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CARDIOPULMONARY FUNCTION OF THE HIGH TRAINED BASKETBALL PLAYERS

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Introduction

All Lithuanian basketball seasons begins with a team renovation problem. Every year, modern Lithuanian style of basketball needs endurance-trained players. As well known thing, main endurance determinant is oxygen transport capacity (ACSM, 1986 Baba et al., 1996; Chapman et al., 1998; Greeg et al., 1998; Helenius et al., 1998; Bishop et al., 1998). Cardiopulmonary function tests are relevant methods for evaluation of oxygen transport capacity (Bonaduce et al., 1998; Fletcher et al., 1990; Franklin et al., 1997; Hill 1996; Poole et al., 1997; Richardson et al., 1998). Preliminary selection of basketball players according to pulmonary ventilation, cardiac capacity, oxygen consumption and physical power parameters may be usable.

The relevance of the study was to establish the physical condition criterions for selection of fitted basketball players.

Purpose of the research. The aim of the study was evaluation of physical exercise tolerance, cardiopulmonary condition and maximal metabolic values.

The tasks of the research. The task of the study was to perform retrograde functional status analysis data of candidates to high league basketball team — high league champion.

Contingent. Were observed 12 basketball players, males (age 18—31). All observations were done before season. All players become Lithuanian high league champions at this season.

Methods of investigation. Cardiopulmonary exercise tests were performed on electronically braked bike ERGOLINE 9000, using modified BALKE protocol. Ventilation and gas exchange assess measured by breath-by-breath method, using VMAX229 metabolic card with paramagnetic oxygen and infrared carbon dioxide analyzer and Sensor Medics gas flow analyzer. Anaerobic threshold estimation was done directly by V-slope method, related with other usual parameters and performed on Sensor Medics VMAX229 analysis program. Heart rate and arterial blood pressure parameters were established during continuous ECG monitoring and analysis integrated VMAX and Marquette 3.01 system with electrocardiograph CORINA. Criterions for exercise terminating were oxygen consumption plateau (1 min. steady state interval with 5 % deviation), considerable heart rate and work ratio increasing with deviation from Jones formula limited interval for trained persons (decreasing of aerobic heart work efficiency with 10 % deviation), double rate product increasing absence.

Next parameters were introduced to samples for statistical analysis:

- Pulmonary ventilation data — VE_{AT} (minute ventilation at anaerobic threshold achieving), VE_{MAX} (maximal minute ventilation), PF_{AT} (peak respiratory flow at anaerobic threshold achieving), PF_{MAX} (peak respiratory flow at maximal workload);
- Cardiovascular condition data — HR_{AT} (heart rate at anaerobic threshold), HR_{VO2MAX} (heart rate at maximal oxygen consumption), DP (double product), DPD (double product ratio between maximal and minimal values);
- Maximal achieved workload;
- Oxygen consumption — VO_{2AT} (oxygen consumption at anaerobic threshold), VO_{2MAX} (maximal oxygen uptake).

Standard statistical analysis was performed. Samples summary statistic described with measuring of central tendency, variability and shape. Performed calculation of averages, variable, standard deviation, standardized kurtosis and skewness. Performed standard samples condition tests. All samples of normality and goodness-of-fit tests were performed with 95 % confidence level.

Results and discussion

Exercise test of the players showed excellent working capacity (workload intensity average 3,47 W/kg, std 0,41, CI at α 0.05 3,19—3,74, p<0,05). The established respiratory function parameters are shown in table 1.

Achieved VE and PF data are lower than maximal values referred by IOC Medical Commission (145—210 L/min.), Jones (for trained persons 153—161 L/min.), Knudson (for healthy persons 90—212 L/min.), Polgar (for healthy persons 105—175 L/min.) and reported by Chapman R.F. and all (for athletes 127—154 L/min.) and indicate good breath reserve as peak flow data (less than 40 % of predicted PEF by Polgar reference). Shultz H. and all reported rather like minute ventilation data (85—130 L/min.). The established heart function parameters are shown in table 2.

Achieved high DP and DP rate values indicate very high blood pump (heart) reserve, but maximal HR values are higher than referred by many authors. It maybe caused high anaerobic energy production as energetic compensation and indicates, that basketball players aren't fitted for long duration intensive work (Wasserman et al., 1994; Sport Med. Manual. 1990; Longhurst et al., 1997). The established oxygen consumption parameters are shown in table 3.

Achieved maximal oxygen uptake values have no significant difference with references for athletes (IOC Medical Commission, Jones, Bruce and Sheppard references for trained persons, and great number research publications).

Conclusions

Basketball players with 3,47 W/kg working capacity and higher level, maximal oxygen consumption higher than 50 ml/kg/min. and

Table 1

Respiratory function parameters achieved during exercise test

Parameter	VE_{AT} (L/min.)	VE_{MAX} (L/min.)	PF_{AT} (L/s)	PF_{VO2max} (L/s)
Average	44,90	126,33	1,87	5,28
Standard deviation	9,673	13,551	0,365	0,775
Standard skewness	0,59	1,097	0,142	0,783
Standard kurtosis	— 0,222	0,312	0,131	— 0,581
Confidence interval at α 0.05	38—51	117—136	1,62—2,11	4,76—5,8

Table 2

Heart function parameters achieved during exercise test

Parameter	HR_{AT} (beats/min,)	HR_{VO2max} (beats/min,)	DP_D	DP
Average	114,73	182,18	3,46	396,7
Standard deviation	23,143	64,809	6,574	68,8
Standard skewness	1,34	0,986	0,74	0,835
Standard kurtosis	0,803	— 0,594	0,394	0,16
Confidence interval at α 0.05	108—122	172—192	4,11—5,57	350,5—442,9

Table 3

Oxygen uptake parameters achieved during performed exercise test

Parameter	VO_{2AT} (mL/min/kg)	VO_{2max} (mL/min/kg)
Average	23,35	50,45
Standard deviation	4,44	7,874
Standard skewness	– 0,084	0,333
Standard kurtosis	– 1,172	0,1
Confidence interval at α 0.05	19,09–25,05	45,16–55,74

DP rate higher than 3,46 are fitted to Lithuanian basketball season.

Basketball players aren't fitted for long duration intensive work, because their anaerobic threshold values are just 19,05-25,05 ml/kg/min. and maximal heart rate during maximal workload achieve high values (172-192 b/min.) and indicate low heart pulse reserve as sign of intensive anaerobic energy generation consequence, but maybe, that usual rules for heart rate reserve calculation are not valid for high trained athletes.

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Summary

Studies aiming out to analyze some of the selected indices of cardio-respiratory system functioning in the top Lithuanian basketball players (n=12), carried out in the middle of preparatory training period, revealed the significant differences. Thus, at level of anaerobic turnover the heart rate (HR/AT b/min) made 108–122 beats/min; the oxygen consumption (VO_2/AT) was 19,09–25,02 ml/min/kg, and the lung ventilation (VE/AT l/min) made 38–51 l/min. The rate of lung maximal ventilation (VE max) was within a range of 117–136 l/min, the maximal oxygen consumption (VO_2 max) made from 45,16 to 55,74 ml/min/kg, and the maximal heart rate (HR/VO_2 max) made 172–192 beats/min.

The authors' results may suggest the significant individual level of organism functioning in the basketball players of a concrete team, and they also may serve as the criteria for optimization of means and methods used during training.

ПОКАЗАТЕЛИ ФУНКЦИОНАЛЬНОГО СОСТОЯНИЯ КАРДИО-РЕСПИРАТОРНОЙ СИСТЕМЫ ВЕДУЩИХ БАСКЕТБОЛИСТОВ

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Резюме

Исследования избранных показателей функционального состояния кардио-респираторной системы ведущих литовских баскетболистов (n = 12), проведенные в середине подготовительного тренировочного периода свидетельствуют о значительных различиях. ЧСС на уровне порога анаэробного обмена (HR/AT b/min) была в пределах 108–122 уд/мин, потребление кислорода на этом уровне обмена (VO2/AT ml/min/kg) — 19,09–25,02 мл/мин/кг, вентиляция легких (VE/AT l/min) — 38–51 л/мин. Уровень их максимальной вентиляции (VE max l/min) находился в пределах 117–136 л/мин, максимальное потребление кислорода (VO_2 max ml/min/kg) — 45,16–55,74 мл/мин/кг, максимальная ЧСС (HR/VO_2 max b/min) — 172–192 уд/мин.

Представленные результаты могут свидетельствовать о значительном индивидуальном уровне функционального состояния организма баскетболистов конкретной команды, могут служить критерием к оптимизированию примененяемых средств и методов тренировочного процесса