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Functional diagnostics in the comparative assessment of physical performance in ski racers to forecast sports performance development

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Abstract. Aim. The article deals with establishing the prognostic features of ergospirometry during the comparative assessment of functional adaptation of the cardiovascular system (CVS) in ski racers. Materials and methods. From the total amount of routine examination in 4 years, the data of two ski racers (Master of Sport) attending training and participating in Russian competitions were taken. Both athletes possess compatible age and anthropometric data, similar sports experience, and almost the same level of sports mastery. Physical performance has been examined with the SCHILLER AT-104 diagnostical system. Results. The results prove the informational value of ergospirometry and establish the conditions and patterns for the development of physical performance in ski racers aged 21-23 years. Conclusion. The data obtained from competition results are proof of a justified assessment of adaptation mechanisms under dynamic monitoring and functional tests.

Key words – cardiorespiratory load, physical performance, sports mastery of ski racers.

I. INTRODUCTION

Sports selection in terms of the development of sports mastery requires establishing the main parameters for the assessment of the functional status in athletes [1, 2, 5]. A regular assessment of morphological indicators, physical performance, and aerobic endurance combined with the dynamics of sports achievements allow estimating sports career [3, 4, 7]. To establish the abovementioned indicators, we used ergospirometry [6].

II. MATERIALS AND METHODS

The study was conducted on the premises of the Scientific and Research center for Sports Science at South Ural State University (National Research University). For the analysis, we used the data obtained in 2013-2016. Two ski racers participated in the study (age 22.00±1.00 years, body length – 179.50±1.50 cm, body mass – 77.50±1.49 kg, Master of Sports).

Physical performance was assessed with the SCHILLER AT-104 diagnostic system provided with the POWER CUBE gas analyzer. The maximal exercise test until exhaustion was used as a research method. The initial load was 50 W with a continual increase of 25 W until the failure of the subject to continue the experiment. Pedal rotation speed was 60 rpm. The test included a continuous ECG recording in 12 standard leads with blood pressure recording. The assessment of the results obtained was conducted using the Bruce protocol. Spirometry was conducted simultaneously with ergometry. The maximal exercise cardiopulmonary test was assessed using the Wasserman principles (fig. 1, 2). The statistical processing of the data obtained was performed with the Statistica V.10.0. software.

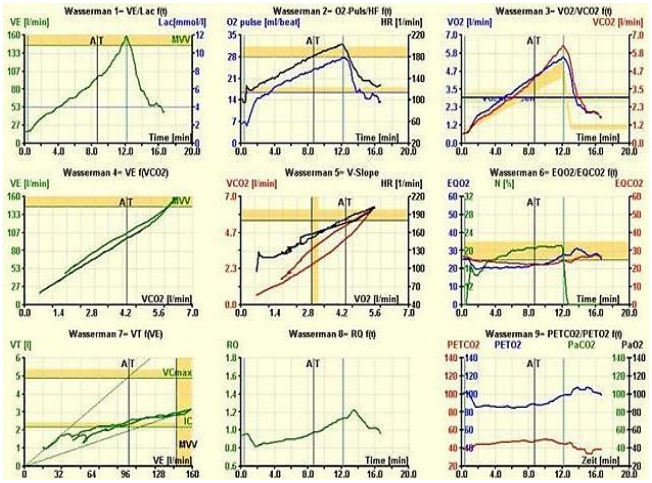

Fig. 1. Maximal exercise test by Wasserman

Fig. 2. The ergospirometry test

III. Results and Discussion

The individual limits of the body's abilities and the data on the increase of physical performance revealed the dominance of Athlete 2 over Athlete 1. (table 1).

TABLE I. ERGOSPIROMETRY DATA OF SKI-RACERS

Parameters	Units of measurement	№1	№2	Difference (%)
Load time	min/s	11:34	1:32	0.18
Recovery time	min/s	4:12	3:32	19.42
Maximum load	W	306.25	350.00	14.29
Maximum to target load ratio	%	127.50	146.00	14.51
Double product	c.u.	331.50	361.38	9.01
Threshold power	W/kg	3.70	4.43	19.73
Maximum HR	bpm	171.00	181.00	5.85
Initial HR	bpm	81.50	75.00	6.75
Chronotropic reserve index	bpm	81.25	106.00	30.46
Initial SAP Initial DAP	mmHg	127.50 85.75	127.33 80.00	0.13 6.71
Maximum SAP Maximum DAP	mmHg	198.50 97.25	199.66 86.66	0.55 10.89
Inotropic reserve index	mmHg	66.75 53.52	72.33 56.68	8.36 5.90
VO_2 max	l/min	3.66	4.20	14.75
VO_2 max to VO_2 target	%	107.75	122.33	13.53
VO_2	ml/min/kg	48.30	53.30	10.35
O_2 – oxygen pulse	ml/beat	21.60	23.80	10.19
VT – respiratory volume	l	2.26	3.78	67.26
PET O_2	mmHg	97.13	92.90	4.35
PET CO_2	mmHg	52.68	52.60	0.15

These advantages were manifested in the increased time of load performance, a higher power of maximum load, higher number of cardiac contractions at load height (the chronotropic functions of the cardiovascular system), higher systolic arterial pressure (the inotropic functions of the cardiovascular system and an indirect indicator of the cardiac contractile function), the increased values of the double product in Athlete 2.

IV. Conclusion

A linear correlation between the time of the load performed, HR, SAP, double product, and VO2 max reveals the adaptation of the neuromuscular apparatus and body reaction to target load in general.

When comparing the results of 2 elite ski racers obtained with the help of spirometry, the assessment of correlations between indirect indicators of physical performance allows forecasting further performance enhancement.

During four years of the experiment, the main results of Athlete 2 were better than those of Athlete 1. This was a result of regular intensive training combined with individual limits and abilities of Athlete 2 resulted from the earlier beginning of training and active participation in various competitions.

Such assessment of adaptation mechanisms during dynamic monitoring and exercise test was justified by the results of competitions obtained from Cross Country Ski Federation of Russia.

Athlete 2 took part in 37 competitions against 23 competitions of Athlete 1. In the system of Cross Country Ski Federation of Russia, Athlete 2 was placed on the seventh position against the forty-second place of Athlete 1.

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