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MORPHOFUNCTIONAL CHARACTERISTICS OF BASKETBALL PLAYERS WITH DIFFERENT ROLES AS SELECTION CRITERIA AT THE STAGE OF PREPARATION FOR HIGHER ACHIEVEMENTS

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Abstract

Objective. To study the morphofunctional characteristics of basketball players aged 17-20 years, taking into account their game role, and to substantiate the possibility of using them as criteria for selection and orientation at the stage of preparation for higher achievements.

Materials and methods. The study participants were 200 basketball players (17-20 years old). The following methods were used: theoretical analysis, pedagogical observation, pedagogical experiment with the use of instrumental methods of functional diagnostics (ergometry, chronometry, spirometry, gas analysis, and pulsometry), anthropometric methods, statistical methods.

Results. The study determined statistically significant differences in height and weight in all playing positions: the point guard is characterized by statistically significantly shorter body height compared to the shooting guard ($U = 46.5$; $z = -6.88$; $p < 0.01$), the shooting guard is statistically significantly shorter than the small forward ($U = 51.0$; $z = -5.58$; $p < 0.01$), the latter is shorter compared to the power forward ($U = 38.0$; $z = -5.56$; $p < 0.01$). The center was found to be statistically significantly taller than the power forward ($U = 82.0$; $z = 4.24$; $p < 0.01$). The model height indicators of centers at this stage of improvement are 205.9 ± 3.53 cm. Groups of athletes, depending on their roles, statistically significantly differ in body weight ($F = 64.304$; $p < 0.01$). Centers are the heaviest and point guards – the lightest basketball players. The dynamics of body height and weight indicators of basketball players from 16 to 20 years were determined.
Point guards and shooting guards have a statistically significantly higher level of VO_2max compared to centers and power forwards. The average level of VO_2max of players in the point guard position was 57.05 ± 3.78 ml.kg.-1min. In centers, this indicator is on average 49.10 ± 4.63 $ml \cdot kg^{-1} \cdot min^{-1}$. Centers had the VLC in the range of 9.38 ± 0.76 l, power forwards – 8.72 ± 0.80 l, defensive players – 7.5-8 l. No statistically significant differences were found in players with different roles in the level of AnT as a percentage of VO_2max.

Conclusions. Morphological and functional characteristics serve as informative criteria for monitoring the individual condition of players, are dynamic and can be used in different age groups, taking into account the specifics of team training and individual qualities.

Keywords: basketball, game position (role), training, morphological and functional criteria, selection.

Introduction

The specifics of the competitive activity in basketball require a distribution of game functions between players on the court. Modern basketball tends to universalize the capabilities of players, but complete unification of athletes' playing actions is impractical (Bezmylov et al., 2013). This is due to significant differences (anthropometric, functional, physical, etc.) between players who perform certain playing functions (Bavli, 2008; Dalextrat et al., 2009; Issurin, 2016).

According to Trninić et al. (2000), in order to perform the functions of all game roles on the court, it is necessary to satisfy the criteria of each of them, which is quite difficult. In basketball, anthropometric characteristics are crucial when distributing playing functions on the court (Cormery et al., 2008).

The dependence of successful competitive activity of certain basketball players on anthropometric characteristics is the cause of problematic issues that arise during the training of basketball players in children and youth sports (Matulaitis et al., 2019). There are cases when a child starts playing basketball too late, at the age of 13-14, during a period of rapid growth (puberty) (Stroganov et al., 2020).

Taking into account good anthropometric characteristics, coaches enroll teenagers in a basketball section, despite the actual lack of basic training. Contradictions arise: teenagers are unable to catch up with their peers, who have more experience in basketball, in mastering and using the technical and tactical arsenal of game actions (Yixiong et al., 2019). In basketball, there are often cases where a player with good anthropometric qualities has a narrow range of playing possibilities on the court. In modern basketball, there are a lot of players with poor anthropometric characteristics (Erol et al., 2014). This explains coaches' interest in tall players, and the process of enrolling such athletes contradicts the general logic and rules of forming training groups in children and youth sports schools and private basketball clubs (Bezmylov et al., 2020a,b; Matulaitis et al., 2019).

The closer to the basket the player has to act, the more important the player's body height and weight are, allowing him/her to successfully fight and effectively attack the basket. And vice versa, the farther from the basket the athlete has to perform actions, the more important the player's speed capabilities, effective technique of movements, etc., become (Dalextrat & Cohen, 2009).

This issue is widely discussed by scientists and is important for basketball players at the stage of preparation for higher achievements. This determined the relevance of the study.

Objective. To study the morphofunctional characteristics of basketball players aged 17-20 years, taking into account their game role, and to substantiate the possibility of using them as criteria for selection and orientation at the stage of preparation for higher achievements.

Materials and Methods

Study participants

The study participants were basketball players of the youth national teams of Ukraine U 18 and U 20, players of the youth club team "Kyiv-Basket", who were at the stage of preparation for higher achievements (17-20 years old). A total of 200 players were examined.

Study organization

The study used the following methods: theoretical analysis, pedagogical observation, pedagogical experiment with the use of instrumental methods of functional diagnostics, morphological methods. The response of basketball players' cardiorespiratory system to aerobic and anaerobic exercise was studied in standardized laboratory conditions, using such methods as ergometry, chronometry, spirometry, gas analysis, and pulsometry. The ergospirometry complex "Oxycon Pro" (Jaeger, Germany) was used for gas analysis (Fig. 1).

Devices were calibrated automatically before and after testing each athlete. The error in registration of indicators was 0.02%. The composition and volume of the calibration mixture were 5% CO_2 and 17% O_2 in the N_2 balance (95%).

Test loads were performed on the LE-200 treadmill according to the standard program. Heart rate (HR, beats.min^{-1}) was measured using the "Sport Test Polar" RS 800 (Finland).

Fig. 1. Fragment of testing basketball players in laboratory conditions, using ergometry and gas analysis

The anaerobic threshold (AnT) was determined in the conditions of incrementally increasing exercise intensity in a non-invasive way, using the computer graphics analysis at the beginning of a non-linear increase in VE and VCO_2, the beginning of an increase in $VCO_2 \cdot VO_2$, and at the beginning of an increase in $EQCO_2$, which was not accompanied by a concomitant increase in $EQCO_2$, as well as at the beginning of an increase in the O_2 fraction in exhaled air (FEO_2,%). The study determined the point of anaerobic threshold and corresponding values of work intensity (WAnT), the time of achievement of AnT (PAnT), and other physiological indicators (VO_2 – AnT, VCO_2 – AnT, VE – AnT, HRAnT). Absolute and relative (in % of maximum) amount of O_2 consumption at the level of anaerobic threshold (VO_2 – AnT in % of VO_2max) was determined.

The indicators of body height (cm), weight (kg) were measured according to the standard. The subject was examined in a standard upright position. The study analyzed the peculiarities of manifestation of these indicators, taking into account the playing specialization of basketball players. The TANITA body analyzer (Japan) was used to determine the percentage of fat, muscle, and bone tissue of different body segments of basketball players. The study determined: body weight and height, percentage of fat in the body, trunk, and limbs – FAT %, fat mass in the body, trunk, and limbs – FAT MASS, kg, weight without fat in the body – FFM, kg, predicted muscle mass in the trunk and limbs – Predicted Muscle Mass (PMS), kg, total body water – TBW, kg, body mass index – BMI, and basal metabolic rate – BMR, kcal.

The study was conducted on the basis of the laboratory of the Research Institute of the National University of Physical Education and Sports of Ukraine.

Statistical analysis

The statistical analysis of data included verification of the observed data for normal distribution, using the Shapiro-Wilk test. If the indicators of basketball players in their role were normally distributed (such as body weight of athletes), the equality of variances of characteristics in comparison groups was assessed by the Levene's test and, since the conditions were met, comparative analysis of the indicators was performed using the one-way ANOVA. The differences between the indicators in all groups were assessed using the Fisher's F-test, and pairwise comparisons – the Bonferroni test. In the case when the indicators did not meet the necessary conditions for using the one-way ANOVA (for example, the body height of athletes), its non-parametric analogue was used, namely the Kruskal-Wallis H test. Post hoc comparisons were performed with the help of the Mann-Whitney U test (Mann, Whitney, 1947; Byshevets, Denysova et al., 2019; Byshevets, Shynkaruk et al., 2019).

The value $\alpha = 0.05$ was taken as the level of statistical significance. Note that in the case when the calculated p-value was less than $1.0 \cdot 10^{-6}$, it was presented as $p < 0.01$. In other cases, the exact p-value is given.

Statistical processing of empirical data was implemented using the statistical analysis package STATISTICA 10.0 (StatSoft, USA).

Results

The analysis of the studied indicators of basketball players, who are at the stage of preparation for higher sports achievements, made it possible to determine model characteristics for each playing position. The indicators of young players of European championships (Spain, France, Lithuania, Serbia, Ukraine) were analyzed. Thus, the data on the body height and weight of basketball players were determined (Tables 1, 2). Statistically significant differences are observed between players of all roles.

Statistical analysis showed that not all indicators of the body height were normally distributed (The Shapiro-Wilk test ranged from 0.933 to 0.969, with p from 0.023 to 0.461), so to compare the body height of athletes, depending on their role, the study used the Kruskal-Wallis non-parametric test (see Table 1). It was found that H (4; 147) was 132.54, with $p < 0.05$, which indicates the statistical significance of differences between the body height of athletes, depending on their role.

The point guard is characterized by statistically significantly shorter body height compared to the shooting guard (U = 46.5; z = -6.88; p < 0.01) (see Table 1). The shooting guard is statistically significantly shorter than the small forward (U = 51.0; z = -5.58; p <0.01), who is statistically significantly shorter compared to the power forward (U = 38.0; z = -5.56; p <0.01). For his part, in contrast to the power forward, the center was found to be statistically significantly

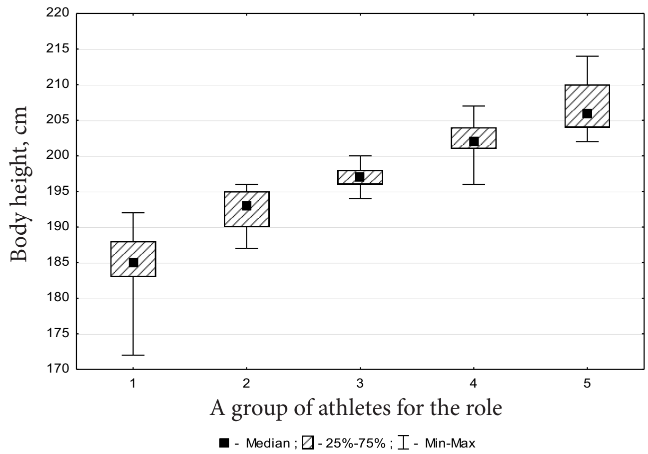

Fig. 2. Comparative analysis of the body height of athletes, depending on their role (n = 147), where 1 – point guard; 2 – shooting guard; 3 – small forward; 4 – power forward; 5 – center

taller (U = 82.0; z = 4.24; p = 2.3 10-5 <0.01). It was proved that all groups of basketball players statistically significantly differ in the body height, depending on their role (Table 1, Fig. 2). Note that the model body height indicators of centers at this stage of improvement are on average 205.9 ± 3.53 cm.

All body weight indicators of basketball players were normally distributed ($0.929 \le W \le 0.972$; $0.104 \le p \le 0.515$), ANOVA was used to compare the body weight of athletes depending on their role (Table 2). Using the Levene's test, the study determined that the variances of athletes' body weight indicators do not differ statistically significantly (F = 0.559; p = 0.693), so the conditions for using the analysis of variance are met. Groups of athletes, depending on their roles, statistically significantly differ in body weight (F = 64.304; p < 0.01).

Table 1. Results of statistical analysis of the body height of basketball players, depending on their role (n=147)

Role	Calculated indicators				
	"Point guard" (n=39)	Shooting guard" (n=35)	"Small forward" (n=23)	"Power forward" (n=31)	"Center" (n=19)
	Average indicators: Me (25; 75)				
Body height, cm H (4, N = 147) = 132.54 p < 0.00001	185 (183;188)	193 (190; 195)	197 (196;198)	202 (201; 204)	206 (204; 210)
	Test of samples for normal distribution: W; p				
	0.9335; 0.02334	0.9335; 0.03556	0.9326; 0.12448	0.9690; 0.49111	0.9333; 0.19901
	Comparative analysis by the Mann-Whitney test		U	z	p
	PG-SG		46.5	-6.88	<0.00001
	SG-SF		51.0	-5.58	<0.00001
	SF-PF		38.0	-5.56	<0.00001
	PF-C		82.0	-4.24	0.00002

Table 2. Results of statistical analysis of the body weight of basketball players, depending on their role (n=147)

Role		Calculated indicators				
		"Point guard" (n=39)	**"Shooting guard" (n=35)**	**"Small forward" (n=23)**	**"Power forward" (n=31)**	**"Center" (n=19)**
Body weight, kg $F_{(4, 142)} = 64.304$, $p < 0.00001$	Average indicators: Me (25;75)					
		82 (74; 75)	87 (83; 935)	90 (85; 93)	100 (95; 103)	101 (99; 105)
	Test of samples for normal distribution: W; p					
		0.9497; 0.08033	0.9725; 0.51484	0.9289; 0.10359	0.9625; 0.33898	0.9518; 0.42412
	Comparative analysis by the Bonferroni test; Probabilities for Post Hoc Tests; Error: Between MS = 38.535, df = 142.00					
		"Point guard"	**"Shooting guard"**	**"Small forward"**	**"Power forward"**	**"Center"**
	PG		0.000042	0.000002	<0.00001	<0.00001
	SG	0.000042		1.000000	<0.00001	<0.00001
	SF	0.000002	1.000000		<0.00001	<0.00001
	PF	<0.00001	<0.00001	<0.00001		1.000000
	C	<0.00001	<0.00001	<0.00001	1.000000	

For post hoc comparisons, the Bonferroni test was used, the results of which showed statistically significant differences between the body weight of athletes in all groups, depending on their role (Fig. 3. See Table 2). Thus, centers are the heaviest and point guards are the lightest basketball players.

It was found that centers are significantly inferior to adult athletes in their anthropometric parameters (Table 3). The same differences are observed among power forwards. A comparison of the height and weight of basketball players by age – from 16 years and up to players of national teams, shows the biggest differences among basketball players of the offensive line.

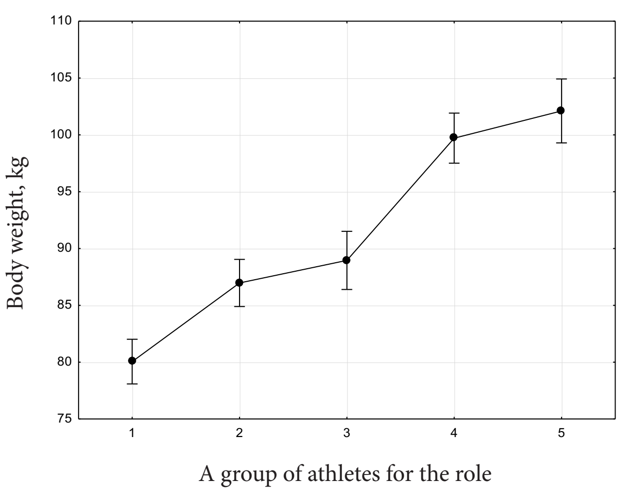

Fig. 3. Implementation of post hoc comparisons of the body weight of basketball players, depending on their game role in the STATISTICA 10.0 program, where vertical bars denote 0.95 confidence intervals

The study data on the functional capabilities of basketball players with different roles, who prepare for higher sports achievements, are presented in Table 4. The average level of VO_2 max in point guards was 57.05 ± 3.78 ml·kg·min^{-1}. The lowest VO_2 max values were found in centers – 49.10 ± 4.63 ml·kg·min^{-1}. In our study, the level of VO_2 max in players decreased linearly from the first to the fifth position.

During the step test, the highest values of maximum voluntary ventilation were recorded in power forwards, the lowest – in defensive players (point guards and shooting guards). During laboratory testing, the indicators of voluntary ventilation of power forwards reached the level of 166.25 ± 14.12 l·min^{-1}.

The highest values of intensity of the work performed during the test (W) were observed in point guards. The average level of maximum load during the step test was 357.50 ± 16.26 (W). During testing, the lowest intensity was achieved by centers – 315.50 ± 18.32 (W) (see Table 4).

There were no statistically significant differences between players with different roles in the level of AnT as a percentage of VO_{2max}. This indicator ranged from 70 to 90% of the level of VO_{2max} and characterized the player's individual level of fitness at the time of testing (Fig. 5). A similar situation was observed in the indicators of heart rate and exercise intensity in basketball players when reaching the AnT.

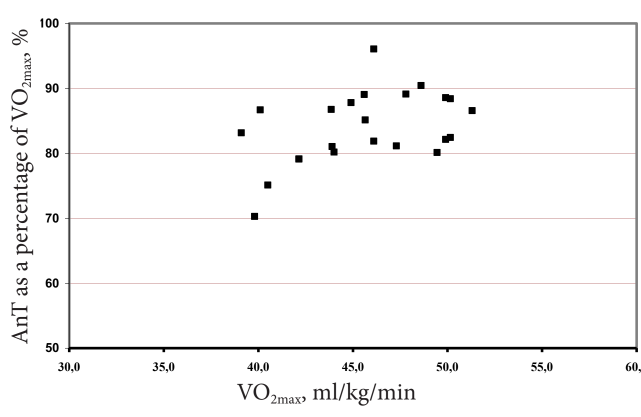

Fig. 4. Achievement of the anaerobic threshold (AnT) by basketball players aged 17-20 as a percentage of maximal oxygen consumption VO_2 max

Table 3. Dynamics of the body height indicators of basketball players, taking into account the age category at international basketball tournaments

No	Age	Point guard (n = 80) X ± s	p < 0.05	Shooting guard (n = 80) X ± s	p < 0.05	Small forward (n = 80) X ± s	p < 0.05	Power forward (n = 80) X ± s	p < 0.05	Center (n = 80) X ± s	p < 0.05
1	U 16	186.3±4.27	–	190.7±4.22	*4, 5, 6	196.4±3.60	4,5,6	201.3±3.93	4, 5, 6	203.6±3.34	2, 3, 4, 5, 6
2	U 17	186.4±4.93	–	192.0±5.26	5,6	196.5±3.88	6	202.0±3.21	5, 6	206.0±3.75	1,5,6
3	U 18	187.7±5.55	–	191.6±4.11	–	197.8±3.71	6	202.3±2.87	5, 6	205.9±3.53	1,5,6
4	U 19	187.2±6.64	–	194.6±4.85	1, 2	199.0±4.57	1	203.7±2.96	1, 6	206.9±3.34	1,6
5	U 20	187.1±5.60	–	194.5±3.44	1, 2	198.1±3.39	1	205.1±2.69	1, 2, 3	208.0±3.59	1,2,3,6
6	National Team	187.3±4.91	–	194.6±2.48	1, 2	199.1±8.42	1,2,3	205.1±7.05	1, 2, 3, 4	210.2±9.98	1,2,3,4,5

Note: * – differences with the corresponding number in the line of national teams are statistically significant, if p < 0.05

Table 4. Morphofunctional characteristics of basketball players at the stage of preparation for higher achievements, taking into account their game role (17-20 years)

No	Indicator	VO_2max ml·kg^{-1}·min^{-1} X ± s	p < 0.05	Voluntary ventilation, l·min^{-1} (MVV) X ± s	p < 0.05	Vital lung capacity VLC, l X ± s	p < 0.05	Peak expiratory flow (PEF), l·s^{-1} X ± s	p < 0.05	Load, Wt X ± s	p < 0.05
1	Point guard	57.05±3.78	4, 5	144.55±12.83	4	7.54±1.02	4,5	11.10±1.18	3, 5	357.50±16.26	5
2	Shooting guard	55.60±3.02	5	141.70±16.87	4, 5	7.89±1.16	5	11.95±1.36	3, 5	325.14±36.51	–
3	Small forward	53.35±4.08	–	146.50±21.05	4	7.38±0.98	4,5	9.15±1.06	1, 2, 4	343.18±24.05	–
4	Power forward	52.95±3.65	1	166.25±14.12	1, 2, 3	8.72±0.80	1,3	11.68±1.92	3, 5	342.70±37.90	–
5	Center	49.10±4.63	1, 2	150.05±19.20	2	9.38±0.76	1,2,3	8.79±1.04	1, 2, 4	315.50±18.32	1

Note: * – differences with the corresponding role are statistically significant, if p < 0.05

Discussion

In team sports and basketball in particular, a characteristic feature of selection at the stage of preparation for higher sports achievements is the need to take into account the game specialization of athletes (Shynkaruk, 2011; Bezmylov et al., 2020; Kostiukevych et al., 2020, 2021). Players are selected for the team, taking into account the specific conditions of the competitive activity where the young player will perform playing functions on the court.

According to Bezmylov et al. (2013, 2020), the height of a basketball player increases linearly from the “first” to the “fifth” position. These differences are most significant between the players who perform the functions of the first (point guard) and the fifth (center) numbers on the court. As for other morphological features and the possibility of using them during sports selection, experts also pay attention to the athlete’s wingspan, body composition, etc. (Apostolidis et al., 2004; Erol et al., 2014; Jeličić, 2002).

In the United States, when assessing the prospects of young basketball players in the NBA draft, the following morphological indicators of players are taken into account: bone length and width, sitting height of the player, chest circumference, body fat and muscle percentage, etc. (Yixiong et al., 2019; Bezmylov, Shynkaruk, & Murphy, 2020). These morphological indicators affect the competitive activity on the court. However, there are many examples (especially in women’s basketball) when athletes do not meet the model anthropometric parameters, but effectively perform game actions on the court and counteract the opponent (Dalextrat & Cohen, 2009).

The structure of the competitive activity in basketball is complex, the final sports result is determined by a number of factors (player’s level of mastery, game intuition, psychological qualities, etc.). Some morphological indicators, that are recommended as informative for determining the prospects of the player, are dynamic or can be actively corrected (body weight, fat-to-muscle ratio, etc.) (Abdelkrim et al., 2010; Matveyev, 1999; Ostojic et al., 2006).

The use of such morphological characteristics for sports selection at the stage of preparation for higher sports achievements is controversial, given that athletes at this stage (17-20 years old) continue to actively develop. In this regard, according to experts (Jeličić et al., 2002; Yixiong et al., 2019), body height is among the most informative morphological characteristics.

In the late 1980s and early 1990s, in the theory and practice of basketball, the division of players into five game roles – point guard, shooting guard, small forward, power forward, center – became widespread. For the first time, such a division of athletes was proposed in the NBA. Today, this division is unified and basic for many basketball countries around the world (Bezmylov, Shynkaruk, 2013; Sallet et al., 2005). This division of players is typical of elite sports.

During previous stages of long-term improvement, there are cases when the athlete focuses on two playing positions with further specification during the training process (Bezmylov et al., 2020).

With increasing body height (208 cm and above), the player is oriented mainly towards the functions of the fifth number (center), with stabilized indicators – the fourth number (power forward) (Yixiong et al., 2019).

Such temporary universalization in adjacent playing positions expands the possibility of using a tall player in subsequent performances in elite sports and minimizes strategic mistakes when choosing an athlete's playing position on the court. It was proved that the body height of the point guard from the age of 16 is quite stable. No statistically significant differences were found between young players (each category) and professional athletes ($p > 0.05$).

The analysis of the body composition of basketball players at the stage of preparation for higher sports achievements showed that almost all players have a low body fat level. This can be explained by the young age of athletes (17-20 years). Our data complement the findings of Ben Abdelkrim et al. (2007), which show that players of professional teams have statistically significantly higher levels of body fat in contrast to young athletes. We did not find any significant differences in body mass index between players performing different game functions on the court. Point guards and small forwards had an advantage, the differences are not statistically significant. In our opinion, this indicator and body mass index (conditional unit) are dynamic, depend on a number of factors, and can be considered auxiliary when monitoring players at the stage of preparation for higher achievements.

Our data showed that in the period from 16 to 20 years, the body height of power forwards and centers significantly changes, which must be taken into account during stage-by-stage determination of the final game specialization on the court. The difference between centers aged 16 and adult basketball players of national teams is 7-8 cm, and the difference in body weight can reach 20 kg and more. These differences are statistically significant ($p < 0.05$). When selecting young players, who are at the stage of preparation for higher achievements, coaches include them in the team on the line of attack (power forward and center) and allow players to perform both game functions.

Players who act mainly under the baskets must have a high level of speed and strength. Attacking players (power forward and center) use their own body size to gain an advantage in the fight for a favorable position when attacking the basket at a short distance, picking up the ball, or setting a screen. At this stage, when deciding on the selection of a player for the team and his/her subsequent orientation to a particular role in the game, height becomes dominant among morphological characteristics (Ostojic et al., 2006; Sallet et al., 2005).

The trend of modern basketball development is the intensification of competitive activity. This is due to the growing level of players' mastery, the use of modern technologies for training athletes, the change in the rules of FIBA competitions in 2000. This affected the game dynamics on the court. The time for an attack was reduced from 30 to 24 seconds, less time was allotted for throwing the ball out of one's half of the court, etc. (Abdelkrim et al., 2007; Cormery et al., 2008; Matulaitis et al., 2019). This affected the spectacularity of basketball matches: the game became faster, the requirements for the level of athletes' functional fitness increased.

Cormery et al. (2008) have long studied the functional capabilities of highly qualified basketball players from leading teams. A graphical comparison showed that the level of maximal oxygen consumption in basketball players who played in the mid-1990s was much lower than in athletes in the mid-2000s (after the introduction of new rules in 2000, which accelerated the dynamic characteristics of the game).

Bompa (2000), Lysenko (2010), Marinkovic et al. (2013) point out that the specifics of the competitive activity in basketball require a high level of both aerobic and anaerobic capacity. At the same time, according to scientists, it is the level of anaerobic capacity that becomes decisive for successful competitive activity in the game. Most of the competitive actions in the game are performed mainly in submaximal or maximal intensity zones. The average heart rate of players during technical and tactical actions (acceleration, jumps, throws, speed movement on the court, etc.) ranges from 85 to 95% of the maximum level (Abdelkrim et al., 2007; Marinkovic et al., 2013).

The specificity of the competitive activity structure in basketball is also determined by the intermittent nature of the game. High-intensity segments of the competitive activity alternate with periods of rest (during free throws, timeouts, rules violations, etc.), the duration of which roughly corresponds to the segments of the game (Yixiong et al., 2019). During short periods of rest (on average from 15 to 40 seconds), there is an active recovery of the athlete's body due to aerobic capacity (Abdelkrim et al., 2010; Bezmylov et al., 2013). After 2000, the time allotted for pauses in the game was significantly reduced. This led to increased requirements for the level of players' functional capabilities.

According to experts (Abdelkrim et al., 2007; Apostolidis et al., 2004; Lamontagne, 2013), defensive players must have the highest level of functional capabilities among other players. This is due to the specific conditions of functional responsibilities in the game. Defensive players have average and below average morphological qualities, but perform the majority of movements on the court during the game. The studies by Abdelkrim et al. (2007) and Apostolidis et al. (2004) show that in some cases, the level of VO_2max in elite basketball players, who play in defensive positions, reached 60-65 $ml \cdot kg^{-1} \cdot min^{-1}$. The lowest indicators of VO_2max were recorded in offensive players (center, power forward).

The study confirmed the data of Cormery (2008) on the intensification of competitive activity in modern basketball. The level of maximal oxygen consumption in skilled basketball players significantly increased (from 45-50 $ml \cdot kg \cdot^{-1} min^{-1}$ in the mid-1990s to 55-60 $ml \cdot kg.^{-1} min^{-1}$ after the introduction of new rules in the 2000s).

In our study, the VO_{2max} of defensive players aged 17-20 years reached 60 $ml \cdot kg^{-1} \cdot min^{-1}$ in some cases during testing. The highest indicators of vital lung capacity (VLC) were shown by centers (9.38 ± 0.76 l) and power forwards (8.72 ± 0.80 l), which can be explained by the larger total size of their body compared to defensive players. Defensive players had a high level of VLC ranging from 7.5 to 8 l.

The peak expiratory flow during a forced spirometry, which characterizes the respiratory muscle strength, was identified as an informative indicator. A high level of peak expiratory flow was observed in defensive players and power forwards ($p < 0.05$) compared to centers and small forwards. This indicator can be recommended to assess the functional fitness of young basketball players during the selection for teams to prepare for and participate in international competitions.

The obtained data confirm the opinions of experts (Abdelkrim et al., 2007; Apostolidis et al., 2004; Lamontagne, 2013) on different levels of fitness of young basketball players, taking into account their game role.

In the process of preparing national teams during four-six weeks, the basic functional training takes no more than two weeks. Athletes who start preparing for competitions in a national team in a better functional state due to individual basic training should be rated higher than others. The characteristics of assessing the level of a basketball player's functional capabilities have a significant reserve for the correction of training, but it is necessary to take into account a confluence of factors that affect the performance in team sports.

Conclusions

The study proved the importance of morphological and functional indicators for basketball players. The height indicators of power forwards and centers were found to be significant.

The determined morphological (height, weight, body composition) and functional characteristics (VO_2max, MVV, VLC, PEF, load intensity W, AnT) serve as informative criteria in the process of stage-by-stage and ongoing monitoring of the individual condition of players, are dynamic and can be used in different age groups, taking into account the specifics of training in a team and individually.

At the stage of preparation for higher achievements, the specifics of the competitive activity of basketball players with different roles put forward differentiated requirements for the level of their functional fitness.

Conflict of Interest

The authors declare no conflict of interest.

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МОРФОФУНКЦІОНАЛЬНІ ХАРАКТЕРИСТИКИ БАСКЕТБОЛІСТІВ РІЗНОГО АМПЛУА ЯК КРИТЕРІЙ ВІДБОРУ НА ЕТАПІ ПІДГОТОВКИ ДО ВИЩИХ ДОСЯГНЕНЬ

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 7 с., 4 табл., 4 рис., 29 джерел.

Мета досліджень. Дослідити морфофункціональні особливості баскетболістів 17-20 річного віку з урахуванням ігрового амплуа та обґрунтувати можливість їх використання як критерію відбору та орієнтації на етапі підготовки до вищих досягнень.

Матеріали і методи. В дослідженнях брали участь 200 баскетболістів (17-20 років). Використано теоретичний аналіз, педагогічне спостереження, педагогічний експеримент з використанням інструментальних методів функціональної діагностики (ергометрії, хронометрії, спірометрії, газоаналізу та пульсометрії), антропометричні методи, методи статистики.

Результати. Визначено статистично значущі відмінності за показниками росту та ваги за всіма ігровими позиціями: «Point guard» характеризується статистично значуще меншою довжиною тіла порівняно з «Shooting guard» ($U = 46,5$; $z = -6,88$; $p < 0,01$), «Shooting guard» відрізняється статистично значуще меншою довжиною тіла з «Small forward» ($U = 51,0$; $z = -5,58$; $p < 0,01$), той має меншу довжину тіла порівняно з «Power forward» ($U = 38,0$; $z =-5,56$; $p < 0,01$). «Center» виявився статистично значуще вищим від «Power forward» ($U = 82,0$; $z = 4,24$; $p = 2,3\cdot10^{-5}<0,01$). Модельні показники росту центрових гравців на цьому етапі вдосконалення – $205,9 \pm 3,53$ см. Групи спортсменів залежно від амплуа статистично значуще відрізняються за масою тіла ($F = 64,304$; $p<0,01$). Баскетболісти позиції «Center» мають найбільшу, а «Point guard» – найменшу масу тіла. Встановлено динаміку показників довжини та ваги тіла баскетболістів з 16 до 20 років.

Баскетболісти «Point guard» та «Shooting guard», мають статистично значуще більший рівень VO_2max у порівняні із «Center» та «Power forward». Середній рівень VO_2max гравців, що виступають на позиції «Point guard» склав – 57,05 ± 3,78 мл·кг·$^{-1}$хв$^{-1}$. У гравців «Center» цей показник в середньому на рівні – 49,10 ± 4,63 мл·кг·$^{-1}$хв$^{-1}$. Гравці позиції «Center» мали значення ЖЄЛ на рівні 9,38 ± 0,76 л, «Power forward» – 8,72 ± 0,80 л, баскетболісти лінії захисту – у діапазоні 7,5-8 л. Статистично значущих відмінностей не виявлено у гравців різного амплуа за рівнем досягнення ПАНО у відсотках від VO_2max.

Висновки. Морфологічні та функціональні характеристики слугують інформативними критеріями моніторингу за індивідуальним станом гравців, є динамічними та можуть використовуватися в різній віковій групі з урахуванням специфіки підготовки в команді та індивідуальних даних.

Ключові слова: баскетбол, ігрова позиція (амплуа), підготовка, морфологічні та функціональні критерії, відбір.

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