UDK 796.922+796.927/796.015.572

ISSN (English ed. Online) 2311-6374
2017, №5(61), pp. 84-87

Impact of a large load of aerobic character with the use of movement on roller skis on the functional state of the body of racing skier 15–16 years

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Purpose: *determine the nature of the course and the timing of recovery as a result of the impact of a large load of aerobic orientation with the use of movement on the roller skis on the functional state of the organism of young racing skier aged 15–16.*

Material & Methods: *in the studies took part the young racing skier of 15–16 years (I, II sports category) of the age group "younger boys". Before the beginning of the training sessions, the subjects registered a set of indicators that allowed assessing the functional state of the organism (cardiovascular, respiratory and neuromuscular systems). Repeatedly recorded the studied indicators for the same complex after the end of training sessions after 1 hour, as well as after 24, 48 and 72 hours.*

Results: *the young racing skier based on the results of the conducted studies analyzed the dynamics of indicators of the functional state of the organism. The timing of restoration of the cardiovascular, respiratory and neuromuscular systems has been established, which must be taken into account when planning the training process in microcycles.*

Conclusion: *as a result of studies on the effect of heavy loads using the movement on skiing rollers, a decrease in the functional parameters of the cardiovascular, respiratory, neuromuscular systems of the body was established. The recovery period as a whole lasted for 72 hours. At the same time, it was revealed that the anaerobic metabolic capacity was restored after 48 hours.*

Keywords: *training load, movement on roller skis, functional condition, and recovery period.*

Introduction

Changes in the functional systems of the athletes body, arising during the recovery period, serve as a basis for improving training. Diagnosis of fatigue is very important for the rational planning of various structural formations of the training process[5].

According to McManus Armstrong (2008), Gamble (2014), a strenuous exercise aimed at increasing aerobic capacity, is more effective after the puberty period, but can also be planned in adolescence [9; 10].

In general, recovery processes after physical works are heterochronous, i.e., recovery and supercompensation of various body functions are not simultaneous. Orientation to the most recently restored indicators would mean the use of exercises with large training loads no more often than once in 4–7 days. The oppression of the athlete's capabilities as a result of intense training does not at all mean that the athlete is not able to show high performance in the near future in a fundamentally different direction, determined primarily by other bodies and functional mechanisms [5]. It is established that fatigue of athletes, which occurs as a result of intense muscular activity, is formed specifically for each type of work, depending on the degree of participation in its implementation of various functional systems and mechanisms [8].

The analysis of scientific and methodological literature made it possible to reveal that research in this direction was carried out by skiers with the use of a competitive training facility [4], while the influence of occupations using preparatory and special preparatory means was not studied.
The results of our studies on the effect of heavy loads using cross-country running and competitive loads using skiing were presented earlier [6; 7].

Getting around on roller skis refers to a specially-preparatory tools, and has a significant share in the preparation of young adolescent athletes [1; 3]. In the group of 15–16-year-old racing skier the share of special physical training makes up 20% of the total amount of all used means, along with general and auxiliary physical training [2].

The purpose of the research: determine the nature of the course and the timing of recovery as a result of the impact of a large load of aerobic orientation with the use of movement on the roller skis on the functional state of the organism of young racing skier aged 15–16.

Material and Methods of the research

In the studies, young racing skier of 15–16 years (I, II sports category) of the age group "younger boys" took part. The membership in the age group was based on the boundaries stipulated in the rules of the competition in cross-country skiing. Also, athletes of this age corresponded to the stage of preliminary basic training on the classification of the age limits of athletes at various stages of long-term preparation of V. N. Platonov.

Before the beginning of the training sessions, the subjects registered a set of indicators that allowed to assess the functional state of the organism (cardiovascular, respiratory and neuromuscular systems) – these data were taken as initial data. Repeatedly recorded study parameters for the same complex after the end of training sessions after 1 hour, and after 24, 48 and 72 hours.

During the studies used roller skis "ELPEX" with stiffness "three" rubbers when moving to that expended effort as close

Table 1

Dynamics of indicators of the functional state of the organism of young racing skier after performing a large load of aerobic orientation using the movement on the roller skis (n=15)

No.	Indicators		Initial $\bar{X}_1 \pm m_1$	After the training session after 1 hour $\bar{X}_2 \pm m_2$	After 24 hours $\bar{X}_3 \pm m_3$	After 48 hours $\bar{X}_4 \pm m_4$	After 72 hours $\bar{X}_5 \pm m_5$
1.	Metabolism of the heart muscle according to the ECG, conv. units	ANAMC*	65,13±1,72	56,67±1,38	62,20±1,51	65,73±1,31	65,20±1,51
		AMC	215,87±5,56	193,33±3,38	209,20±5,09	212,40±4,74	216,53±6,04
2.	HR, beat·min-1		60,27±1,16	66,20±1,26	63,00±1,71	61,00±1,71	60,07±1,51
3.	Ruffier-Dickson test, conv. units		16,79±0,67	19,71±0,62	18,16±0,63	17,26±0,65	16,88±0,69
4.	Endurance factor, conv. units		10,29±0,51	13,10±0,49	11,17±0,59	10,72±0,51	10,37±0,52
5.	Skibinsky index, conv. units.		20,09±1,25	16,04±1,37	18,71±1,80	19,39±1,57	20,49±1,55
6.	Tremorography	Amplitude, cm	0,77±0,04	0,99±0,07	0,86±0,06	0,78±0,07	0,76±0,08
		Frequency, Hz	10,31±0,98	13,99±1,43	11,63±1,20	10,83±1,30	10,14±1,37
7.	Simple reaction time, ms	On a light stimulus	212,3±14,5	257,3±13,2	229,7±11,3	220,1±16,6	210,7±14,7
		On a sound stimulus	200,3±12,0	251,3±20,8	211,2±14,5	202,5±15,0	198,9±15,9

Remark. ** – indicators return to the baseline level after 48 hours.*

as possible in its effects to movement on skis.

Results of the research and their discussion

Moving on roller skis is one of the main special-preparatory means of racing skier. Results of the study on the effect on the racing skier body lessons with a large load of aerobic largest directional movement using roller skis on the classic style are presented in Table 1.

The amount of work performed in one training session prior to the onset of apparent fatigue, when using this special preparation in the experimental group was 27,0±2,0 km. Overcoming this distance had a significant impact on the functional systems of the body of young racing skier, the restoration of which lasted for three days.

In 24 hours after the training session, the data of ANAMC increased in comparison with the previous day by 5,53 conv. units (t=2,70, p<0,05), and AMC at 15,87 conv. units (t=2,60, p<0,05) (Table 2). On the second day, the increase in results was 9,06 conv. units (t=4,77, p<0,05) in terms of ANAMC and 19,07 conv. units (t=3,27, p<0,01) in terms of AMC. Completely the parameters of the heart metabolism returned to the initial and even slightly exceeded them in 48 hours in anaerobic and 72 hours in the aerobic component (p>0,05).

The same dynamics was observed in the heart rate and Ruffier-Dickson test (Table 3), which reached the baseline data only on the third day of the recovery period.

Endurance factor, combining the results of heart rate and pulse pressure, after training session increased by 2.81 conv. units (t=4,00, p<0,001). Data reduction occurred for 72 hours (Table 4).

The data of the Skibinsky index (Table 4), reflecting the functional state of the respiratory system, were also subject to a general trend: a significant decrease after training at 4,05 conv. units (t=2,19 p<0,05) and gradual recovery by the end of the third day (p<0,05).

An analysis of the dynamics of the results characterizing the state of the neuromuscular system made it possible to reveal

Table 2

Matrix of the t-test and the confidence levels (p) of the difference between the indicators of ANAMC and AMC in young racing skier during the recovery period after a heavy aerobic load using the movement on the roller skis (n=15)

Time of study	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_4$	$\bar{X}_5$
$\bar{X}_1$	3,83 (p<0,001) 3,46 (p<0,01)	1,28 (p>0,05) 0,88 (p>0,05)	0,28 (p>0,05) 0,47 (p>0,05)	0,03 (p>0,05) 0,08 (p>0,05)
$\bar{X}_2$		2,70 (p<0,05) 2,60 (p<0,05)	4,77 (p<0,05) 3,27 (p<0,01)	4,16 (p<0,001) 3,35 (p<0,01)
$\bar{X}_3$			1,77 (p>0,05) 0,46 (p>0,05)	1,40 (p>0,05) 0,93 (p>0,05)
$\bar{X}_4$				0,27 (p>0,05) 0,54 (p>0,05)

Remark. *$\bar{X}_1$ – initial indicators, $\bar{X}_2$ – after the training session after 1 hour, $\bar{X}_3$ – after 24 hours, $\bar{X}_4$ – after 48 hours, $\bar{X}_5$ – after 72 hours; top line – AHAME, bottom line – AME.*

Table 3

Matrix of t-test and confidence levels (p) differences in HR and Ruffier-Dickson tests in young racing skier during the recovery period after a large aerobic load using movement on the roller skis (n=15)

Time of study	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_4$	$\bar{X}_5$
$\bar{X}_1$	3,47 (p<0,01) 3,21 (p<0,01)	1,32 (p>0,05) 1,49 (p>0,05)	0,35 (p>0,05) 0,50 (p>0,05)	0,11 (p>0,05) 0,10 (p>0,05)
$\bar{X}_2$		1,51 (p>0,05) 1,76 (p>0,05)	2,45 (p<0,05) 2,73 (p<0,05)	3,13 (p<0,01 3,05 (p<0,01
$\bar{X}_3$			0,82 (p>0,05) 0,99 (p>0,05)	1,29 (p>0,05) 1,36 (p>0,05)
$\bar{X}_4$				0,41 (p>0,05) 0,40 (p>0,05)

Remark. *$\bar{X}_1$ – initial indicators, $\bar{X}_2$ – after the training session after 1 hour, $\bar{X}_3$ – after 24 hours, $\bar{X}_4$ – after 48 hours, $\bar{X}_5$ – after 72 hours; top line – HR, bottom line – Ruffier-Dickson tests.*

Table 4

Matrix of the t-test and the confidence levels (p) of the difference in the endurance coefficient and the Skibinsky index for young racing skier during the recovery from a heavy aerobic load using movement on the roller skis (n=15)

Time of study	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_4$	$\bar{X}_5$
$\bar{X}_1$	4,00 (p<0,001) 2,19 (p<0,05)	1,13 (p>0,05) 0,63 (p>0,05)	0,60 (p>0,05) 0,35 (p>0,05)	0,11 (p>0,05) 0,20 (p>0,05)
$\bar{X}_2$		2,51 (p<0,05) 1,18 (p>0,05)	3,39 (p<0,01 1,61 (p>0,05)	3,85 (p<0,001 2,15 (p<0,05)
$\bar{X}_3$			0,58 (p>0,05) 0,29 (p>0,05)	1,02 (p>0,05) 0,75 (p>0,05)
$\bar{X}_4$				0,48 (p>0,05) 0,50 (p>0,05)

Remark. *$\bar{X}_1$ – initial indicators, $\bar{X}_2$ – after the training session after 1 hour, $\bar{X}_3$ – after 24 hours, $\bar{X}_4$ – after 48 hours, $\bar{X}_5$ – after 72 hours; top line – endurance coefficient, bottom line – Skibinsky index.*

Table 5

Matrix of the t-test and the confidence levels (p) of the differences in the tremorography indexes (amplitude and frequency) in young racing skier during the recovery period after a large aerobic load using movement on the roller skis (n=15)

Time of study	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_4$	$\bar{X}_5$
$\bar{X}_1$	2,55 (p<0,05) 2,13 (p<0,05)	1,17 (p>0,05) 0,85 (p>0,05)	0,16 (p>0,05) 0,32 (p>0,05)	0,09 (p>0,05) 0,10 (p>0,05)
$\bar{X}_2$		1,32 (p>0,05) 1,27 (p>0,05)	2,05 (p<0,05) 1,64 (p>0,05)	2,06 (p<0,05) 1,94 (p>0,05)
$\bar{X}_3$			0,83 (p>0,05) 0,45 (p>0,05)	0,95 (p>0,05) 0,82 (p>0,05)
$\bar{X}_4$				0,19 (p>0,05) 0,36 (p>0,05)

Remark. *$\bar{X}_1$ – initial indicators, $\bar{X}_2$ – after the training session after 1 hour, $\bar{X}_3$ – after 24 hours, $\bar{X}_4$ – after 48 hours, $\bar{X}_5$ – after 72 hours; top line – amplitude of tremorography, bottom line – frequency of tremorography.*

a regularity similar to the data described above. The amplitude and frequency components of tremorography increased by 0.22 cm (t=2,55; p<0,05) and 3,68 Hz (t=2,13; p<0,05) respectively, after the training session (Table 5). Return of indicators to the initial data occurred gradually over three days. After a session with a heavy load, a more delayed response (p>0,05) was observed following a simple reaction to the light and sound stimulus, and only 72 hours after it returned to the initial data (Table 6).

Table 6

Matrix of the t-test and the confidence levels (p) of the differences in the time parameters of a simple reaction to light and sound stimuli in young racing skier during the recovery period after a large aerobic load using movement on the roller skis (n=15)

Time of study	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_4$	$\bar{X}_5$
$\bar{X}_1$	2,29 (p<0,05) 2,13 (p<0,05)	0,94 (p>0,05) 0,58 (p>0,05)	0,35 (p>0,05) 0,11 (p>0,05)	0,08 (p>0,05) 0,07 (p>0,05)
$\bar{X}_2$		1,59 (p>0,05) 1,58 (p>0,05)	1,75 (p>0,05) 1,90 (p>0,05)	2,36 (p<0,05) 2,01 (p>0,05)
$\bar{X}_3$			0,47 (p>0,05) 0,42 (p>0,05)	1,03 (p>0,05) 0,57 (p>0,05)
$\bar{X}_4$				0,43 (p>0,05) 0,16 (p>0,05)

Remark. *$\bar{X}_1$ – initial indicators, $\bar{X}_2$ – after the training session after 1 hour, $\bar{X}_3$ – after 24 hours, $\bar{X}_4$ – after 48 hours, $\bar{X}_5$ – after 72 hours; top line – reaction to light, bottom line – reaction to sound.*

Conclusions

As a result of carried out studies on the effect of a large load using a special preparatory means-movement on roller skis, a decrease in the functional parameters of the cardiovascular, respiratory neuromuscular systems of the body. Recovery period as a whole lasted for 72 hours. At the same time, the rates of anaerobic metabolic capacity, as in previous studies, are restored after 48 hours.

Prospects for further research are related to the determination of the impact of impact microcycles on the functional state of the organism of young racing skier, whose content includes the use as a training vehicle for roller skis.

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: 14.09.2017.
Published: 31.10.2017.

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