THE TECHNICAL AND PHYSICAL PREPARATION OF BASKETBALL PLAYERS

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ABSTRACT

Purpose. The study aim was to analyse the technical and physical preparation of highly qualified basketball players, as well as to determine the level of development of their aerobic and anaerobic functions.

Methods. When conducting laboratory examinations on a cycloergometer, for the purpose of determining the level of aerobic and anaerobic potential of basketball players, measurements of pulmonary ventilation, the level of oxygen consumption and the allocation of carbon dioxide, and the frequency of cardiac contractions were carried out.

Results. The paper presents results concerning the technical and physical preparation level of highly qualified basketball players, as well as the level of development of their aerobic and anaerobic functions, taking into account play functions.

Conclusions. The results revealed a need to increase the efficiency of high-level players training system. It was also observed that, despite positive changes, the training system applied in basketball did not ensure sufficient impact upon the energy functions of highly qualified basketball players.

Key words: physical, technical, functional training, highly qualified basketball players

Introduction

The choice of an effective system of training highly qualified basketball players is very complex, if it is not known, on the one hand, which requirements are put forward to the athletes by the play itself, and, on the other hand, what level of their technical, physical, and other types of preparation is and how it is implemented during the play [1–3]. The most acute issue is the definition of requirements for technical, and especially physical and functional fitness of sportsmen in sports games [4–8]. The absence of a clear relationship between the indicators of technique, motor activity, and functional changes in the body of athletes of these kinds of sports does not allow to fully proceed from the results of sports performances.

The purpose of the paper was to study the technical and physical preparation of highly qualified basketball players, as well as to determine the level of development of their aerobic and anaerobic functions.

Material and methods

Participants

The total of 69 sportsmen took part in the experiment, designed to determine the level of technical and physical preparation of basketball players. All of them were honoured masters of sports and masters of sports of the international class. Each athlete was informed about the research design and the requirements, benefits, and risks of the study.

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Overall, 74 honoured masters of sports and masters of sports of international class took part in the experiment for the purpose of determining the level of aerobic and anaerobic potential of basketball players, which satisfied the requirements concerning the sample volume at the confidence level of $p < 0.05$.

Methods

To obtain the necessary data, an examination program was implemented including 9 special tests. These tests met the established requirements [3, 9–12].

When conducting laboratory examinations on a cycloergometer, for the purpose of determining the level of aerobic and anaerobic potential of basketball players, measurements of pulmonary ventilation, the level of oxygen consumption and the allocation of carbon dioxide, and the frequency of cardiac contractions were carried out.

Statistical analysis

All statistical analyses were performed with the SPSS software, version 21, adapted to medical and biological research. All variables were tested for their conformity with the assumption of distributional normality; Student's *t*-test was applied. The significance for all statistical tests was set at $p < 0.05$.

Ethical approval

The research related to human use has been complied with all the relevant national regulations and institutional policies, and has followed the tenets of the World Medical Association (WMA) Declaration of Helsinki – ethical principles for medical research involving human subjects.

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

The results referring to the physical preparation of the highly qualified basketball players are presented in Table 1. As it is seen, the running time of the 6-m running in the basketball players performing central functions is 1.30 ± 0.041 s, which is lower than in the forwards (1.26 ± 0.035 s) and defenders (1.23 ± 0.031 s). But it should be borne in mind that the difference is only between the indicators of the centre players and defenders ($p < 0.01$). This means that the

starting speed of the defenders is better than that of the central players.

If one analyses the data of the 20-m running at 20 m, it turns out that the forwards and the centre players are inferior to the defenders, with a high level of reliability difference between the indicators. The maximum speed at the distance in the centre players is lower than that of the forwards and defenders. The increase in speed in the run from 6 to 20 m is 1.50 ± 0.104 m/s in the centre players and 1.70 ± 0.124 m/s in defenders ($p < 0.01$). Thus, it is observed that tall basketball players, especially those who perform the functions of central players, are inferior to the defenders in the initial acceleration, in the possibility of developing maximum speed at the distance, and in the results of 20-m running.

However, it should be noted that in quite a number of indicators that characterize speed qualities of basketball players (35% of the total number), the difference is absent or insignificant. This suggests significant positive changes in the training system of speed qualities in highly qualified basketball players. The high jumping analysis revealed a low level of development of this quality in the highly qualified basketball players. The results of the jump height in the basketball players of different play functions, as evidenced by the study results, are different. The defenders' jump height is 57.7 ± 2.71 cm, which, on average, is by 8.2 cm more than among the centre players ($p < 0.01$) and by 5.3 cm more than in the forwards ($p < 0.05$).

The correlation analysis carried out between the height data and the jump height indicators in highly qualified basketball players showed that there was a rather high but negative dependence ($r = -0.589$) between them.

The study has proved that in terms of the development of general and special high-speed endurance in basketball players of high qualification, there are significant reserves, especially in the centre players. The average factor in the Cooper test is 2845.3 ± 91.4 m in the centre players, 3075.5 ± 53.5 m in forwards, and 3087.9 ± 71.5 m in defenders. The difference between the average indicators of the centre players and defenders is significant and equals 242.6 m, whereas between the centre players and the forwards it is 230.2 m. It should be noted that the height of the forwards, as well as of the central players is above 200 cm.

The indicators of special high-speed endurance show similar results. During the test, the average indicator in the 3×40-s running is 560.9 ± 10.04 m in the centre players, 581.2 ± 6.52 m in the forwards, and 548.8 ± 10.92 m in the defenders. The difference be-

Table 1. Results of the tests on physical preparation in highly qualified basketball players

Indicators	Players' functions			Difference certainty
	Centre players (C)	Forwards (F)	Defenders (D)	
20-m running	(n = 15)	(n = 17)	(n = 20)	
– 6-m running time (s)	1.30 ± 0.041	1.26 ± 0.035	1.23 ± 0.031	(C-F) $p < 0.01$ (C-D) $p < 0.01$ (F-D) $p < 0.05$
– 20-m running time (s)	3.30 ± 0.082	3.13 ± 0.049	3.04 ± 0.027	(C-F) $p < 0.01$ (C-D) $p < 0.001$ (F-D) $p < 0.01$
– maximum speed at a distance (m/s)	6.08 ± 0.016	6.38 ± 0.021	6.60 ± 0.031	(C-F) $p < 0.01$ (C-D) $p < 0.001$ (F-D) $p < 0.01$
– increase in speed from 6 to 20 m (m/s)	1.50 ± 0.104	1.61 ± 0.100	1.70 ± 0.124	(C-F) $p < 0.05$ (C-D) $p < 0.01$ (F-D) $p < 0.05$
Jump height	(n = 27)	(n = 15)	(n = 27)	
– height standing on tiptoes with the hand above the head (cm)	279.6 ± 2.4	271.0 ± 3.49	256.9 ± 3.42	(C-F) $p < 0.05$ (C-D) $p < 0.01$ (F-D) $p < 0.01$
– absolute jump height (cm)	328.1 ± 3.12	324.1 ± 3.65	314.4 ± 3.42	(C-F) $p < 0.05$ (C-D) $p < 0.01$ (F-D) $p < 0.01$
Cooper test	(n = 17)	(n = 20)	(n = 21)	
– number of meters for 12 min of running	2845.3 ± 91.4	3075.5 ± 53.5	3087.9 ± 71.5	(C-F) $p < 0.01$ (C-D) $p < 0.01$ (F-D) $p < 0.05$
3 × 40-s running after 1 min rest	(n = 12)	(n = 15)	(n = 21)	
– number of meters for 120 s of running	560.9 ± 10.04	581.2 ± 6.52	548.8 ± 10.92	(C-F) $p < 0.05$ (C-D) $p < 0.05$ (F-D) $p < 0.01$

tween the indicators of the centre players and the forwards is 20.3 ($p < 0.05$); it is 12.7 m ($p < 0.05$) between the centre players and defenders, and 32.4 m ($p < 0.01$) between the forwards and defenders.

The analysis of the study results of the highly qualified basketball players' technical preparation (Table 2) has shown that the advantage of the defenders over the centre players and forwards is observed in all indicators, with the exception of two: the work time in the ball shooting in a jump from 40 m test and overall work ability in shots.

This suggests that the level of technical preparation of tall players has significant reserves, especially in passing the basketball using one hand from the shoulder performed with the use of the 'weaker' hand (usually the left hand), and in the foul shot. It is known that during the match, tall players, especially centre players, most often perform foul shots. But they have a lower scoring rate of 24.0 ± 1.43 (83.8%), while a scoring rate

of defenders is 26.5 ± 0.689 (88.3%). The reliability of the difference between the indicators is high ($p < 0.01$).

The analysis of the functional capabilities of basketball players showed that the maximum oxygen consumption in basketball players of high qualification reached the value of 58.5 ± 5.59 ml/kg/min.

The average indicators of critical power in highly qualified basketball players equalled 1741 kg/min, anaerobic exchange threshold: 60.7%, physical working capacity: 170–1325 kg/min; the total 'excess' of CO_2 emission was 4.86 l.

The analysis of the functional capability indicators of highly qualified basketball players, with the consideration of their game functions, showed that the reliable difference between them was observed in 25.9% of cases. The difference between the indicators of the central players and forwards was significant in 16.6% of cases, between centre players and defenders in 55.5% of cases, and between forwards and defenders in 5.5% of cases.

Table 2. Results of the tests on technical preparation in highly qualified basketball players

Indicators	Players' functions			Difference certainty
	Centre players (C)	Forwards (F)	Defenders (D)	
Movement in the defender's position	(n = 18)	(n = 19)	(n = 17)	
– time per 100 m (s)	35.31 ± 2.26	34.01 ± 1.21	32.27 ± 1.09	(C-F) $p < 0.05$
Passing the ball to the wall within 30 s	(n = 25)	(n = 25)	(n = 25)	
– number of times, 'strong hand'	35.4 ± 0.892	38.7 ± 0.984	42.2 ± 0.915	(C-F) $p < 0.05$ (C-D) $p < 0.01$ (F-D) $p < 0.05$
– number of times, 'weak hand'	32.0 ± 0.011	35.2 ± 0.856	38.8 ± 0.711	(C-F) $p < 0.05$ (C-D) $p < 0.01$ (F-D) $p < 0.05$
– number of times, two hands from the breast	34.0 ± 0.815	37.9 ± 0.372	41.2 ± 0.912	(C-F) $p < 0.05$ (C-D) $p < 0.001$ (F-D) $p < 0.01$
Foul shots from the distance of 30 m	(n = 15)	(n = 20)	(n = 28)	
– number of hits	24.0 ± 1.43	25.15 ± 0.875	26.5 ± 0.689	(C-F) $p < 0.05$ (C-D) $p < 0.01$ (F-D) $p < 0.05$
Ball shooting in a jump from 40 m	(n = 23)	(n = 20)	(n = 28)	
– number of hits	25.95 ± 1.45	27.04 ± 1.62	29.96 ± 1.35	(C-F) $p < 0.05$ (C-D) $p < 0.01$ (F-D) $p < 0.99$
– percentage of hits	64.9 ± 3.63	67.6 ± 4.06	74.0 ± 3.4	(C-F) $p < 0.05$ (C-D) $p < 0.01$ (F-D) $p < 0.05$
– work time (min/s)	4.13 ± 0.187	4.25 ± 1.108	4.11 ± 0.138	(C-F) $p < 0.05$ (C-D) $p < 0.05$ (F-D) $p < 0.05$
– general work ability in ball shooting (s)	0.162 ± 0.006	0.157 ± 0.039	0.164 ± 0.007	(C-F) $p < 0.05$ (C-D) $p < 0.05$ (F-D) $p < 0.05$
– throwing technique efficiency till fatigue (number of hits for 1 s)	0.105 ± 0.008	0.107 ± 0.006	0.125 ± 0.007	(C-F) $p < 0.05$ (C-D) $p < 0.001$ (F-D) $p < 0.001$
Complex test 2 × 26	(n = 18)	(n = 19)	(n = 18)	
– speed (m/s)	14.8 ± 0.646	14.6 ± 0.438	13.67 ± 0.705	(C-F) $p < 0.05$ (C-D) $p < 0.05$ (F-D) $p < 0.05$

Discussion

A significant contribution to the problem of assessing the level of physical preparation may be the study of the functional capabilities of basketball players [13–15]. The change during the game significantly influences aerobic and anaerobic metabolism indicators [6, 10, 16].

It is known [5, 11, 17] that one of the most important indicators of physical work capacity, which characterizes the level of development of aerobic functions, is the maximum oxygen consumption. The values of the maximum O_2 consumption are lower than the similar indicators in representatives of other types of sports [1, 18, 19].

It should be noted that in cyclic sports athletes, the maximum oxygen consumption reaches 70 ml/kg and above [15]. Relatively small values are recorded in indicators that characterize the level of development of aerobic and anaerobic performance of sportsmen.

The results of the study supplement the information on the control of aerobic and anaerobic functions of basketball players regulating the expediency of pedagogical influences to ensure the efficiency of the basketball players' competitive activities [13–15, 18]. This knowledge enhances the effectiveness of preparation of highly skilled basketball players during long-term training [20–22].

Conclusions

1. The study has revealed that in 20.2% of cases, there is no difference between physical preparation indicators or the difference is uncertain in players with different functions. In the technical preparation indicators, this percentage is 30.5. This shows, on the one hand, a certain progress in the system of training of highly qualified basketball players, and, on the other, the necessity to increase the efficiency of the training system for tall players, especially those performing functions of centre players.

2. The determination of the maximum of aerobic and anaerobic performance indicates that, despite positive changes, the system of preparation applied in basketball does not ensure sufficient influence upon the energy functions that form the basis of both general and special endurance. This is evidenced by the data obtained among basketball players of various game functions.

Future research should focus on the competitive activities efficiency in basketball players.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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