Individual monitoring of aerobic and anaerobic performance of hockey players during the annual training cycle

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Abstract

Objective of the study was to increase functional readiness based on individual assessment of aerobic and anaerobic performance of hockey players throughout the annual training cycle.

Methods and structure of the study. Changes in the functional readiness of 15 hockey players of the university student hockey team at the age of 19.5±0.5 years were determined through aerobic and anaerobic testing to assess and correct the direction of the training process in certain periods of the annual training cycle.

Results and conclusions. The aerobic power of the players was stable and maintained at a high level throughout the entire macrocycle. Improvement in the aerobic performance of players during the competitive period was reflected in an increase in the level of VO_2 max to 55-60 ml/min/kg. A decrease in the parameters of anaerobic performance of the subjects was revealed.

Keywords: *hockey players, aerobic and anaerobic performance, oxidative-metabolic capabilities, training macrocycle.*

Introduction. The need to increase the efficiency of adaptation processes over many years of training in elite sports requires a systematic individual approach. A meta-analysis of performance in hockey confirmed the feasibility of training effects in both aerobic and anaerobic training regimes [7].

Physiological profiles of highly qualified hockey players convey the priorities for the development of general and strength endurance, anaerobic power, flexibility and skating speed. Muscle performance in hockey is 70% provided by anaerobic bioenergy systems and 30% depends on the athlete's aerobic performance [3]. To a certain extent, the operation of the anaerobic energy supply system may depend on the level of oxidative capabilities of the hockey players' body [4, 8].

Achieving an optimal level of performance is ensured by obtaining information about current structural changes in sports form and making appropriate adjustments to the content of the training process of hockey players. Determining the individual adaptation effect caused by different types of training stimuli is crucial for the effective training of players and the team as a whole [1, 6].

Effective formation of conditioning readiness requires optimal regulation of the training load, ensuring the effectiveness of individual adaptation processes in the corresponding bioenergetic zones [2, 5].

Objective of the study was to increase functional readiness based on individual assessment of aerobic and anaerobic performance of hockey players throughout the annual training cycle.

Methods and structure of the study. The sample of the experiment consisted of 15 hockey players from the university student hockey team at the age of 19.5±0.5 years. Changes in functional fitness were de-

termined through aerobic and anaerobic testing to assess and correct the direction of the training process in certain periods of the annual training cycle. Functional performance was measured in the preparatory period, three times during the competitive preparation phase and in the transition period.

Aerobic performance was assessed using a spiroergometric test performed on a bicycle ergometer and a shuttle running test at n 20 m. The internal response of the body to physical activity was expressed in maximum oxygen consumption (VO2max), which characterizes the oxidative-metabolic capabilities of the body and the power of the circulatory system.

To determine the value of maximum oxygen consumption (VO2max), a step-by-step spiroergometric test was carried out to the maximum. The initial load was 1.5 W per kg of body weight. The load increased by 20 W every minute. The test was performed until volitional fatigue or until the respiratory coefficient reached 1.05.

Aerobic performance was also assessed using a shuttle run test for n × 20 m. The intensity of running increased after the first minute. The starting speed of 8 km/h increased by 0.5 km/h every minute. The measured parameters were distance traveled (m) and VO_2 max (ml/kg/min).

Anaerobic performance was measured using a 30-second ergonometric anaerobic test performed on a bicycle ergometer. The test was carried out to anaerobic fatigue with a constant resistance of 7.5% of the subject's body weight. The measured parameters were peak anaerobic power (W/kg), average anaerobic power (W/kg) and anaerobic fatigue index (%).

Results of the study and discussion. The goal of physical training in hockey is to develop speed and strength qualities, achieve a high level of anaerobic and aerobic performance, and increase the ability to neutralize lactate in working muscles. Taking into account the nature of hockey games, it is advisable to gradually change the ratio of aerobic and anaerobic load.

It was found that anaerobic power increased during individual phases of the macrocycle, with the exception of the end of the season. The level of anaerobic performance, expressed by the maximum and average values of anaerobic power, progressively increased throughout the entire macrocycle, with the exception of the end of the competitive period, during which the parameter values decreased.

Training during the transition period was aimed at developing general and speed endurance and strength; Special training on ice was not included in the content of the training sessions.

Improvement in the aerobic performance of players during the competitive period was reflected in an increase in the level of VO2max to 55-60 ml/min/kg. The results are consistent with other studies reporting VO2max values of 50-70 ml/min/kg. A higher level of aerobic performance corresponded to a fatigue index, which in the middle of the competitive period exceeded the data of the initial testing (see table).

The results of the load testing revealed a player fatigue index of 30.2%, which, according to the developed standards, can be considered the optimal value. The results of anaerobic testing at the end of the competitive period indicated a decrease in the measured parameters. The direction of the body's adaptation processes is determined by the content of pre-competition preparation.

When assessing the power of anaerobic energy supply processes, a decrease in the parameters of anaerobic productivity of the subjects was revealed. The sample averages turned out to be lower than the values of anaerobic fitness found in hockey players during the transition and preparatory training period.

Indicators of functional readiness of hockey players

Indicator	Period of the annual macrocycle					
	GPT	SPT	CP_1	CP_2	CP_3	TP
P_{max}, W/kg	9,1±3,2	9,6±0,9	11,8±3,2	11,1±0,7	10,9±0,6	9,3±0,8
P_{avg}, W/kg	8,2±2,5	8,7±3,1	9,3±2,7	9,6±0,4	8,2±1,4	9,0±1,6
Fatigue index, %	28,7±3,0	26,8±2,9	39,5±4,6	30,2±3,7	41,4±5,3	27,5±5,4
Multi-stage fitness test, m×10m³	2,1±0,7	2,2±0,5	2,7±0,1	2,8±0,2	2,5±0,3	2,3±0,3
VO_2max, ml/kg/min	48,4±6,9	41,7±6,2	59,7±9,6	61,6±8,3	62,7±8,6	44,3±8,7

Note: P_{max} – peak power; P_{avg} – average power; GPT – period of general physical training; SPT – period of special physical training; CP_1 – competitive period (beginning); CP_2 – competitive period (middle); CP_3 – competitive period (end); TP – transition period.

The highest values of aerobic power of hockey players were recorded during the competitive period. The aerobic power of the players was stable and maintained at a high level throughout the entire macrocycle. Probably, the achieved result is associated with the high level of endurance of the hockey players, maintained at certain stages of the annual training cycle.

It can be assumed that the positive adaptation of aerobic energy supply mechanisms is caused by the corresponding orientation of the training process. This was reflected in an increase in the level of oxidative processes compared to the off-season preparation stage. At the end of the competitive period, the level of aerobic performance of hockey players increased, and anaerobic performance decreased. The decrease in players' anaerobic fitness can be explained by the lower intensity of games and training compared to previous stages.

Conclusions. When assessing the level of energy supply of players, it is necessary to take into account the individual characteristics of each player. Despite the identical training content, each player adapts to the exercises individually. During the annual cycle, individual monitoring of the functional state of players is significant for identifying adaptation features and making appropriate adjustments to the content and direction of the training process.

Varying the ratio of aerobic and anaerobic load based on test results increases the efficiency of training hockey players during the annual training cycle.

References

1. Bolotin A.E., Poniasov O.E., Aganov S.S. et al. Selektivnost vosproizvedeniya obraznykh predstavleniy v trenirovochnom protsesse legkoatletov-studentov. Teoriya i praktika fizicheskoy kultury. 2022. No. 1. pp. 51-53.
2. Bolotin A.E., Bakaev V.V., Van Zwieten K.Ya. et al. Differentsirovannaya podgotovka plovtsov-marafontsev k sorevnovaniyam na otkrytoy vode s uchetom tipov energeticheskogo metabolizma. Teoriya i praktika fizicheskoy kultury. 2020. No. 10. pp. 37-39.
3. Kolesnikov N.V., Poniasov O.E., Fursov V.V. et al. Faktornaya struktura predsorevnovatelnoy podgotovki skorokhodov vysokoy kvalifikatsii. Teoriya i praktika fizicheskoy kultury. 2023. No. 7. pp. 90-92.
4. Mikhailov K.K., Poniasov O.E., Titarenko Yu.A. Proyavleniye dykhatelnykh funktsiy khokkeistov pri trenirovochnykh vozdeystviyakh razlichnoy napravlennosti. Teoriya i praktika fizicheskoy kultury. 2023. No. 3. pp. 9-11.
5. Morozova L.V., Poniasov O.E., Bystrova I.V. Ekzogennyye faktory razvitiya khudozhestvennoy gimnastiki v sovremennykh usloviyakh. Teoriya i praktika fizicheskoy kultury. 2023. No. 7. pp. 13-15.
6. Poniasov O.E., Pugachev I.Yu., Paramzin V.B. et al. Kinematicheskiy analiz tekhniki plavaniya na osnove sinkhronnoy videozapisi lineynogo dvizheniya. Teoriya i praktika fizicheskoy kultury. 2023. No. 1. pp. 14-16.
7. Bakayev V., Bolotin A., & You C. (2018). Reaction of vegetative nervous system to loads in female long-distance runners with different fitness level. Journal of Human Sport and Exercise, 13(2proc). pp. 245-252.
8. Bakayev V., Bolotin A. (2019). Peculiarities of Adaptation to Training Loads in Paralympian Cross-country Skiers with Visual Impairment versus Able-bodied Athletes based on Analysis of Heart Rate Variability Data. In Proceedings of the 7th International Conference on Sport Sciences Research and Technology Support. Volume 1: icSPORTS, ISBN 978-989-758-383-4, pp. 132-137. DOI: 10.5220/0008065601320137