functioning of the respiratory system. Therefore, in the training program of the study groups, interval hypoxic training was additionally included, using two regimens: 15–15 (experimental group) and 30–30 (control group).

Studies about the features of the use of funds climbers training in individual mesocycles precompetitive stage, which define the factor structure of the types of training and the correlation relationship between the individual means of GDP and SDP it possible to determine the content of the preparatory period to overcome Elbrus(5642 m).

The preparatory period begins in November and ends in July before the beginning of the ascent (June and August are the most favorable period for overcoming Elbrus). Period consists of a retracting, basic (GDP), a base (SDP) and precompetitive mesocycle.

The highest in terms of load is planned in the base mesocycle (impact microcycle), and the intensity of the exercise – in the pre-competition mesocycle (control-preparatory).

The introduction into the training process of the experimental group of additional interval hypoxic training in the 15–15 mode with breathing through the system into a confined space with an adjustable composition of inhaled air in the complex train-

Table 1

Correlation interrelation of indicators of general and specially-preparatory exercises of qualified climbers (n=26)

Indicators	1	2	3	4	5	6	7	8	9	10	11
1		0,11	0,29	0,14	0,12	0,40	0,39	0,44	0,48	0,22	0,14
2			0,52	0,16	0,20	0,18	0,17	0,12	0,14	0,17	0,41
3				0,15	0,12	0,09	0,11	0,15	0,12	0,14	0,40
4					0,47	0,44	0,48	0,52	0,50	0,57	0,21
5						0,20	0,46	0,53	0,48	0,61	0,15
6							0,56	0,62	0,44	0,49	0,08
7								0,64	0,51	0,50	0,09
8									0,52	0,58	0,11
9										0,52	0,10
10											0,09

Remark. *Indicators: 1 – lifting the legs on the crossbar; 2 – standing long jump; 3 – squatting on one leg; 4 – pull-ups; 5 – push-ups; 6 – arm dynamometry; 7 – hang on the bent hands; 8 – hang on one bent arm 9 – hang in the block; 10 – flexion of the hand with burdening; 11 – interval running (6x1,4 km).*

ing process of climbers with the regime of application, presented in Table 2, allowed to obtain better results of indicators of special physical preparedness than in the control group with the 30–30 regime. So, if at the beginning of the study there was no significant difference between the groups, they were investigated, there were no indicators in the indicators, then after the use of IHT they were obtained.

In performing hang on the bent hands difference were 4,2 s (t=2,86; p<0,05), hang on one bent arm 7,2 s (t=3,12; p<0,01), hang in the block 3,6 s (t=2,58; p<0,05), interval run 6x1,4 km on 11,0 s (t=6,96; p<0,001) (Table 2).

In terms of general physical preparedness, the advantage of climbers of the experimental group is less pronounced (Table 3). Reliably the best figures are obtained in performance lifting the legs on the crossbar (t=2,16; p<0,05) and push-ups (t=2,15; p<0,05). Along with this, in both groups the majority of indicators obtained significant changes, but in the experimental they are more significant.

Conclusions

The use at the pre-competition stage of preparation for the overcoming of the mountain peaks of Elbrus by interval hypoxic training in the 15–15 mode with breathing through the system into the closed one simply allows to significantly increasing the results of exercises that are performed with a delay in breathing when the cardiovascular system is operated in anaerobic-aerobic regime.

Prospect of further research is to determine the influence of IHT on the climatic parameters of climbers during the Elbrus mountain crossing (5642 m).

Table 2

Data of the special physical readiness of the climbers of the control (n=14) and experimental (n=12) groups of the level of SP1 at the beginning and at the end of the pre-competition period

Types of tests	Measurements	CG $\bar{X}_1 \pm m_1$	EG $\bar{X}_2 \pm m_2$	Estimate of probability t	p
Hang on the bent hands, s	Before	25,8±1,01	25,2±1,00	0,42	p>0,05
	After	29,6±1,03	33,8±1,05	2,86	p<0,05
		t=1,94; p>0,05	t=5,24; p<0,001		
Hang on one bent arm (sum), s	Before	29,7±1,04	29,4±1,03	0,21	p>0,05
	After	36,3±1,57	43,5±1,70	3,12	p<0,01
		t=3,51; p<0,01	t=7,09; p<0,001		
Hang in the block, s	Before	73,8±0,80	72,9±1,08	0,67	p>0,05
	After	75,2±0,80	78,8±1,14	2,58	p<0,05
		t=1,23; p>0,05	t=3,76; p<0,01		
Flexion of the hand with burdening, number of times	Before	15,2±0,6	16,1±0,4	1,53	p>0,05
	After	17,0±0,5	18,1±0,3	1,84	p>0,05
		t=2,31; p<0,05	t=4,00; p<0,01		
Interval running (6x1,4 km), s	Before	2034,0±1,16	2032,0±1,18	1,20	p>0,05
	After	2028,0±1,15	2017,0±1,09	6,96	p<0,001
		t=3,68; p<0,01	t=9,32; p<0,001		

Table 3

Indicators of the data of the general physical readiness of climbers of the control (n=14) and experimental (n=12) groups of the level of SP1 at the beginning and at the end of the pre-competition period

Types of tests	Measurements	CG $\bar{X}_1 \pm m_1$	EG $\bar{X}_2 \pm m_2$	Estimate of probability t	p
Lifting the legs on the crossbar, number of times	Before	10,7±0,86	10,4±0,85	0,24	p>0,05
	After	12,6±0,94	15,5±0,96	2,16	p<0,01
		t=1,50; p>0,05	t=3,98; t=0,01		
Standing long jump, s	Before	263,7±4,2	262,7±4,1	0,17	p>0,05
	After	268,5±4,3	273,8±4,2	0,88	p>0,05
		t=0,80; p>0,05	t=1,89; p>0,05		
Squatting on one leg, number of times	Before	14,7±1,1	14,9±1,3	0,12	p>0,05
	After	18,2±1,3	20,7±1,4	1,31	p>0,05
		t=2,06; p>0,05	t=3,04; p<0,05		
Pull-ups, number of times	Before	16,2±0,5	16,0±0,2	0,25	p>0,05
	After	18,2±0,6	19,7±0,7	1,63	p>0,05
		t=2,56; p<0,05	t=5,07; p<0,001		
Push-ups, number of times	Before	44,7±0,9	45,1±1,0	0,30	p>0,05
	After	51,6±1,2	55,4±1,3	2,15	p<0,05
		t=4,60; p<0,001	t=6,28; p<0,001		
Arm dynamometry, kg	Before	56,0±0,6	54,7±0,8	1,23	p>0,05
	After	61,3±1,1	62,5±0,9	0,85	p>0,05
		t=4,24; p<0,001	t=6,50; p<0,001		

Conflict of interests. The authors declare that no conflict of interest.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 17.09.2017.
Published: 31.10.2017.

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