Morphological Characteristics According to Basketball Playing Positions

Características Morfológicas Según las Posiciones de Juego del Baloncesto

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SUMMARY: This paper aimed to investigate the morphological characteristics according to the positions of basketball players. In this work, a sample of 62 basketball players aged 16-17 years, whose body height was 177.31 ± 8.112 cm, while body mass of 72.44 ± 13.27 kg, were divided into five main positions of the basketball game: Organizer of the game (n=13), shooting guard (n=14), small forward (n=14), power forward(n=11) and center (n=10). Tested are from the clubs RTV-21, ProBasket-Pristina, M - Junior from Pristina of the male gender who are following the training program from Basketball. In this research, morphological space variables were applied (n=10). Based on the obtained results, very few significant values were presented in the morphological characteristics between the group of outside players (organizer of the game, small forward and power forward) who covered the 6.75-meter line. However, the group of interior players (power forward and centers) under the basket showed significant values in all morphological variables. In the end, it can be concluded that the results of this research will be able to contribute to a better definition of the morphological characteristics between the groups defined according to the players' positions.

KEY WORDS: Analysis; Morphology; Positions; Basketball players.

INTRODUCTION

Basketball is a collective game that is played by two teams consisting of 5 players, from the point of view of the positions in the game, the basketball players are divided into five positions: 1. Organizer of the game -PG, 2. Shooting guard -SG, 3. Small forward -SF, 4. Power forward-PF and 5. Center-C (Ivanovic, 2009; Kryeziu, 2013, 2015). In addition, morphological characteristics influence overall motor performance and situational efficiency in the basketball game (Trninic & Dizdar, 2000; Jelicic *et al.*, 2002; Kryeziu, 2013, 2015). Morphological characteristics are the main determinants for the orientation and direction of young players in game positions, morphological characteristics are an important factor in the effectiveness of basketball training. Basketball requires an extremely tall body and some other measures of height mainly affect the performance of certain specific movements of future players (Dezman, 1988; Erculj, 1996; Kryeziu, 2013). Previous studies have confirmed that players in different positions in basketball are as follows:

players in the center position are characterized by longitudinal and transversal dimensions of the skeleton compared to players who play in the position of the forward, while guard have shown higher values of lower than other positions in the morphological space (Trninic, 2006; Abdelkrim *et al.*, 2010; Kryeziu, 2013). The purpose of this study is to investigate and analyze some morphological characteristics of the five positions of basketball players in the junior category.

MATERIAL AND METHOD

Sample of participants: In this research, players of the junior category were included, who were evaluated according to the positions of basketball players in some morphological characteristics. The tests are included in the sample of 62

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young players, aged 16-17 years, who belong to the male gender. The sample of participants are young players from the clubs of the Republic of Kosovo, including KB RTV-21 - Pristina, KB ProBasket - Pristina, and KB M - Junior - Pristina. 5 (five) main basketball positions were researched where the entities are included as follows: Organizer of the game (n=13), shooting guard (n=14), small forward (n=14), power forward(n=11) and center (n=10). The criterion for choosing these young people has been that these young people are regular followers of the training program and active participants in the basketball competitions which are developed and organized by the Kosovo Basketball Federation (FBK). Young basketball players of this age group and the positions that the players have, follow 3 (three) year basketball training programs and actively participate in regular championship competitions that are ranked quite high in the classification table. The entities tested during the measurements were prepared with adequate equipment for testing and were carried out in the same period.

Conditions for measuring morphological characteristics: To minimize the omissions as much as possible as well as to ensure optimal conditions for the measurement of morphological characteristics, it is carried out to obtain the most accurate measurements. The measurements are described following the method recommended by the International Biological Program (IBP). The measurements of the morphological characteristics were made in daily time on the same day, in the morning, from 8:00 to 10:00. All measurements were made in good infrastructural, hygienic conditions, and suitable temperatures for the actors. Tests were repeated up to 3 times for some variables. This is to score the best or most accurate score. The measurements were made on the left side of the candidate's body by the same team, with the same anthropometric instrument to avoid possible errors during the morphological measurements. The measurements were carried out by the specialists of the Center for Research, Studies in Physical Education, Sport and Health - CRSPES who have experience in research projects. During the measurements, the players were dressed in sports clothes. The measurements of the morphological measures were made on the premises of the clubs, in the sports halls that we have selected to do the research. All players before the measurements were given a consent form to be signed by the parent to participate in the research, and all parents agreed that their children will participate in the research. All participants were treated and evaluated following the ethical norms of the Declaration of Helsinki, where the research was then approved by the Ethics Committee.

The error in the measurement of the morphological characteristics is reduced by the assignment of the reference measurement points on the body. In this way, the measurement of the same variables was done in approximately the same places. Measuring reference points can be: Fixed points - They are easy to find and are stable (eg celestial elevations); Virtual points - are non-stable points that can be lost by changing the position of the body. For this reason, these points should be marked on the skin with a demographic. The morphological characteristics that were used in this research will be selected following a model of morphological status (Jelicic *et al.*, 2002; Kryeziu, 2013).

Sample variables: The research aims to evaluate the characteristics according to the players' positions. So, for each space, the variables for the assessment of young basketball players have been applied. Ten (10) variables have been applied in the morphological space, which are the measuring instruments (Viswanathan & Chandrasekaran, 2011; Kryeziu, 2013, 2015; Kryeziu & Asllani, 2016).

Body mass is estimated in light clothing and without sneakers with an accuracy of up to 0.1 kg (Tanita BC530), while body height is estimated with a stadiometer with an accuracy of up to 1 cm (SECA, Germany).

While the length of the hand and the length of the sole are measured with the short anthropometer (Viswanathan & Chandrasekaran, 2011), while the length of the open arms is measured with an improvised anthropometer (Viswanathan & Chandrasekaran, 2011).

The length of the palm and the width of the palm are measured with a sliding compass (Viswanathan & Chandrasekaran, 2011).

However, arm circumference, thigh circumference, and hip circumference are measured with the metric shirt at the designated points before the start of the measurement (Viswanathan & Chandrasekaran, 2011).

Statistical Analysis: The collected data will be processed in the manifest space for morphological characteristics. The basic statistical methods for determining the basic statistical indicators of the descriptive variables are Minimum score (Min.); Maximum result (Max.); Arithmetic average (Mean); Standard Deviation (SD); Asymmetry of the distribution curve (Skewess); Sharpness of the distribution curve (Kurtosis). The basic statistical indicators of morphological characteristics according to positions we have: Arithmetic mean (Mean) and Standard Deviation (SD). In this case, we applied canonical discriminant analysis to see and prove discriminations between groups according to game positions. The results were processed with the SPSS program, version 22.0 for WINDOWS.

RESULTS

According to the above table, this research has confirmed the finding that the manifest morphological variables are homogeneously distributed, except for one variable which tends to abnormal tilt according to asymmetry with a value of 1.184. In the variable, the circumference of the arm, the minimum score, and the maximum score move in the space of 20.90 to 38.11 cm, while the sharpness of the distribution curve has a positive value and reaches the value of 1.410. From the observation, variable body height has asymmetry with a negative value of -.586, the minimum score and the maximum score move in the space of 154.30 to 195.00 cm, while the sharpness of the distribution curve has a positive value of 1.159. The hand length variable has shown asymmetry with a negative value of -.085, the minimum and maximum results range from 65.00 to 83.50 cm. The variable, the length of the open arms, has realized asymmetry with a negative value of -.625, while the minimum and maximum results move in the space of 150.20 to 203.00 cm, with which significant values are observed in the standard deviation of 10.40327. The palm width variable presented an asymmetry with a negative value of -.070, the minimum score and the maximum score range from 17.00 to 26.50 cm, while the sharpness of the distribution curve has a negative value and reaches a value of -1.389. The leg length variable has shown asymmetry with a negative value of -.272, the minimum and maximum results range from 90.20 to 115.00 cm. Cartilage circumference variables have shown asymmetry with a negative value of -.072, the minimum score and the maximum score move in the space of 27.00 to 44.50 cm, while the sharpness of the distribution curve has a negative value and reaches the value of -.134. The variables body weight, palm length, and thigh circumference have shown positive asymmetry (Table I).

As we have the results in Table II, we see that center players dominate in all morphological variables, except for small forward which is one variable. The small forward has the dominant value in the palm width variable (ALL 20.8500

Table I. Basic statistical data in manifest morphological space.

	N	Min.	Max.	Mean	SD	Skewness	Kurtosis
BW(kg)	62	50.00	110.00	72.4419	13.27967	.824	.400
HB(cm)	62	154.30	195.00	177.3129	8.11187	-.586	1.159
LH(cm)	62	65.00	83.50	74.1915	3.89803	-.085	-.020
AL(cm)	62	150.20	203.00	180.3677	10.40327	-.625	.858
LP(cm)	62	17.00	26.50	21.0776	2.68525	-.070	-1.389
WP(cm)	62	17.30	23.00	20.3695	1.56742	.006	-1.034
THL(cm)	62	90.20	115.00	102.7806	4.91784	-.272	.518
AC(cm)	62	20.90	38.11	26.1373	3.89813	1.184	1.410
THC(cm)	62	41.00	72.00	53.5166	5.97041	.864	1.480
CC(cm)	62	27.00	44.50	37.2929	3.70196	-.072	-.134

Minimum score (Min.); Maximum result (Max.); Arithmetic average (Mean); Standard Deviation (SD); Asymmetry of the distribution curve (Skewess); Sharpness of the distribution curve (Kurtosis). Body weight-BW; Height body-HB; The length of the hand-LH; Open arms length-AL; The length of the palm-LP; Width of palm-WP; The length of the leg -THL; Arm circumference-AC; Thigh circumference-THC; Calf circumference-CC.

Table II. Basic statistical data on morphological characteristics according to players' positions.

	Organizer of the (n=13)		Shooting guard (n=14)		Small forward (n=14)		Power forward (n=11)		Center (n=10)	
	Mean	SD.	Mean	SD.	Mean	SD.	Mean	SD.	Mean	SD.
BW(kg)	72.38	14.46	69.50	10.38	68.65	10.77	71.10	12.14	83.42	16.03
HB(cm)	170.13	9.64	173.69	5.56	178.77	4.12	179.44	3.26	187.31	5.12
LH(cm)	70.56	3.81	73.58	3.42	74.92	2.91	76.04	3.13	76.69	3.44
AL(cm)	172.86	12.70	177.76	8.34	179.72	8.74	184.39	3.81	190.25	8.37
LP(cm)	20.84	3.10	21.02	2.43	20.85	2.59	20.44	2.33	22.47	2.98
WP(cm)	19.95	1.31	20.00	1.95	20.85	1.39	20.29	1.78	20.83	1.17
THL(cm)	99.20	5.64	101.19	4.15	102.95	3.33	103.36	2.34	108.77	3.40
AC(cm)	25.25	3.12	25.55	2.56	24.32	3.14	26.54	3.63	30.18	5.12
THC(cm)	51.63	4.80	54.14	4.85	51.73	5.55	53.85	5.40	57.21	8.58
CC(cm)	35.61	3.35	37.06	3.51	38.74	3.18	38.19	4.38	37.10	3.71

Arithmetic Mean (Mean) and Standard Deviation (Std. Dev.). Body weight-BW; The height of the body-HB; The length of the hand-LH; Open arm's length-AL; The length of the palm-LP; Width of palm-WP; The length of the leg -THL; Arm circumference-AC; Thigh circumference-THC; Calf circumference-CC.

cm ± 1.39160). The player of the center managed to achieve maximum values in the body weight variable (WEIGHT 83.4200 kg ± 16.03141), body height (Height 187.3100 cm ± 5.12260), hand length (LENGTH 76.6930 cm ± 3.44339), arm's length open (GJKHA 190.2500 cm ± 8.375667), palm length (GJAPADO 22.4700 cm ± 2.98032), leg length (BLOOD 108.7700 cm ± 3.40948), arm circumference (PERKR 30.1840 cm ± 5.12970), hip circumference (PERKF 30.1840 cm ± 5.129) and the circumference of the cartilage (AROUND 38.7490 cm± 3.71337) which showed dominant values in all the variables presented, while lower values were presented in the other positions.

Canonical discriminant analysis. Through the canonical discriminant analysis, the multidimensional differences (variables measured in the group) between the tested groups were tested, as well as the variables that make the best discrimination of the groups were potentiated (Table III).

Meanwhile, based on the nature of the discriminative function, the characteristics of these groups have been obtained, based on the characteristics of the discriminative equation l= 1.484. The correlation between the discriminative function and the linear function of the system of variables has the value Rc= .773. The criterion for the discriminative power of the applied morphological variables has a value of Wilks' l= .164. The testing of the statistical variables of the discriminative equation was done with Bartlet's test X^2= 96.622, for df= 40 degrees of freedom. The level of statistical significance of the discriminant function is Sig=.000. Canonical discriminant analysis yielded two statistically significant functions. Based on the significance level, the difference of the discriminant function is Sig=.000. From this we prove that the group of players, according to the players' positions in the morphological space, are statistically different from each other.

Table III. Canonical discriminant function.

Function	Eigenvalue	% of Variance	Cumulative %	Canonical correlation (Rc)
1	1.484	56.2	56.2	.773
2	.853	32.3	88.5	.678
3	.221	8.4	96.9	.426
4	.083	3.1	100.0	.277

Test of Function (s)	Wilks' Lambda (Kriteri i forcës diskriminuese)	Chi-square	df	Sig.
1 through 4	.164	96.622	40	.000
2 through 4	.408	47.938	27	.008
3 through 4	.756	14.943	16	.529
4	.924	4.257	7	.750

Table IV. Structural matrix.

	Function			
	1	2	3	4
HB	.782(*)	-.148	.019	-.104
THL	.644(*)	-.017	-.030	.216
AL	.515(*)	-.140	-.288	.147
LH	.465(*)	-.375	-.074	.078
BW	.255	.262(*)	-.218	.174
AC	.376	.207	-.501(*)	.498
LC	.169	-.046	.278(*)	-.278
CC	.165	-.085	.037	.737(*)
THC	.217	.034	-.255	.653(*)
WP	.151	.142	.065	.329(*)

Table IV shows the importance and structure of the discriminative function where they were calculated to determine the differences in the morphological space variables according to the positions of the players, among which are: (Organizer of the game, shooting guard, small forward, power forward and center). This is evident from the four structural functions, all of which are important.

In the first discriminant function, based on the numerical values of the five positional groups (1, 2, 3, 4, 5), as seen from the position of the players (Table V).

Table V. Player group centroids by position.

	Function			
	1	2	3	4
Organizer of the game	-1.301	1.259	-.133	-.179
Shooting guard	-.780	-.398	3.757	.460
Small forward	.157	-.569	.693	-.220
Power forward	.235	-1.086	-.712	-.213
Center	2.305	.911	-6.602	.131

DISCUSSION

But if we look at the variables separately, we can see that the basketball players on whom we did the research during the measurements and data processing can be compared with some relevant and important works for the morphological space. The variable body weight, if we com-
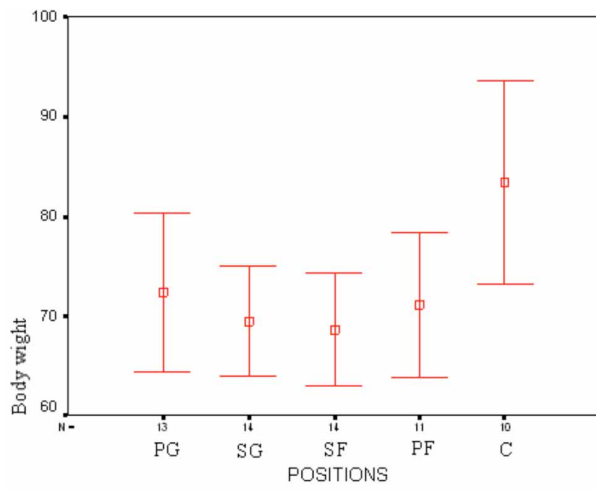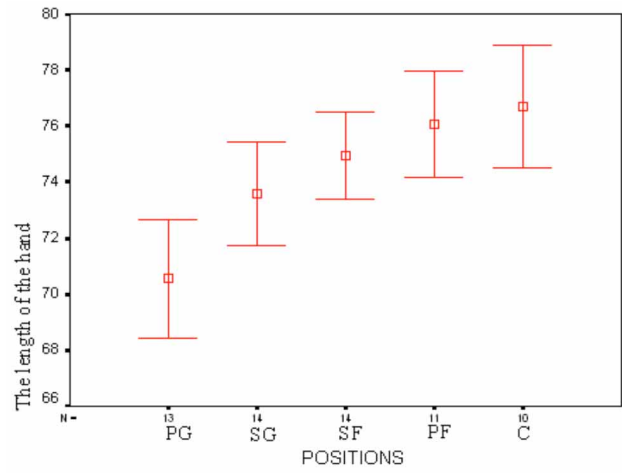
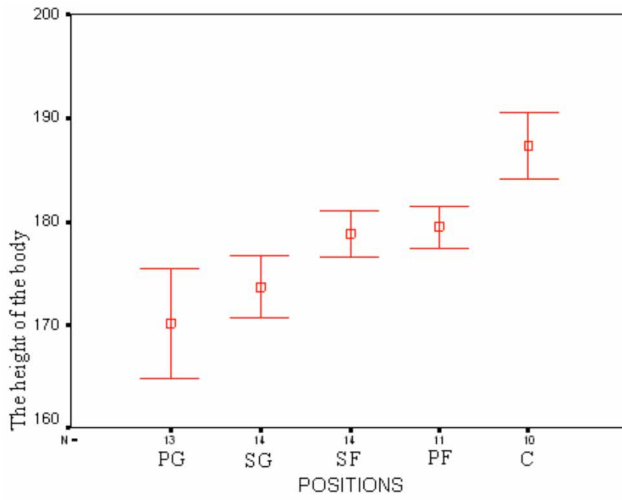Fig. 1. Body weight.

Fig. 2. The height of the body.

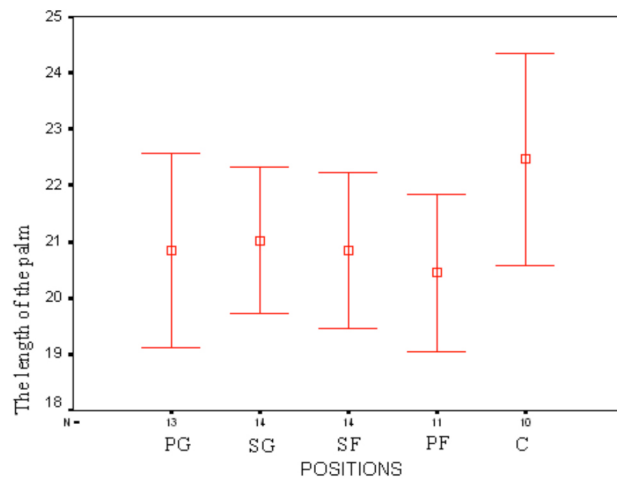Fig. 3. Open arm's length.

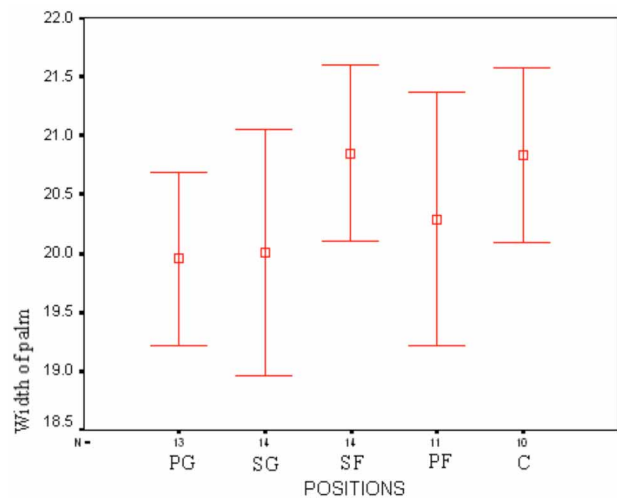Fig. 4. The length of the hand.

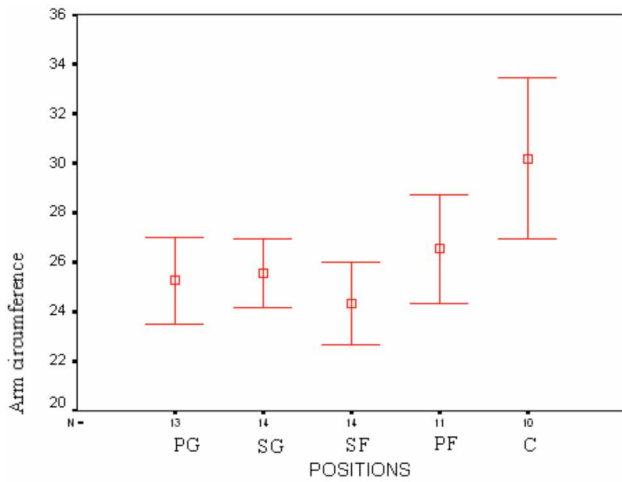Fig. 5. The length of the palm.

Fig. 6. Width of the palm.

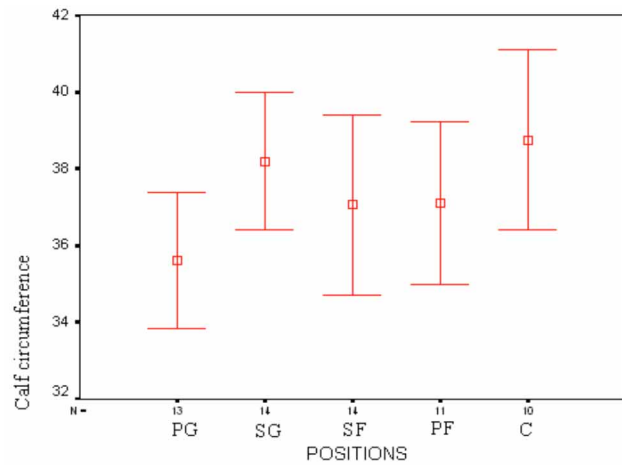Fig. 7. The length of the leg.
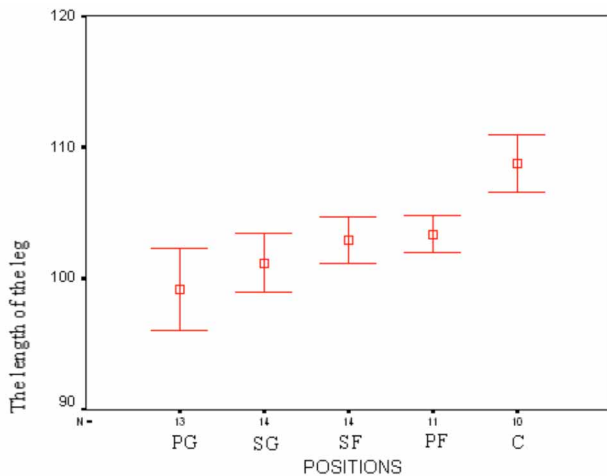

Fig. 9. Thigh circumference.
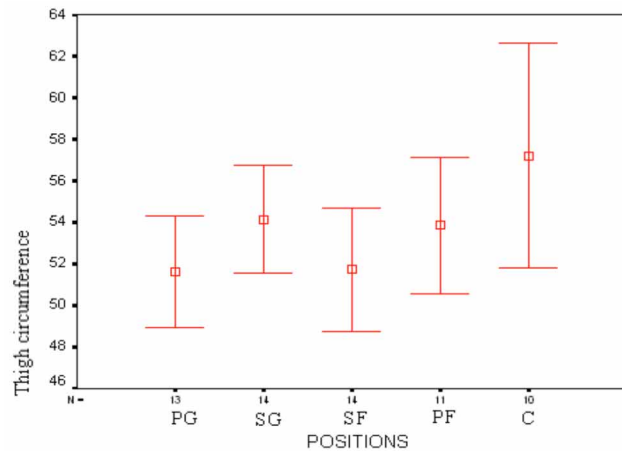

Fig. 8. Am circumference.

Fig. 10. Calf circumference.

pare the results with the players of the European junior basketball championship (Jelicic *et al*., 2002), that for 16.43 kg they have greater values than the players we took for the experiment, while the variables body height is to compare with players from Croatia (Jelicic *et al*., 2002) have differences of 18.13 cm in favor of players of the European junior basketball championship. The hand length variable, if we compare it with the players of the European junior basketball championship, which reaches 13.06 cm, has a lower value than the players we measured (Jelicic *et al*., 2002). In the open arm's length variable, the players we measured showed lower values of 21.25 cm compared to the work of the authors from Croatia (Jelicic *et al*. 2002). Whereas, the variable length of the palm has shown a lower value of 1.51 centimeters compared to the players of the European junior basketball championship (Jelicic *et al*., 2002). For the leg length variable, if we compare the results with basketball players from the European junior basketba-

ll championship, we see that for 88.81 cm, the players we measured presented lower values (Jelicic *et al*., 2002). In the arm circumference variable, if we compare the values of basketball players (Jelicic *et al*., 2002) for 4.66 cm, the players we have measured have shown lower values, while the thigh circumference for 6.73 cm, which has differences in favor of players from the European junior basketball championship, while the cartilage circumference is 2.82 cm, which has a difference in favor of the players from the European junior basketball championship (Jelicic *et al*., 2002). Basketball players in terms of differences between outside and inside players can be said, that inside players have significantly larger longitudinal and transverse dimensions, body circumference, and body mass, these results are expected taking based on many studies on the population of European basketball players (Ostojic *et al*., 2006; Vuckovic & Mekic, 2009; Köklü *et al*., 2011). According to the results found and compared to those of

the aforementioned authors, we see that the basketball players who were evaluated by the authors who are from several European junior basketball teams, it is found that we have lower results than the basketball players we measured. The group of outside players (organizer of the game, shooting guard and small forward) if we compare them with the basketball players from the European junior basketball championship, we see that the basketball players that we had for research have lower values than the players who cover the line 6.75 cm (Jelicic *et al.*, 2002). Also, the morphological structure during the observation was for these players within the team, we assume that these players can play on defense with the opponent during the transition because in contemporary basketball these players are much more athletic, also the body circumference is more visible than other parameters (Jelicic *et al.*, 2002; Abdelkrim *et al.*, 2010; Trninic *et al.*, 2013). Whereas, the group of players who cover the indoor game (power forward and center) according to the results, we see that the players have presented differences in favor of the players from the European junior basketball championship (Trninic *et al.*, 2013). We can assume that the length of the skeleton is one of the most important values ??for the players of the center position, in terms of their role in the game, they perform more efficient tasks in the internal positions in the defense and attack phase (Jelicic *et al.*, 2002; Trninic *et al.*, 2013). The physical structure of the players in the future positions certainly enables effective defensive play in the internal and external positions as it enables the use of the potential of the basketball players in the game (Trninic *et al.*, 2000; Trninic *et al.*, 2013; Kryeziu & Asllani, 2016). The game organizer has a negative function centroid. While the realization side has realized negative centroid with higher values.

The other players in this function have presented positive values, small forward with the lowest value of the group, and the tall and power forward are the centers where he realized positive centroid. In the second discriminating function, based on the positions of the centroids of the groups according to the positions, the center has a value of positive centroids, on the other hand, the organizer of the game in this group dominates with a higher value. On the other hand, the winger dominates with negative values, then come the Power forward and the performing winger. In the third discriminant function, based on the positions of the centroids of the groups according to the positions, the performing side has the highest positive value of the group. Whereas, the centers have the highest value of the group, but it is negative, then come the long winger and the organizer of the game, which have the lowest value with the average of the group. In the end, the fourth function is presented, based on the numerical values of the five groups according to positions,

the performing side has managed to have the maximum value of the group, while the center has a lower than positive value. The organizer of the game then comes the fast winger and finally the long winger which have negative values. Thus, the correlations included in the first, second, third, and fourth functions are following the role and tasks according to the positions of basketball players, which issue has been addressed by different authors (Trninic, 2006; Kryeziu, 2013; Trninic *et al.*, 2013).

The importance of the length dimensions of future players, it is also known that in basketball the main criterion for the classification of players on the field of play is body height, but the indicator of body height should not always be the only criterion in determining the position of basketball players (Erculj *et al.*, 2009; Viswanathan & Chandrasekaran, 2011; Kryeziu, 2013, 2015). Adequate development of motor performance would be a special indicator as well as a good knowledge of technical-tactical elements is important in determining the positions of basketball players (Erculj & Bracic, 2009; Kryeziu, 2013, 2015). It can be observed that through the comparison the long side and the center may have a longitudinal connection, as well as the dominance of the center in the transverse dimensions of the skeleton that comes based on the determination of the longitudinal parameters.

CONCLUSION

In the research done, the test subjects showed very few significant values in the morphological characteristics between the group of players, organizer of the game, shooting guard and small forward . In the morphological space players, power forward and centers showed significant values in all variables, such as body weight, body height, arm length, leg length, arm's length, palm length, leg circumference, hip circumference, thigh circumference and arm circumference. According to this, significant values have been presented in the characteristics of the group of power forward and center players. In the end, it can be concluded that the results of this research will be able to contribute to a better definition of the analysis of the morphological characteristics between the groups defined according to the players' positions. Also, the results of this research have scientific importance, which has mainly reflected on the positions of basketball players, as well as the characteristics that are important for the game of basketball in the junior category.

IMPORTANCE OF RESEARCH. The research is important mainly to determine the analysis of the players' positions in the anthropological space among young people. The results that have been achieved will be useful in raising and advancing the theoretical and practical values of the results of some morphological characteristics according to the positions of young players who follow the training program in the game of basketball. We believe that this research will find practical applicability, especially in determining the anthropological dimensions, which can help determine the players according to their position in the basketball game. Analysis of players' positions according to anthropological characteristics that are important for the game of basketball.

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RESUMEN: Este trabajo tuvo como objetivo investigar las características morfológicas según las posiciones de los jugadores de baloncesto. Una muestra de 62 jugadores de baloncesto entre 16-17 años de edad, cuya altura corporal era de 177,31 ± 8,112 cm, y la masa corporal de 72,44 ± 13,27 kg, se dividieron en cinco posiciones principales del juego de baloncesto: Organizador del juego (n=13), escolta (n=14), alero (n=14), ala-pívot (n=11) y centro (n=10). Los evaluados fueron hombres de los clubes RTV-21, ProBasket-Pristina, M - Junior de Pristina quienes están siguiendo el programa de entrenamiento de Baloncesto. En esta investigación se aplicaron variables espaciales morfológicas (n=10). Con base en los resultados obtenidos, se presentaron muy pocos valores significativos en las características morfológicas entre el grupo de jugadores externos (organizador del juego, alero y ala-pívot) que cubrieron la línea de 6,75 metros. Sin embargo, el grupo de jugadores interiores (pívot y pívot) bajo canasta mostró valores significativos en todas las variables morfológicas. Se puede concluir que los resultados de esta investigación podrán contribuir a una mejor definición de las características morfológicas entre los grupos definidos según las posiciones de los jugadores.

PALABRAS CLAVE: Análisis; Morfología; Posiciones; Jugadores de baloncesto.

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