

Publication date: 01.04.2022
DOI: 10.51871/2782-6570_2022_01_01_7
UDC 769.922; 612.062

REACTION OF THE CARDIOVASCULAR SYSTEM OF ADOLESCENT SKIERS IN RESPONSE TO FUNCTIONAL TESTS DURING THE PREPARATORY TRAINING PERIOD

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Annotation. This article presents results of studying functional state of the cardiovascular system in adolescents aged 15-18 years, who are specialized in ski racing, during the preparatory training period. We have studied main indicators of the cardiovascular system at rest and in case when loading tests are applied. We also evaluated reaction types in response to following tests: the Martinet-Kushelevskij test, the Physical Working Capacity test and the Ruffier-Dickson test. The individual analysis of athletes' reaction to loads in each of conducted tests was the most informative one. In the Martinet-Kushelevskij test, 60% of test subjects had the normotonic type of reaction to loads, 40% – the dystonic type. When conducting the Ruffier-Dickson test, we found that 20% had good performance, 30% – average performance, 40% had poor performance. The Physical Working Capacity test with the two-step load revealed satisfactory indicators of the maximal oxygen consumption ($\text{VO}_2 \text{ max}$). Results of conducted studies are going to serve as a foundation for correction of the training process of adolescents and selection of recovery measures of the examined group.

Keywords: functional state, cardiovascular system, ski racing, preparatory period of the training process, adolescence.

Introduction. The sports activity of skiers takes place in conditions of significant physical and psychoemotional loads. Achievement of the highest athletic performance is possible only in case of appropriate construction of the training process, based on physical, functional capabilities and reserves of athletes [1-3].

This aspect has the highest relevance during puberty, because adolescence is related to significant system-related alterations of a young athlete's body. The training process, constructed without considering age, gender, morphofunctional features and periods of sensitive development of physical qualities and functional features can lead to overtraining, failure of adaptive capabilities and early "burn-out" in sports [4]. Therefore, stage-based and current control of body state of adolescents engaged in sports has a certain significance in construction of the training process. Meanwhile, the training process's efficiency depends significantly on adequately selected recovery measures [5-6], which should promptly correct the revealed disorders in the state of health.

The purpose of this study was to examine main indicators of the cardiovascular system in skiers aged 15-18 years during the preparatory training period at rest and in case when load tests are applied.

Methods and organization. Assessment of the cardiovascular system's functional state was carried out at rest and in response to following tests: the Martinet-Kushelevskij test, the Ruffier-Dickson test and the Physical Working Capacity test.

The study was conducted within the period of November 2015 to April 2017 in the Budgetary Healthcare Institution of the Omsk Region "Exercise Therapy Center". We studied functional state of the cardiovascular system in 10 young men aged 15-18 years engaged in ski racing, with the first adult sports category.

The results obtained were processed with methods of mathematical statistics (mean value, standard derivation).

Results and discussion. Assessment of functional state of the cardiovascular system in adolescent skiers during the preparatory

training period was carried out in conditions of rest and loading tests. At rest, the heart rate (HR, beats/min) was 76 ± 0.06 beats/min, systolic blood pressure (sBP) – 110 ± 12.7 mm of Hg, diastolic blood pressure (dBP) – 68 ± 0.08 mm of Hg, which match the age norms and

correspond to values typical for people engaged in sports.

Results of average group values of the cardiovascular system's reaction in response to the Martinet-Kushelevskij test are presented in table 1.

Table 1

Reaction of the cardiovascular system in adolescent skiers in response to the Martinet-Kushelevskij test

Measurement stages	sBP, mm of Hg (M±m)	dBP, mm of Hg (M±m)	HR, beats/min (M±m)	Character of the pulse (Ps)
Rest	107 ± 0.09	76 ± 0.06	84 ± 0.05	regular
1 minute of recovery	130 ± 0.03	68 ± 0.08	120 ± 0.05	regular
2 minute of recovery	110 ± 0.08	70 ± 0.09	111 ± 0.04	regular
3 minute of recovery	107 ± 0.08	66 ± 0.1	96 ± 0.02	regular

HR at rest amounted to 84 ± 0.05 beats/min, character of the pulse is regular, blood pressure – $107/76$ mm of Hg.

After loads, in the 1 minute of recovery, HR increased by 30% compared to initial values and amounted to 120 ± 0.05 beats/min. Growth rate of the sBP was 5.3% from initial values. dBP decreased by 11.7%. In the second minute of recovery, HR decreased by 6.5%, sBP – by 2.6%, dBP increased by 2.8%. In the third minute of recovery, following values were obtained: HR increased by 12%, sBP increased by 2.7%, dBP decreased by 7.8%.

In response to the Martinet-Kushelevskij test, growth rate of HR and pulse pressure was

synchronous. Pulse growth rate amounted to 35.5%, remained within limits of standard values and was rated as a favorable reaction of the cardiovascular system to loads.

When analyzing individual indicators, we discovered that 60% of athletes (n=6 people) have the normotonic type of the reaction to loads. 40% (n=4 people) have the dystonic type, which indicates physical overtraining, vegetative-vascular dystonia. These signs can be noticed in adolescents during puberty.

In order to evaluate performance of adolescent skiers, we used the Ruffier-Dickson test, results of which are presented in table 2.

Table 2

Assessment of the performance of adolescent skiers, according to the Ruffier-Dickson test

Measurement stages	sBP, mm of Hg (M±m)	dBP, mm of Hg (M±m)	HR, beats/min (M±m)	Character of the pulse (Ps)
Rest	108 ± 0.07	62 ± 0.11	72 ± 0.06	regular
After loads	115 ± 0.06	58 ± 0.1	114 ± 0.02	regular
1 minute of recovery	110 ± 0.09	60 ± 0.05	108 ± 0.04	regular

Before the test, HR indicators at rest amounted to 72 ± 0.06 beats/min, sBP – 108 ± 0.04 mm of Hg, dBP – 62 ± 0.11 mm of Hg. In response to the Ruffier-Dickson test, HR increased by 5.2% immediately after loads, sBP – by 7% respectively. Meanwhile, sBP

remained unchanged. In the 1 minute of recovery, HR (beats/min) increased by 33%, sBP increased by 6%, dBP increased by 4.3% compared to initial indicators. In total, the performance amounted to 6 points and was rated as ordinary physical performance.

When analyzing individual indicators of skiers' recovery, we have found that 20% of test subjects ($n=2$) had good performance, 30% ($n=3$) – average performance, 10% ($n=1$) – satisfactory performance, 40% ($n=4$) – poor performance. Rating of the physical performance test revealed unsatisfactory results that are related to discovered frequent cases characterized by the heterochronic physical development, occurrence and increase of overstrain processes.

Before the Physical Working Capacity test (PWC-170), HR was 79 beats/min, which corresponds with age norms and matches values typical for people engaged in ski sports. sBP and dBP at rest also matched age norms and the specificity of athletic activity, and amounted to $109\pm0.05/63\pm0.09$ mm of Hg respectively (table 3).

Table 3

Results of the Physical Working Capacity test (PWC-170) in adolescent skiers during the preparatory training period

Measurement stages	sBP, mm of Hg (M $\pm$ m)	dBP, mm of Hg (M $\pm$ m)	HR, beats/min (M $\pm$ m)	Character of the pulse (Ps)
Rest	109 ± 0.05	63 ± 0.09	79 ± 0.03	regular
1 load	120 ± 0.02	62 ± 0.09	108 ± 0.02	regular
2 load	115 ± 0.04	64 ± 0.08	93 ± 0.03	regular

After the two-stage Physical Working Capacity test (PWC-170), when assessing the examined indicators in the 5 minute of recovery, we have discovered a following reaction of the cardiovascular system: HR and sBP increased by 19% and 6% respectively, dBP decreased by 3% compared to initial values. Value of the maximal oxygen consumption (MOC) amounted to 5.27 ± 0.08 l/kg/min, rated as the perfect condition of the cardiovascular system. However, when examining individual indicators, two athletes (25% of the whole selection) revealed satisfactory indicators of the maximal oxygen consumption.

When evaluating the type of reaction to physical loads, we revealed that 90% of the group have the normotonic type, while the hypotonic type was found in 10% of cases.

After the PWC-170 test, when evaluating the examined indicators of recovery, we obtained following information. Compared to initial data, HR increased by 26% and amounted to 174 ± 0.03 beats/min. Average value of sBP amounted to 120 ± 0.02 mm of Hg,

growth rate amounted to 9% from initial values. dBP decreased by 1.5% from initial values and amounted to 62 ± 0.09 mm of Hg. Nine athletes (90% of the group) had the normotonic type, one athlete (10%) had the hypotonic type of the cardiovascular system's reaction to physical loads.

Conclusion. In studies on evaluation of functional state of the cardiovascular system in adolescent ski racers at rest and during loading tests, the individual analysis of the body reaction to loads was the most informative. It was justified due to a high risk of morphofunctional changes and system-related alterations in adolescent age, which in case of irrational construction of the training process can lead to overtraining, failure of adaptation capabilities and early "burnout" in sports. The revealed derivations in the reaction of the cardiovascular system in skiers in response to loading tests allowed assessing the training process and served as a foundation for selection of appropriate recovery measures.

REFERENCES

1. Yatsyk V.Z., Gorbikov I.I., Vasilchenko O.S., Paramzin V.B. Dynamics of the functional state of

beginner ski racers in the conditions of short-term training camps in the Middle Mountains. *Theory*

and Methods of Physical Culture and Sport, 2016, no. 2(1), pp. 7–13. (in Russ.)

2. Mikhalev V.I., Koryagina Yu.V., Antipova O.S., Aikin V.A., Suhinin E.M. Special performance of ski racers: modern tendencies (based on foreign literature). *Scientific Notes of the P.F. Lesgaft University*, 2015, no. 4 (122), pp. 139–144. (in Russ.)

3. Koryagina Yu.V., Salova Yu.P. Biological rhythms and adaptation to the muscular activity of skiers. Omsk, 2013. – 148 p. (in Russ.)

4. Sonkin V.D. Physiological regularities of ontogenesis and their possible applications to the theory of physical training. *Human Physiology*, 2015, vol. 41, no 5, pp. 125–136. (in Russ.)

5. Rybina I.A., Mikheev A.A., Nekhvyadovich A.I. Adaptive changes in homeostasis under the influence of high-intensity physical activity. *Questions of Balneology, Physiotherapy and Exercise Therapy*, 2016, vol. 93, no. 1, pp. 21–24. (in Russ.)

6. Lunina N.V., Tarareeva Yu.S. The functional state of the cardio-respiratory system of skiers aged 15-18 at the stage of a special preparatory period. Proceedings of the XLI Regional Student Scientific and Practical Conference "Youth of the Third Millennium". Omsk, April 10-28, 2017, pp. 1495–1499. (in Russ.)

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For citation: Lunina N.V., Tarareeva Yu.S. Reaction of the cardiovascular system of adolescent skiers in response to functional tests during the preparatory training period. *Russian Journal of Sports Science: Medicine, Physiology, Training*, 2022, vol. 1, no 1. DOI: 10.51871/2782-6570_2022_01_01_7