Proceeding

Supplementary Issue: Spring Conferences of Sports Science. Costa Blanca Sports Science Week, 26-28 April 2018. Calpe. Alicante, Spain

Anthropometrics characteristics and jumping ability in basketball

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ABSTRACT

The basketball is a situational sport classified among activities laying on alternative aerobe and anaerobic processes, with an important participation of the muscular mass and an accentuated prevalence of the alactacid anaerobic process. The purpose of this work is to analyze and evaluate the correlations between the various variables of an anthropometric character and the differences in performance between the roles, testing a group of senior high-level basketball players, subdividing them according to their role within of the team. Data were collected by 40 basketball players (Senior elite), divided into four groups: Power Forward (n = 12; age = 24.5 + 1.4 y.), Pivot (n = 12; age 24.1 + 1.1 y.); Playmaker/Guard (n = 8; age = 24.4 + 1.3 y.), and Small Forward (n = 8; age = 23.5 + 1.2 y.). Morphological data were height, weight, body mass index (BMI), Abalakov test modified. The explosive strength was measured with the method of Bosco: squat jump (SJ), counter movement jump (CMJ) and CMJ with arms (CMJas). Jumping performance and of coordination was determined through the difference between the measurement on the technical action of the shot block with one hand (St) and the height with one stretched arm (AB1); then, the measurement of the technical action of the rebound at two hands (Rb) and the height with two stretched arms (AB2). The results of the anthropometric parameters showed significant differences in height ($F = 4.75$, $p < 0.006$), height with a stretched arm AB1 ($F = 3.60$; $p < 0.02$) and height with two stretched arms AB2 ($F = 3.66$; $p < 0.02$). In the comparison by role we did not obtain any statistical significance regarding the Bosco test. Results of Abalakov test modified showed significant differences in St ($F = 7.29$; $p < .001$) and in Rb ($F = 3,95$; $p < 0.01$). With the Bosco test the information obtained concerns the assessment of the athlete's jumping capacity not related to specific technical gestures; differently with the Abalakov Test, has provided precise indications on the elevation abilities connected to the technical gesture of the blocked shot and of the rebound. A high correlation was found between the results of the anthropometric parameters and those of the Abalakov test. In senior high-level basketball, the anthropometric profile of the players is directly related to specific variables

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Supplementary Issue: Spring Conferences of Sports Science. Costa Blanca Sports Science Week, 26-28 April 2018. Calpe. Alicante, Spain.
JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

doi: 10.14198/jhse.2018.13.Proc2.22

which must be used for training planning and for the choice of players in setting up a team. Modern basketball, due to the increasing intensity of the game rhythm, increasingly engages the anaerobic alactacid component; it is above all for this reason that we need more and more powerful athletes, who are both fast and capable of high performance in jumps. This is the reason why assessment, training and continuous monitoring of jumping skills are a decisive aspect of performance. **Key words**: BASKETBALL ELITE, JUMPING TEST, ABALAKOV TEST MODIFIED, MONITORING AND EVALUATION.

Cite this article as:
Altavilla, G., D'Isanto, T., & Di Tore, P. (2018). Anthropometrics characteristics and jumping ability in basketball. *Journal of Human Sport and Exercise, 13*(2proc), S385-S392. doi:https://doi.org/10.14198/jhse.2018.13.Proc2.22

INTRODUCTION

Basketball is a sport of the situation (Raiola, 2015), for sports situation means all those sports in which it is not possible to predetermine the actions that will occur in the development of the game (Altavilla & Raiola, 2014). Sports activities such as basketball include all the educational and training features required for the development of athletes (Altavilla et al, 2018, Raiola D'Isanto, 2016b). Competitive basketball is an intermittent high-intensity physical activity that requires a well developed aerobic and anaerobic fitness and it is featured from activity of short time at high intensity (Castagna et al, 2008). This type of commitment in basketball increases the anaerobic alactacid commitment (Gaetano & Rago, 2014), so the training of aerobic capacity is not specific and contraindicated (Katch & Weltman, 1979). In modern basketball the speed of play is a clear sign of a greater demand for physical strength and the speed of the technical gesture; in fact, in the activity of training and selection of the players to set up a winning team the explosive dynamic strength, the elevation and the speed of displacement are selective and determining (Ashley & Weiss, 1994). Physical demands during the match differ from each playing position (Altavilla et al, 2017). Coaches involved in training of the players should take in account for these positional variations in distance covered in order to design position-specific physical drills (Rago et al, 2017). For basketball, in accord to the analysis given by Professor Dal Monte (1969), is classified as a sport in which they are considered, in addition to matters bioenergy (commitment cardiovascular and type of mainly energy system), also aspects of the biomechanics of muscle under both aerobic and anaerobic energy (Altavilla & Raiola, 2015) and in different proportions depending on the intensity, of the density, of the volume of the charge, of the frequency (Bompa & Haff, 2009; Raiola & D'Isanto, 2016a). The analysis of the workload during the competition is today fundamental for the planning of training (Altavilla & Raiola, 2018; Carlomagno et al, 2010), since currently physical conditioning is increasingly characterized by the integration of exercises that reproduce specific technical-tactical gestures (Bosco et al, 1994). The performance is also linked to other qualities such as neuro-muscular coordination, motor control (Raiola, 2017; Raiola & Di Tore, 2017), tactical attitudes and motivational characteristics (Raiola, 2014). The purpose of this work is to analyze and evaluate the correlations between the various variables of an anthropometric features and the differences in performance between the roles, testing a group of senior high-level basketball players, subdividing them according to their role within of the team.

MATERIALS AND METHODS

Subjects

40 male basketball players took part in this study with experience of at least 8 years of competitive activity and perform on average 5 training sessions per week. The tests were carried out on a group of athletes participating in the second division Italian league. The basketball players were divided into four groups according to their role: Power Forward, n.12; age: 24.5 ± 1.4 years, Pivot, n.12; age: 24.1 ± 1.1 years, Playmaker/Guard, n.8; age: 24.4 ± 1.3 years and Small Forward, n.8; age: 23.5 ± 1.2 years.

Details on experimental procedure

An evaluation of the anthropometric parameters was carried out considering the following variables: height (cm), weight (kg), body mass index (BMI): kg/m² and measurements of the height reached at the maximum extension of one arm (AB1 in cm) and two arms (AB2 in cm). The second type of data concerns the analysis of jump capacities. To obtain this information we used two detection systems that evaluate the general jump capacity thanks to the indirect measurement of the explosive strength obtained with the Bosco Test and the elevation capabilities using the Abalakov test modified. With the Abalakov test the measurement of the height reached with a stretched arm (AB1) and after a jump with a run-up step (St) was detected; also the height

reached by stretching both arms (AB2), and after a from standstill jump (Rb). Each player simulates the technical action of the rebound from standstill (Rb) and the technical action of the shot block (St). For each test three tests are carried out: of the jumps performed only the best result will be considered for the statistical analysis. Evaluating the results obtained by the difference between the measure of the attack action of the blocked shot (St) and the measure reached by extending an arm (AB1), between the technical action of the rebound from standstill (Rb) and the measure reached by extending both upper limbs (AB2). In this way it was possible to calculate the elevations obtained by the various players jumping from standstill and moving. The result in cm of elevation with use of the movement, (difference in movement, DM), is obtained from the difference between St and AB1 while that from standstill (difference without movement, DWM) corresponds to the difference between Rb and AB2. Other data that we have obtained concern the difference between the two evaluated elevation forms (DM-DWM = Diff in cm). With the Bosco method the height reached is measured by performing jumps with different techniques. Each test is characterized by the execution of three jumps: for the statistical survey the best result is considered. It consists in the indirect evaluation of the dynamic-explosive strength and of the explosive strength through calculation of the vertical displacement of the center of gravity with the Bosco method (Bosco et al, 1983). The players perform a series of jumps that provide data subsequently processed by a software program that calculates the contact and flight times in milliseconds, the heights in centimeters and the powers in Watts. In this study, only three tests of the test battery developed by Bosco were used: the Squat Jump (SJ), the Counter Movement Jump (CMJ), the Counter Movement Jump with the use of the arms (arms) and CMJ as. The difference in cm obtained from the results of the CMJ and the SJ (CMJ-SJ). This value gives indications on the ability of the subject to use elastic energy (Bobbert et al, 1996; Komi & Bosco, 1978). In the first test, Squat Jump (SJ), each player performs a vertical jump starting from a position with lower limbs bent at 90° with his hands on his hips, without making any counter-movement downwards. The Squat-Jump allows to evaluate the explosive strength of the lower limbs. In the second test that of the Counter Movement Jump (CMJ), a vertical jump is performed, starting from an upright position, with the hands on the hips, performing a counter-movement of the lower limbs downward, until reaching a bending of about 90° with explosive muscle activation. From the difference of the results of the first two tests (CMJ-SJ) a value is obtained that represents an index to evaluate the elasticity of the extensor muscles of the lower limbs. The third test is represented by the CMJ as, characterized by a jump with counter-movement, with the use of the upper limbs.

Statistics analysis

Data on the anthropometric characteristics and results of the Bosco test and the modified Abalakov test are presented as mean and standard deviation (SD). For the comparison of the anthropometric data and jumping ability according to the role is the analysis of variance was performed. The correlations between all the variables considered were calculated using the Pearson correlation coefficient. Prior to each statistical analysis the homogeneity of variance was verified with Bartlett's test, and the normality of distribution of each variable was tested with the Shapiro-Wilk test. Statistical analysis was performed using SPSS 22.0 (SPSS Inc., Chicago, IL, USA). For all the performed analyses, a P-value <0.05 was considered significant.

RESULTS

The tables 1 and 2 present the mean and standard deviation of anthropometric values and jumping ability of all basketball players considered. The results of the comparison of the anthropometric parameters and jumping ability according to the role, are indicated in table 3. With regard to the anthropometric data, we obtained significant results for the height ($F = 4.75$; $p < 0.006$), AB1 measures with a stretched arm ($F = 3.60$; $p < 0.02$) and AB2 measures with two outstretched arms ($F = 3.66$; $p < 0.02$). The Pivot group (P) achieved higher values of the playmakers / guards (P / G): height (P: 200.2 ± 5.1 cm vs P / G: 190.1 ± 3.8 cm; p <

0.01), AB1 (P: 263.5 ± 6.8 cm vs P / G: 253.2 ± 5.2 cm; p <0.01 and AB2 (P: 258.5 ± 6.3 cm vs P / G: 249.5± 4.5 cm, p <0.05) In the comparison by role we did not obtain any statistical difference regarding the Bosco test. The results of the modified Abalakov test instead show significant variations for as regards the St (F = 7.29; p <0.001) and the Rb (F = 3.95; p <0.01). The analysis of the correlation matrix shows that the height and weight are correlated with each other and also with AB1 and AB2 (table 4). As for the tests of the Bosco Test and the modified Abalakov Test, the different variables of each test are correlated with each other. With the Bosco test, the information obtained concerns the ability to jump not connected to technical gestures; differently with Abalakov Test more specific indications were found on the coordination skills linked to a technical gesture.

Table 1. Anthropometric values of all basketball players

Variables	***Average ± SD (n=40)***
Height (cm)	*195,4 ± 4,3*
Weight (kg)	*84,5 ± 3,15*
BMI (kg/cm^2)	*22,1 ± 1,1*
AB1 (cm)	*257,5 ± 7,3*
AB2 (cm)	*254,2 ± 7,1*

Table 2. Test results of the jumping ability

Variables	*Average ± SD (n=40)*
Bosco test	
SJ (cm)	*38,1 ± 3,8*
CMJ (cm)	*43,2 ± 3,9*
CMJ-SJ (cm)	*5,1 ±1,4*
CMJas (cm)	*50,1 ± 4,6*
Abalakov test modified	
St (cm)	*332,1 ± 8,1*
Rb (cm)	*309,1 ± 8,2*
DM (cm)	*74,1 ± 5,8*
DWM (cm)	*54,2 ± 5,9*
Diff (cm)	*19,9 ± 5,1*

Table 3. Comparison of the anthropometric and jump abilities variables according to the role

Variables	Power Forward (n=12)	Pivot (n=12)	Playmaker/ Guard (n=8)	Small Forward (n=8)	F	*p*
Height (cm)	198,4±4,1	200,2±5,1	190,1±3,8	194,8±5,4	4,75	*0,006*
Weight (kg)	88,9±6,3	86,3±4,9	80,7±5,5	84,5±8,3	1,64	*0,221*
BMI (kg/cm2)	22,5±1,4	21,5±1,3	22,3±1,3	22,2±1,2	0,25	*0,704*
AB1 (cm)	258,1±6,1	263,5±6,8	253,2±5,2	257,7±6,1	3,60	*0,022*
AB2 (cm)	255,1±6,1	258,5±6,3	249,5±4,6	254,2±6,2	3,66	*0,020*
SJ (cm)	38,7±3,8	39,6±2,8	37,5±5,3	36,8±4,8	1,03	*0,388*
CMJ (cm)	43,8±3,9	44,6±2,1	41,8±5,9	42,7±4,7	0,72	*0,546*
CMJ-SJ (cm)	5,1±1,6	5,0±1,4	4,3±1,5	5,9±1,4	0,24	*2,199*
CMJas (cm)	50,6±4,5	51,5±2,8	49,5±6,5	49,1±7,2	0,70	*0,555*
St (cm)	332,9±6,6	336,7±6,4	327,8±8,7	328,9±2,1	7,29	*0,001*
Rb (cm)	309,8±8,7	313,7±7,3	305,6±8,3	306,7±5,1	3,95	*0,01*
DM (cm)	74,8±4,9	73,2±6,2	74,6±4,0	71,2±6,0	2,67	*0,061*
DWM (cm)	54,7±6,0	55,2±6,9	56,1±5,9	52,5±2,5	0,44	*0,728*
Diff (cm)	*20,1±4,6*	*18,0±5,4*	*18,5,0±3,7*	*18,7±6,5*	*1,41*	*0,253*

Table 4. Correlation matrix (anthropometric variables and jumping ability)

	Height	*Weight*	*AB1*	*AB2*	*SJ*	*CMJ*	*CMJ-SJ*	*CMJas*	*St*	*Rb*
Height	-									
Weight	*0,631*	-								
AB1	*0,860*	*0,690*	-							
AB2	*0,873*	*0,674*	*0,990*	-						
SJ	*-0,342*	*-0,356*	*-0,298*	*-0,328*	-					
CMJ	*-0,294*	*-0,282*	*-0,198*	*-0,234*	*0,933*	-				
CMJ-SJ	*0,114*	*0,186*	*0,259*	*0,242*	*-0,131*	*0,234*	-			
CMJas	*-0,274*	*-0,239*	*-0,250*	*-0,296*	*0,737*	*0,813*	*0,246*	-		
St	*0,596*	*0,392*	*0,705*	*0,680*	*0,198*	*0,264*	*0,190*	*0,215*	-	
Rb	*0,640*	*0,442*	*0,730*	*0,707*	*0,109*	*0,245*	*0,379*	*0,107*	*0,837*	-

DISCUSSION

These analyzes show that the action of the arms in the jumps for the rebounds and the blocked shot, the strength developed by the lower limbs, the use of a step in the jump phase and the coordination between the movements of the arms and legs, can be decisive for assessing the potential of an athlete (Feltner et al, 1999; Harman et al, 1990). The strong correlation between St and Rb could be an indicator of an athlete's ability to transform the accumulated kinetic energy during the run-up phase into potential energy. Some indicators, such as height, AB1 and AB2 for Pivot, Power Forward and Small Forward players, are related to the technical needs that depend on the evolution of the game. These players have to decrease the flight time to interfere in the increasingly fast opposing actions; a greater extension of the arms decreases the time of flight necessary to recover the ball to rebound, receive the ball from the companions or stop the opponent's ball. The correct identification of the morphological characteristics and the close connection of these with the technical role becomes fundamental to obtain significant results. The anthropometric height parameters of AB1 and AB2 are decisive and selective even for power forward, because they are closely related to the

performance of jumping skills in specific gestures such as the blocked shot and the rebound, (St and Rb). The results of the battery Bosco test showed no difference between the different roles in terms of jumping ability among basketball players. These results confirm the link between the morphological characteristics, the orientation towards technical specialization in relation to the role and the training of individualized muscular qualities. The analysis of the correlation matrix (Table 5) shows that most of the anthropometric variables are correlated with each other: in particular height with weight and AB1 and AB2. In relation to the different parameters of the jumping ability we have verified that all anthropometric variables are positively correlated to St and Rb, and negatively to SJ.

CONCLUSIONS

In basketball senior high level, the profile anthropometric of the players is directly linked to several variables to be used for training planning and in setting the choice of players of a team. Modern basketball, due to the increasing intensity of the game rhythm, increasingly commits the alactacid anaerobic component; it is above all for this reason that we need more and more powerful athletes, who are both fast and capable of high performance in jumps. For these reasons the evaluation, training and continuous monitoring of jumping ability are a vital aspect for the operation.

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