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DIFFERENCES BETWEEN VARIABLES FOR ASSESSMENT OF THE EXPLOSIVE POWER, THE AGILITY AND THE BIOMECHANICAL INDICATORS IN THE PERFORMANCE OF JUMP-SHOOT

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(Original scientific paper)

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Abstract
Basketball is one of the most dynamic sports games. It requires from the players the ability to overplay the opponent, possession of: speed, spin, versatility, explosive force, flawless movement with, successful realization of technical and tactical tasks and above all possession of good perception and intelligence. Has been conducted a survey with a sample of 54 young basketball players aged 14 to 16, of which 18 at 14 years of age, 18 at 15 years of age and 18 at 16 years of age in order to determine whether there are differences in structural basketball elements with a ball (ball-leading and jump-shot), the explosive force, the running speed and agility in young basketball players representing Macedonia. A total of 10 variables were applied to accomplish the research goals, 4 for estimating the explosive force, 1 variable speed rate estimation and 1 variable for agility assessment and 3 biomechanical variables . It can be concluded that in the variables for evaluating the explosive force, the basketball players at the age of 14 show weaker results in the variation of the double-edged jump in height with hands on hips compared to basketball players 15 and 16 years of age. Also, 14-year-old basketball players achieve weaker results in the variation of a double-edged jump in height from a high-pitch compared to basketball players aged 16 years. The arsenic jump in height did not determine statistically significant differences between players 14, 15 and 16 years of age. Basketball players at the age of 16 are showing better results in throwing the ball from the chest in a sitting position than the basketball players aged 14 and 15. It can be concluded that in the speed estimation variable (running at 20 m. high start), the basketball players at the age of 16 show better results than basketball players aged 14 and 15. Basketball players of 15 years of age show better results in the variable 20 m run from a high start aside from basketball players aged 14. There weren`t statistically significant differences in the variable agility (t-test) estimation between basketball players 14, 15 and 16 years of age.

Keywords*: basketball, motor skills, technique, variables, ability, age .*

Introduction

Motor skills are important factors that determine the success of basketball. Every situation during the game should be adequately accomplished with motor skills. It can be accomplished through the locomotor system which includes the strength, the accuracy, the speed, the coordination, the balance and the agility of the players. Basketball is characterized by a large number of jumps in defense and attack. Along with frequent fast movements, with change of direction with and without the ball, fast passes and short sprints, i.e structure of movements for which the explosive force is present. The high frequencies of these structures in the game indicate that the explosive force significantly contributes to the success of each individual player. Other forms, such as, repetitive and static force, contribute significantly less to success, because the structure of movements in which these two forms of force are present, static and repetitive, in basketball are very rare. Almost every action in the game ends with a shooting at the basket, which implies that in basketball it is most important to hit the basketball hoop of the opponents. The motoring capability that is responsible for achieving a point is the precision. Precision must be present in the passing and the leading of the ball, if these elements of the technique are desired to be successfully performed. The speed in the basketball game structure is most often present as the speed of a motor reaction, which is the capability of the player to react quickly to important information from the environment during the match and on the basis of the received information to create a response in the form of an adequate motor reaction by assessing the situation on the court. The position of the ball and the opponent and anticipating the possibility of the continuation of the action, all this requires a high level of this ability. The speed of movement during the action in the match - counterattack, return to defense - is significantly affected by the explosive strength, because the structure of the game is such that the distance that needs to be overcome is short, and the speed of overcoming them depends to a large extent on the fast explosive start.

The frequency of the movement as a form of speed is the ability of the players which is present during the entire game. This motor skill will help the defensive players in a position of defensive basketball attitude to disable the player who is attacking. Coordination is the ability to effectively solve complex motor tasks. Keeping in mind that basketball is a complex game, whose complexity is conditioned by the small court and the specifics of the morphological construction of the basketball players and the presence of the ball, one should not specifically point out the influence of the coordination capacity of the final success in the game.

Agility is responsible for the rapid change in the direction of movement, at different angles, in the structure of the movement without and with a ball. In the basketball game, it is especially emphasized because of the narrow space where the activity is performed, and because of that, the player with better agility will more often find himself in a more favorable position for realization, that is because this ability will enable efficient movement and closing of his own basket.

The main aim of the research is to determine and compare the differences in structural skill jump shot in basketball, explosive strength, running speed, agility and some biomechanical parameters, among young basketball players representing Macedonia at the age of 14, 15 and 16 years.

Method of Work

Sample of respondents

The sample of respondents is drawn from the male youth basketball representations of Macedonia U14, U15 and U16.

A sample of variables

The sample of variables consists of tests for the estimation of explosive strength (countermovement jump with arm swing, countermovement with the hands of the hips, countermovement jump with arm swing after landing, basketball throw from the chest while sitting on the floor), speed (20m run), agility (t-test) and biomechanical indicators for assessing the technique of performance of the jump shot element (jump shot ball release angle, jump shot duration, relative elbow angle before extension).

Testing Protocol

To register part of the test results was used the Physical Ability Test 02 system, which is composed of a photocell module and an optojump module.

The tests were conducted in a registered hall according to FIBA standards and propositions, before the start of the preparations of the selected representatives.

The measurement was carried out by experts in the field of kinesiology, with many years of experience in the field of kinesiology and practical knowledge of the use of systems for testing of sports performances.

Before the test, the examinees had several minutes of warming up and then were introduced with the tests. The best result of the three test attempts was followed for analysis. The temperature in the hall was from 17 to 22 ºC. All respondents were in sports equipment and divided into groups.

To record the movements, was used a high-speed camcorder Casio Exilim FH 100 with a recording speed of 120 frames per second and a spatial resolution of 640x480 pixels were used. The camera was positioned perpendicularly at a distance of 12 m from the plane of movement in order to avoid the errors in the perspective (Payton, C.J. and Bartlett, R, 2008).

Three superficial contrast markers were placed at appropriate anatomical points according to the Dempster's model (Robertson, E.G.D. et al. 2014) (glenohumeral joint, elbow axis, wrist axis) for defining two body segments (forearm, forearm).

Then using the software KINOVEA 0.8.25, the biomechanical indicators of the performance technique of the element were determined. To determine the relative elbow angle, the moment was not taken before the subject began to extend elbow.

The release angle was determined 10 frames after throwing the ball, ie from the moment of finishing the fingertip contact with the ball to the tenth frame.

To determine the duration of the jump shot, the time interval from the moment of contact with the two feet of the ground was taken until the point of release of the basket.

Statistical analysis

For all applied general and specific motor tests and biomechanical variables, the basic descriptive statistical parameters are calculated: arithmetic mean (X), standard deviation (SD), lower and upper limit of the range in which the results are moving (Min-Max), coefficient of variation (CV), standard arithmetic mean error (SE), skewness symmetry (Skew), Kurt's Kurtosis, and Kolmogorov-Smirnov test (KS), which tests the distribution's normality.

The univariate and multivariate analysis of variance (ANOVA, MANOVA) was used to determine the quantitative and qualitative intergroup differences, and the univariate differences in the analyzed variables were determined by applying the LSD - post-hoc test.

The statistical program package Statistica 5 was used to process the obtained data.

Results

Table 1. Descriptive statistics and the normal distribution of basic and specific motor tests and biomechanical variables in basketball at the age of 16 years

	Mean	Minimum	Maximum	SD	CV.	S.E.	Skewness	Kurtosis
OSVISM	43,66	37,20	58,20	5,15	11,79	1,21	1,30	2,62
OSVISRK	32,63	25,20	41,70	3,56	10,92	0,84	0,47	2,05
OSDVIS	39,19	28,70	52,30	5,51	14,05	1,30	0,48	0,94
TRC20MVS	3,09	2,84	3,29	0,12	3,81	0,03	-0,40	-0,38
FRLBGRS	12,33	11,00	14,33	0,93	7,51	0,22	0,41	-0,32
TTEST	10,83	10,06	11,82	0,43	4,00	0,10	0,22	0,42
RALPESS	64,39	38,00	83,00	10,50	16,31	2,47	-0,74	1,13
AIBSS	43,53	37,00	48,30	3,01	6,91	0,71	-0,50	0,10
VREMSS	0,52	0,38	0,68	0,08	14,85	0,02	0,31	-0,16

Table 2. Kolmogorov-Smirnov test for basketball players at the age of 16 years

	N	max D	K-S
OSVISM	18	0,19	p > .20
OSVISRK	18	0,15	p > .20
OSDVIS	18	0,16	p > .20
TRC20MVS	18	0,13	p > .20
FRLBGRS	18	0,11	p > .20
TTEST	18	0,11	p > .20
RALPESS	18	0,10	p > .20
AIBSS	18	0,10	p > .20
VREMSS	18	0,14	p > .20

From the overview of Table 1, it can be seen that scoring values in most variables in basketball players aged 16 are in the range of the recommended values from -1 to +1, indicating that the distribution of the results is approximately symmetrical. Positive asymmetry - epicurtic it is noted only in the OSVISM variable (Sk = 1.30). From the values of the kurtosis, it can be seen that all general and specific motor tests and biomechanical variables show platykurtic distribution.

The homogeneity of the sub-example of basketball players at the age of 16, based on the calculated coefficients of variability, is at a satisfactory level. The highest level of scattering of the results is observed in the variable RALPESS (CV = 16.31).

The value of the basic central and dispersive parameters of the applied variables, in the minimum and maximal result, contains about four or more standard deviations (SD), on the basis of which a satisfactory sensitivity of all variables can be established. Based on the values of the standard deviations (SD) and its ratio with the mean, we can conclude that in most variables there is no statistical significance of the results of the arithmetic mean.

The numerical values of the standard error show a minimum burst, because they are proportionately insignificant to the corresponding value of the standard deviation.

The results of Kolmogorov-Smirnov's test showed that all variables for basketball players at the age of 16 were normally distributed.

Table 3. Descriptive statistics and the normal distribution of basic and specific motor tests and biomechanical variables in basketball players at the age of 15 years

	Mean	Minimum	Maximum	SD	CV.	S.E.	Skewness	Kurtosis
OSVISM	41,72	33,90	55,20	5,54	13,27	1,31	0,74	0,57
OSVISRK	33,66	25,30	47,00	5,24	15,56	1,23	1,24	1,75
OSDVIS	37,14	31,10	45,50	4,63	12,47	1,09	0,53	-0,82
TRC20MVS	3,32	3,00	3,68	0,23	6,97	0,05	0,09	-1,50
FRLBGRS	10,88	8,60	13,70	1,58	14,48	0,37	0,31	-1,04
TTEST	11,13	9,88	12,15	0,81	7,33	0,19	-0,11	-1,54
RALPESS	64,17	38,00	73,00	9,39	14,63	2,21	-1,48	2,21
AIBSS	47,78	42,90	52,80	3,44	7,20	0,81	0,08	-1,39
VREMSS	0,47	0,24	0,60	0,09	19,09	0,02	-1,02	1,55

From the overview of Table 3, which presents the results of the central and dispersive parameters of general specific motor tests and biomechanical variables, in basketball players at the age of 15, it can be concluded that most results in the mean are valid because the standard error of the arithmetic mean (SE) in all variables is five times smaller than its mean value. The value of the basic central and dispersive parameters of the applied variables in the invariants minimum (Min) and Max (Max) result, contains about four or more standard deviations (SD), based on which a satisfactory susceptibility of all variables can be established.

The homogeneity of the sub-example basketball players at the age of 15, on the basis of the calculated coefficients of variability, is satisfactory. The highest level of scattering of the results is observed in the variable VREMSS (CV = 16.31).

Table 4. Kolmogorov Smirnov test in basketball players at the age of 15 years

	N	max D	K-S
OSVISM	18	0,14	p > .20
OSVISRK	18	0,26	p < ,15
OSDVIS	18	0,13	p > .20
TRC20MVS	18	0,14	p > .20
FRLBGRS	18	0,18	p > .20
TTEST	18	0,15	p > .20
RALPESS	18	0,21	p > .20
AIBSS	18	0,15	p > .20
VREMSS	18	0,15	p > .20

From the overview of Table 3, it can be seen that the values of the skweness in most variables are within the limits of the recommended values from -1 to +1, indicating that the distribution of the results is approximately symmetric. Negative asymmetry (hipokurtic) is observed only in the variable RALPESS (Sk

= -1,48), Positive asymmetry - epikurtic (the greater number of results are in the zone of the better ones), it is noted only in the OSVISRK variable (Sk = 1,24) .

From the values of the kurtosis (Table 3), it can be seen that all applied variables show a consistency (platykurtic distribution).

The results of Kolmogorov-Smirnov test showed that all variables for basketball players at the age of 15 are normally distributed.

Table 5. Descriptive statistics and the normal distribution of basic and specific motor tests and biomechanical variables in basketball at the age of 14 years

	Mean	Minimum	Maximum	SD	CV.	S.E.	Skewness	Kurtosis
OSVISM	41,61	30,30	49,30	5,24	12,59	1,35	-0,44	-0,06
OSVISRK	29,72	22,70	35,70	3,27	11,00	0,77	-0,44	-0,05
OSDVIS	34,23	20,40	44,00	6,19	18,10	1,46	-0,87	0,93
TRC20MVS	3,50	3,23	3,97	0,18	5,13	0,04	1,11	1,61
FRLBGRS	9,68	7,60	10,94	0,98	10,13	0,23	-0,59	-0,61
TTEST	11,08	10,19	11,45	0,30	2,74	0,07	-1,54	3,33
RALPESS	60,00	21,00	87,00	17,53	29,22	4,13	-0,43	-0,16
AIBSS	48,13	39,80	55,50	4,25	8,84	1,00	0,14	-0,27
VREMSS	0,46	0,33	0,84	0,12	26,67	0,03	1,89	5,17

From the overview of Table 5, it can be seen that scoring values in most variables for basketball players aged 14 are in the range of the recommended values from -1 to +1, indicating that the distribution of the results is approximately symmetrical. Positive asymmetry-epikurtic (most of the results are in the zone of the better ones), it is only noted in the variable TRC20MVS (Sk = 1.11). Negative asymmetry (hypokurtic) is observed in the T-TEST variable (Sk = -1.54).

From the values of the kurtosis in Table 5, it can be seen that most of the applied anthropometric measures, general and specific motor tests and biomechanical variants show solidity (platokurtic distribution). Mesokyrtic (normal distribution) shows only the T-TEST variable, while the leptokurtic distribution shows the variable VREMSS.

The homogeneity of a sub-example of basketball players at the age of 14, based on the calculated coefficients of variability, is at a satisfactory level. The highest level of scattering of results is observed in the variable RALPESS (CV = 29,22).

Table 6. Kolmogorov-Smirnov test for basketball players at the age of 14 years

	N	max D	K-S
OSVISM	15	0,09	p > .20
OSVISRK	18	0,13	p > .20
OSDVIS	18	0,21	p > .20
TRC20MVS	18	0,18	p > .20
FRLBGRS	18	0,15	p > .20
TTEST	18	0,19	p > .20
V20MDR	18	0,12	p > .20
V20MNDR	18	0,12	p > .20
VODTMS	18	0,15	p > .20
RALPESS	18	0,08	p > .20
AIBSS	18	0,09	p > .20
VREMSS	18	0,18	p > .20

The value of the basic central and dispersive parameters of the applied variables in the minimum and maximum results intervals contains about four or more standard deviations (SD), on the basis of which a satisfactory sensitivity of all variables can be established. Based on the values of the standard deviations (SD) and its ratio with the mean (Mean), it can be concluded that in most variables there is no statistically significant deviation of the results from the arithmetic mean.

The numerical values of the standard error show a minimum burst, because looking proportionally, they are insignificant in relation to the corresponding value of the standard deviation.

The results of Kolmogorov-Smirnov procedure showed that all variables for basketball players at 14 years of age are normally distributed.

Although this is a small selective sample of respondents (top young basketball players), the results of the analysis indicate that in all variables there is a normal distribution of their results, based on which it can be concluded that the degree of normality of distributions of applied manifest variables, meets the necessary methodological and statistical criteria for the application of correct and justified multivariate and univariate statistical procedures for further processing of the received data. Indeed, this created conditions for sufficient precise scientific determination, analysis and comparison of data.

Differences between groups in general and specific motor tests and biomechanical variables

The results of the research were analyzed in order to address the basic problem of the research, ie. what differences exist in basic and specific motor tests and biomechanical variables among basketball players 14, 15 and 16 years of age.

Table 7. Significance of differences between basketball sub-examples of 16, 15 and 14 years of age

	Value	F	Hypothesis df	df	Sig.	n^2
Pillai's trace	1,218	3,633	30	70	,000	,609
Wilks' lambda	,137	3,866	30	68	,000	,630
Hotelling's trace	3,726	4,098	30	66	,000	,651
Roy's largest root	2,799	6,530	15	35	,000	,737

Table 8. Significance of individual differences between basketball sub-examples of 16, 15 and 14 years of age

	16		15		14		F	Sig.	n^2
	Mean	SD	Mean	SD	Mean	SD			
OSVISM	43,66	5,15	41,71	5,54	41,61	5,24	0,82	0,446	0,11
OSVISRK	32,63	3,56	33,66	5,24	29,72	3,27	4,43	**0,017**	0,10
OSDVIS	39,19	5,51	37,14	4,63	34,23	6,20	3,73	**0,031**	0,45
TRC20MVS	3,09	0,12	3,32	0,23	3,50	0,18	22,01	**0,000**	0,44
FRLBGRS	12,33	0,93	10,88	1,58	9,68	0,98	22,21	**0,000**	0,05
TTEST	10,83	0,43	11,13	0,81	11,08	0,30	1,43	0,250	0,31
RALPESS	64,39	10,50	64,17	9,39	60,00	17,53	0,65	0,525	0,25
AIBSS	43,53	3,01	47,78	3,44	48,13	4,25	9,09	**0,000**	0,06
VREMSS	0,52	0,08	0,47	0,09	0,46	0,12	2,10	0,133	0,42

With the use of multivariate analysis of variance (MANOVA), ie by testing the significance of differences in arithmetic mean in all variables between sub-examples of young top basketball players (14, 15 and 16 years old), a statistically significant difference was found because Wilks' Lambda .131 and for degrees of freedom df = 68, gives a statistical significance at level Q = .000. The size of the partial effect of the determinants (partial n2) shows high values, 630.

In order to determine in which measures and tests there are statistically significant differences, univariate analysis of variance (ANOVA) for each variable has been calculated. From the overview of Table 8, it can be seen that there are statistically significant differences in all the variables studied: countermovement with the hands of the hips (F = 4.43; p = 0.017), a countermovement jump after landing (F = 22.01; p = 0.000), basketball throw from the chest while sitting on the floor (F = 22.21; p = 0.000), running 20m (F = 3.73; p = 0.031)), and jump shot ball release angle in the jump-shot (F = 9.09; p = 0.000). The partial effect of the partial-n2 determinants is ranked between .01 and .45 and shows little effect on impact. The greatest effect in determining the differences is shown by the variables: countermovement jump with arm swing after landing (partial-n2 = .45) and running 20 m (partial-n2 = .44)

To determine which suppressers there are statistically significant differences in each individual variable, LSD (least significant difference test) tests have also been applied.

Table 9. LSD post-hoc tests on the variable arrayed countermovement jump with arm swing

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
OSVISM	16	15	1,945	1,77	,278	-1,62	5,51
		14	2,053	1,86	,275	-1,68	5,79
	15	16	-1,945	1,77	,278	-5,51	1,62
		14	,108	1,86	,954	-3,63	3,84
	14	16	-2,053	1,86	,275	-5,79	1,68
		15.	-,108	1,86	,954	-3,84	3,63

From the overview of Table 9 , it can be seen that in the variable countermovement jump with arm swing, there are no intergroup statistically significant differences.

Table 10. LSD post-hoc tests on the variable countermovement jump with the hands of the hips

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
OSVISRK	16	15	-1,0333	1,37	,455	-3,787	1,721
		14	2,9056*	1,37	,039	,152	5,660
	15	16	1,0333	1,37	,455	-1,721	3,787
		14	3,9389*	1,37	,006	1,185	6,693
	14	16	-2,9056)*	1,37	,039	-5,660	-,152
		15.	-3,9389)*	1,37	,006	-6,693	-1,185

From the overview of Table 10, it can be seen that basketball players at the age of 15 and 16 show better results in the variable of the variable countermovement jump with the hands of the hips compared to basketball players aged 14 years. Among basketball players aged 15 and 16, no statistically significant differences were found in the variable countermovement jump with the hands of the hips.

Table 11. LSD post-hoc tests on the variable countermovement jump with arms after landing

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
OSDVIS	16	15	2,0539	1,83	,266	-1,615	5,722
		14	4,9656*	1,83	,009	1,297	8,634
	15	16	-2,0539	1,83	,266	-5,722	1,615
		14	2,9117	1,83	,117	-,757	6,580
	14	16	-4,9656)*	1,83	,009	-8,634	-1,297
		15	-2,9117	1,83	,117	-6,580	,757

From the overview of Table 11, it can be seen that basketball players at the age of 16 show better results in the variable countermovement jump with arms swing after landing compared to basketball players aged 14. Among basketball players aged 15 and 16 and 14 and 15, no statistically significant differences were found in the variable countermovement jump with arms swing after landing.

Table 12. LSD post-hoc tests on the variable running 20 m

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
TRC20MVS	16	15	-,22144)*	0,06	,001	-,3433	-,0996
		14	-,40194)*	0,06	,000	-,5238	-,2801
	15	16	,22144*	0,06	,001	,0996	,3433
		14	-,18050)*	0,06	,004	-,3023	-,0587
	14	16	,40194*	0,06	,000	,2801	,5238
		15	,18050*	0,06	,004	,0587	,3023

From the overview of table 12, we can see that basketball players at the age of 16 show better results (the variable is inverse-the lower value indicates a better result) in the variable running at 20m with basketball players from 14 and 15 years of age. Basketball players of 15 years of age show better results in the variable running 20m against basketball players aged 14.

Table 13. LSD post-hoc tests on the variable basketball throw from the chest while sitting on the floor

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
FRLBGRS	16	15	1,4506*	0,40	,001	,649	2,252
		14	2,6561*	0,40	,000	1,855	3,457
	15	16	-1,4506)*	0,40	,001	-2,252	-,649
		14	1,2056*	0,40	,004	,404	2,007
	14	16	-2,6561)*	0,40	,000	-3,457	-1,855
		15	-1,2056)*	0,40	,004	-2,007	-,404

From the overview of Table 13, it can be seen that basketball players at the age of 16 show better results in the variable basketball throw from the chest while sitting on the floor in relation to basketball players aged 14 and 15. Basketball players from 15 years of age show better results in the same variable compared to basketball players aged 14 years.

Table 14. LSD post-hoc tests on the agility T-test variable.

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
TTEST	16	15	-,294000	0,19	,122	-,66938	,08138
		14	-,246556	0,19	,193	-,62194	,12883
	15	16	,294000	0,19	,122	-,08138	,66938
		14	,047444	0,19	,801	-,32794	,42283
	14	16	,246556	0,19	,193	-,12883	,62194
		15	-,047444	0,19	,801	-,42283	,32794

From the overview of Table 14, it can be seen that the variable agility t-test did not determine intergroup statistically significant differences.

Table 15. LSD post-hoc tests on the variable relative elbow angle before extension In the jump-shot

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
RALPESS	16	15	,222	4,33	,959	-8,47	8,91
		14	4,389	4,33	,315	-4,30	13,08
	15	16	-,222	4,33	,959	-8,91	8,47
		14	4,167	4,33	,340	-4,52	12,86
	14	16	-4,389	4,33	,315	-13,08	4,30
		15	-4,167	4,33	,340	-12,86	4,52

From the overview of Table 16, it can be seen that basketball players at the age of 16 show a smaller angle of jump throwing the basketball in terms of basketball players aged 14 and 15. Among basketball players aged 14 and 15, no statistically significant differences were found in the variable jump shot ball release angle.

From the overview of Table 17, it can be seen that in the variable the duration of the jump-shot , no statistically significant difference was detected.

Table 16. LSD post-hoc tests on the variable jump shot ball release angle

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
AIBSS	16	15	-4,2500)*	1,20	,001	-6,662	-1,838
		14	-4,6000)*	1,20	,000	-7,012	-2,188
	15	16	4,2500*	1,20	,001	1,838	6,662
		14	-,3500	1,20	,772	-2,762	2,062
	14	16	4,6000*	1,20	,000	2,188	7,012
		15	,3500	1,20	,772	-2,062	2,762

Table 17. LSD post-hoc tests on the variable duration of the jump-shot.

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
VREMSS	16	15	,050667	0,03	,127	-,01498	,11631
		14	,063333	0,03	,058	-,00231	,12898
	15	16	-,050667	0,03	,127	-,11631	,01498
		14	,012667	0,03	,700	-,05298	,07831
	14	16	-,063333	0,03	,058	-,12898	,00231
		15	-,012667	0,03	,700	-,07831	,05298

Discussion

Analyzing the variables for assessing explosive strength, it can be concluded that basketball players at the age of 14 show weaker results in the variable countermovement with the hands of the hips in relation to basketball players 15 and 16 years of age. Also, 14-year-old basketball players achieve weaker results in the variable countermovement jump with arm swing after landing compared to basketball players aged 16 years. In the variable, the countermovement jump with arms swing did not determine statistically significant differences between players 14, 15 and 16 years of age.

If we compare the variables for assessing the explosive strength of this research with the results of young players from other countries, it can be concluded that the Portuguese young players at the age of 15 in the variable countermovement jump with their hands on the hips reach 32 cm (Silva et al. 2008), Turkish players 33.53 cm (Emre et al. 2014), Lithuanian at 14 years 45.1 cm, 15 years old 46.6 cm and at 16 years 50.1 cm and Australian players at the age of 14 up to 17 years of age, achieved a score in the 65.5 cm test (Drinkwater et al., 2008). On the other hand, the Macedonian players achieve poorer results in the same variable versus their colleagues from abroad (the Macedonian players at the age of 14 are 19.27 cm, at 15 years 33.66 cm and at 16 years 32.63 cm).

Analyzing the speed estimation variable (running at 20 meter), it can be concluded that basketball players at the age of 16 show better results than basketball players aged 14 and 15. Basketball players at the age of 15 show better results in the 20 meter running against basketball players aged 14 years.

If we compare the variables for estimating the speed of this research with the results of the young players from other countries, it can be concluded that the Turkish young players at the age of 15 achieve weaker results in the variable run of 20 m (Macedonian 3.32 s, Turkish 3 , 75 sec.). Lithuanian players in the same 14-year age variable score 3.27 sec at 15 years of age 3.21 sec and 16 at age 3.07 sec. Austrian players in the variable running 20 m at the age of 14 to 17 achieve an average score of 3.04 sec.

Concerning basketball players from this research with their peers from the sports academy (Daskalovski et al., 2017), it can be concluded that at the age of 15 young athletes from the sports academy in the 20 meter test score an average score of 3.27 seconds, is a better result than the respondents of the same age in this research (3.32 sec), while at the age of 16 they achieve an average score of 3.20 sec, a weaker score than the respondents of the same age in this research (3.09 sec) .

Basketball players at the age of 16 show better results in the variable basketball throw from the chest while sitting on the floor than basketball players aged 14 and 15. In the variable relative elbow angle before extension in the jump-shot, no statistically significant difference was found. Basketball players at the age of 16 show a smaller elbow angle than at age 14 and 15.

In agility (t-test), no statistically statistically significant difference was found between basketball players 14, 15 and 16 years of age.

Differences in basic and specific motor skills and biomechanical variables among basketball players 14, 15 and 16 are probably conditioned both by external (exogenous) and by internal (endogenous) factors. In addition to the quality of the training process, the selection as well as the processes of growth and development was of course influenced. To determine the quality of the training in the difference between the different age groups in future studies, it is necessary to include a normal population of the same age, on which the same measures and tests will be applied, and the results obtained will be compared with the elite youth basketball players. In this way, it will be determined how much a measure is influenced by growth and development, and how much is affected by the training process.

Every motor skill has its own developmental path, which coaches need to know to plan and program the training properly. The maximal speed develops from 16 to 18-19 years. A critical period is between 11 and 15 years. By the age of 12, the exponent increases at the expense of the speed of movement, from 12 to 14 as a result of body growth, the explosive strength and increase in muscle mass, and from 16 to 18 increases mainly as a result of the improvement of the explosive strength (Trunic, 2007).

Sensitive periods in the development of the explosive strength and the endurance of the force begin sometime about 8 years of life. Critical phases in the age range from 7 to 17 years, which should be divided into periods from 8-9, 10-11, 13-14, and especially from 14-15 years. The sensitive period in the development of the maximal force is in the period of 12-13 to 18 years. Critical phases are ages 10-11, 13-16 and especially 16-17 years of age (Trunic, 2007).

Conclusions

On a sample of 54 young basketball players aged 14 to 16, of which 18 at 14 years of age 18 at age 15 and 18 at 16 years of age.

Based on the results obtained, following the application of the appropriate statistical methods, the following conclusions have been drawn:

- In the variable for estimating the level of the structural basketball element jump-shot, it can be concluded that in the variable relative elbow angle before extension in the jump-shot no intergroup statistically significant differences were determined. Basketball players at the age of 16 show a smaller elbow angle players at age 14 and 15.
- In the explosive strength variables, it can be concluded that basketball players at 14 years of age show weaker results in the variable countermovement with the hands of the hips compared to basketball players 15 and 16 years of age. Also, 14-year-old basketball players achieve weaker results in the variable countermovement jump with arms swing after landing compared to basketball players aged 16 years. In the variable, countermovement jump with arm swing did not determine statistically significant differences between players 14, 15 and 16 years of age. Basketball players at the age of 16 show better results in the variable basketball throw from the chest while sitting on the floor than basketball players aged 14 and 15.
- In the speed estimation variable (running 20 m), it can be concluded that basketball players at the age of 16 show better results than basketball players aged 14 and 15. Basketball players at the age of 15 show better results in the 20 meter run running from a high start against basketball players aged 14 years.
- In agility variable (t-test), no statistically significant difference was found among basketball players of 14, 15 and 16 years of age.

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