

## ORIGINAL SCIENTIFIC PAPER

# Comparative Study of Anthropometric Measurement and Body Composition between Different Levels of Competition

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## Abstract

The purpose of this study was to describe morphological characteristics and body composition of the basketball players from Super League and Second League of Serbia as well as to make comparison between them. Forty-eight males were enrolled in the study, divided into two groups: twenty-four senior players from the Super League and twenty-four senior players from the Second Basketball League of Serbia. Morphological characteristics were evaluated by a battery of four variables: body height, body weight, arm span and leg length. Body composition was evaluated by a battery of two variables: Body mass index and body fat percentage. The standard central and dispersive parameters of all variables were calculated. The significance of the differences between the basketball players from the Super League and the Second League of Serbia was determined by a t-test for small independent samples. The purpose of this study is to describe the anthropometric characteristics and body composition of the basketball players, as well as to determine possible differences in relation to the ranking of the competition. The results showed that a significant difference was found for five variables among the group: body height, body weight, arm span, leg length and body fat percentage, while the difference was not observed for body mass index. Therefore, these findings may give coaches knowledge that there are significant differences between teams in relation to the rankings of the competition.

**Key words:** *Basketball, Morphological Characteristics, Body Composition, Serbia*

## Introduction

Basketball as a sporting activity has evolved from an alternative game to a highly selective sports branch through its long-standing history, in which success is reserved exclusively for the most talented and most capable individuals (Vukasevic, 2010). It was initially a game designed and available to everyone, which led to its incredibly rapid expansion and popularity around the world.

There is a wide range of motives for engaging an individual in active or recreational basketball playing, which is conditioned by the numerous desires and needs of the player himself (Vukasevic, Spaic, & Masanovic, 2018; Masanovic, 2018). Based on the needs of individuals and social groups, the desired levels of sports activities, the scale of values and the types of engagement in sports, we can distinguish several basic types of sports consumption:

developmental sport, recreational sport, standard sport, and top sport (Havelka & Lazarević, 1981). Developmental sport is conceived so that it is realized in teaching practice, with the basic aim of exercising physical exercise tasks (Bjelica & Krivokapic, 2011; Bjelica, 2002; Bjelica, 2005). Recreational sport is largely focused on maintaining psychophysical abilities at an optimum level, and is characterized by its free choice of physical activity (Bjelica, 2006a; Bjelica, 2006b). Standard sport is reflected in its mass and widespread presence in every living environment (Vukasevic, 2010). The top sport is defined as an activity aimed at achieving the highest sport results, where the basic measure of success is exactly the sport score (Havelka & Lazarević, 1981; Bjelica & Krivokapic, 2010; Bjelica & Krivokapic, 2012). The achievement of the highest sport results depends to a large extent on the timely selection of players (Masanovic, 2008; Masanovic,

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2009; Masanovic, Popovic, & Molnar, 2009; Popovic, Masanovic, Molnar, & Smajic, 2009; Popovic, Molnar, & Masanovic, 2010). Talent identification and efficient implementation of the transformational activities is a basic stage in the process of programming, planning and realization of the training process, which is largely based on the results of sports science and practice (Bjelica, Popovic, & Gardasevic, 2016a; Bjelica, Popovic, & Gardasevic, 2016a; Masanovic, Popovic, & Bjelica, 2018; Mašanović, Vukotić, Popović, & Bjelica, 2018). The selection criteria, which are multidisciplinary, fully cover the entire anthropological status of basketball players (Vukotic, 2010; Vukotic, 2011; Popovic, 2017; Vukasevic, Vukotic, & Masanovic, 2018).

The anthropometric characteristics and body composition of basketball players play a very important role in the selection of younger categories as well as in the quality of play in seniors' competition (Carter & Heath, 1990; Popovic, Smajic, Joksimovic, & Masanovic, 2010; Bjelica, Gardaevic, & Vasiljevic, 2018). Research confirms that the morphological structure of basketball players means distinctive body height and long extremities, and that the amount of subcutaneous fat tissue negatively affects the player's effectiveness and limits their motor and functional potentials (Popovic, Akpinar, Jaksic, Matic, & Bjelica, 2013; Masanovic, Vukotic, Bjelica, & Popovic, 2018; Popovic, Bjelica, Vukotic, & Masanovic, 2018; Vukotic, Corluka, Vasiljevic, & Bubanja, 2018; Vukotic, 2018). A successful basketball player must have certain morphological characteristics mutually different in relation to his specialty in the game (Saavedra, Þorgeirsson, Kristjansdóttir, Halldorsson, Guðmundsdóttir, & Einarsson, 2018; Cvorovic, 2012). The amount of body fat is affected by genetic factors, but it depends much more on nutrition and physical activity (Misigoj-Durakovic, Matkovic, & Medved, 1995; Nikolaidis & Vassiliou-Karydis, 2011; Sermaj, Popovic, Bjelica, Gardasevic, & Arifi, 2017). The increase in sports fitness has the effect of reducing the percentage of body fat (Bošnjak, Bukovala, & Soudil, 1986). For the training technology of basketball players, information on the structure of morphological characteristics represents very important aspects of their transformation in the desired direction at any time in their career (Stojanovic, Calleja-Gonzalez, Mikic, Madic, Vučković, & Ostojić, 2016; Nepocatyč, Balilionis, & O'Neal, 2017). Under the morphological characteristics of anthropological status, we take the processes of growth and man's ontogenetic development into account. (Bjelica & Fratric, 2011; Bjelica, 2013).

The first and most important element in defining a successful basketball player is precisely the anthropometric characteristics (Karalejić & Jakovljević, 2008). In addition to these dimensionalities, body composition and somatotyping of the player are mentioned as well. The morphological structure of the basketball player's body is based on the interaction of all anthropological measures that are predominantly influenced by genetic, endogenous, and exogenous, that is, environmental factors (Vukasevic, 2010). Congenital coefficient for the skeleton development is 0.98%, for volume 0.90%, and for subcutaneous fat 0.50%, and the greatest possible transformation by training and other exogenous influences is possible for the characteristics with a low innateness. Body mass is not highly genetically inherited, which means that the training process can affect its reduction, and the body-mass index (BMI), which is defined as the height-weight indicator of individual's nutrition, is also subject to changes under the influence of sports training (Strel, 2006).

Today, we have a better approach to a lot of knowledge in all areas, the athlete is brought to a high level of competence; records

in some disciplines are so high that the question is whether they are reachable any more (Masanovic, 2015). At the biggest sporting venues, a large number of almost equal sportsmen participate; slight differences between the super and top players decide the winner (Ramos-Campo et al., 2014; Masanovic & Vukasevic, 2009). Comparison of the players who compete at different competitive levels can help us understand what are the nuances that make the difference and help on the road to victory (Vukasevic et al., 2018). The morphological characteristics of basketball players of different quality are of crucial importance in determining the success of top athletes (Bjelica, 2004; Popovic, Bjelica, Jaksic, & Hadzic, 2014; Gusic, Popovic, Molnar, Masanovic, & Radakovic, 2017). Observing the details, expressed in the morphology of basketball players, we can find the crucial factors that separate them individually and give them a greater chance of success. In other words, we can assess the extent to which they affect quality and success in performance and competence in a certain ranking of competitions, that is, to determine the relation of individual characteristics, with the degree of competitive quality. The purpose of this study is to describe the anthropometric characteristics and body composition of the basketball players, and to determine possible differences in relation to the ranking of the competition.

## Methods

The sample of respondents makes a total of 48 basketball players of senior age, divided into two sub-samples. The first sub-sample was made by 24 basketball players who play in the Super League of Serbia, with an average age of  $25.08 \pm 5.56$  years, while the other sub-sample consisted of 24 basketball players who play in the Second League of Serbia, with an average age of  $22.33 \pm 3.89$  years.

Anthropometric research was carried out in compliance with the basic rules and principles related to the selection of the measuring instruments and measurement techniques that are standardized according to the guidelines of the International Biological Program. For the purposes of this study, four variables of morphological measures were measured: body height (BH), body weight (BW), arm span (AS), leg length (LL), and two variables for assessing body composition: body mass index (BMI), and body fat percentage (FP). For this anthropometric measurement, standardized measurement instruments were used: Martini anthropometer and scale. All relevant anthropometric dimensions (except for the morphological characteristic - arm span that is measured by an anthropometer in standard conditions) are determined according to the standards of the International Biological Program. A Tanita scale, model BC-418MA was used to estimate body composition. The operating principle of this scale is based on the indirect measurement of body composition where a safe electrical signal is transmitted through the body via electrodes located in the separate unit. Tanita scale, thanks to its athletic mode, allows athletes to closely monitor their body weight, health and fitness, with all relevant parameters.

The data obtained through the research are processed by descriptive and comparative statistical procedures. For each variable, central and dispersion parameters, as well as asymmetry and flattening measures are processed. Differences in morphological dimensions and body composition of basketball Super league players and Second League players of Serbia were determined by using a discriminatory parametric procedure, t-test for small independent samples, with statistical significance of  $p < 0.05$ .

## Results

In Tables 1 and 2, the basic descriptive statistical parameters of the anthropometric variables and body composition of two of the strongest Serbian leagues basketball players are presented, where the values of central and dispersive tendencies are calculated: arithmetic mean (Mean), standard deviation

(Std. Dev.), variance (Variance), minimal (Min) i maximal (Max) values, coefficients of curvature (Skewness) and elongation (Kurtosis). Central and dispersion parameters of the variables were analyzed first for the evaluation of the morphological characteristics and body composition of the basketball players that perform in the Serbian Super league (Table 1).

**Table 1.** Central and dispersion parameters of the variables for assessment of morphological characteristics and body composition of the basketball players from Serbian Super league

	Min	Max	Mean	Std.D.	Variance	Skewness		Kurtosis	
						Stat.	Std. E.	Stat.	Std. E.
BH	183.00	215.00	200.25	7.92	62.72	-.054	.472	-.224	.918
BW	80.00	116.00	96.63	9.84	96.85	.503	.472	-.620	.918
AS	184.00	226.00	204.08	10.55	111.29	.251	.472	-.498	.918
LL	108.00	129.00	117.88	4.89	23.94	.027	.472	.357	.918
BMI	18.82	26.78	24.07	1.62	2.63	-1.164	.472	3.908	.918
FP	8.00	16.10	10.67	2.14	4.56	.896	.472	.354	.918

Legend: body height (BH), body weight (BW), arm span (AS), leg length (LL), and two variables for the estimation of body composition: body mass index (BMI), and body fat percentage (FP).

Based on the central and dispersive parameters, the values of the Skewness and the variance, it can be noted that all the variables are within the normal distribution boundaries. It can be seen from the value of the Skewness that the variables of body mass, arm span, leg length and BMI have mild

asymmetry, which is not statistically significant for the weaker results because they have a positive sign; while the variables of body height and fat percentage have a negative sign which indicates that the results reside right from the value of the arithmetic mean, i.e. among the higher values. By the value of

**Table 2.** Central and dispersion parameters of the variables for assessment of morphological characteristics and body composition of the basketball players from Serbian Second league (N=24)

	Min	Max	Mean	Std.D.	Variance	Skewness		Kurtosis	
						Stat.	Std. E.	Stat.	Std. E.
BH	185.00	205.00	195.04	7.15	51.17	.100	.472	-1.503	.918
BW	79.00	105.00	90.96	8.52	71.65	.270	.472	-1.144	.918
AS	186.00	211.00	196.79	8.10	65.74	.409	.472	-1.229	.918
LL	102.00	123.00	112.92	5.79	33.56	.061	.472	-1.036	.918
BMI	22.16	26.25	23.87	1.10	1.21	.645	.472	-.222	.918
FP	7.70	16.10	12.43	2.46	6.10	.162	.472	-.709	.918

the Kurtosis, it can be seen that the variables of body height, body mass, and arm span show that the distribution is flatter than normal, that is, there are more results accumulated in the tails of distribution, while the variables of leg length, BMI and fat percentage show the peaked distribution, i.e. more results accumulated around the distribution center.

Based on the central and dispersive parameters, the values of Skewness and Kurtosis, for the players that perform in the second quality level of the competition in Serbia, it can be concluded that all variables are within the normal distribution boundaries. By the positive values of the Skewness in all variables, it is seen that most of the results are on left of

**Table 3.** T-test values between the arithmetic means of the variables for the evaluation of morphological characteristics and body composition of basketball players of Super League and Second League

Variables	Club	Mean	Std. D.	Std. E.M.	t-test	Sig.	Mean Diffe.
BH	Super league	200.25	7.92	1.62	2.391	.021	5.208
	Second league	195.04	7.15	1.46			
BW	Super league	96.63	9.84	2.01	2.132	.038	5.667
	Second league	90.96	8.52	1.74			
AS	Super league	204.08	10.55	2.15	2.685	.010	7.292
	Second league	196.79	8.11	1.66			
LL	Super league	117.88	4.89	0.10	3.203	.002	4.958
	Second league	112.92	5.79	1.18			
BMI	Super league	24.071	1.62	0.33	0.513	.610	0.205
	Second league	23.866	1.10	0.22			
FP	Super league	10.67	2.14	0.44	-2.644	.011	-1.763
	Second league	12.433	2.47	0.50			

the mean, on the side of weaker results. Negative values of flattening (variance) in all variables show that the distribution is flatter than normal, that is, it has more results accumulated in the tails of the distribution. In order to determine whether there are statistically significant differences in the analyzed variables of basketball players of the two of the best quality leagues of Serbia, the statistical procedure t-test (Table 3) was applied.

Based on the obtained t-test results, it can be noticed that there are statistically significant differences in five variables at the  $p < 0.05$  significance level, namely body height, body mass, arm span, leg length, and body fat percentage, while statistically significant difference was not observed for the variable of body mass index. It can be concluded that a comparative analysis of morphological characteristics and body composition shows that the Super league basketball players of Serbia are considerably taller than the Second League basketball players; they have a significantly higher body mass, arm span and leg length, and their body fat percentage is significantly lower. When it comes to body mass index, a significant difference relating to the rank of competition is not noticeable.

## Discussion

In his research (2010), Guarav points to the fact that basketball players are characterized by great body height, which is also an important parameter in the selection process of the players, and he lists the specifics of the game - the height of the hoop, and the constant need to surpass the opposing player, as the basic reasons for that. The advantage of tall players is the possibility to shoot from a shorter distance, to have a higher reach during jumping for the ball, as well as in blocking. If we compare the players from the highest quality Serbian league with the first teams after the last European Basketball Championship (EuroBasket), we can notice a certain difference in height, which is not statistically significant. According to the official data, the average height of the Slovenian champions is 199,5 cm, while the runner-up Serbia, and Spain, as the third, surpass 2,00m on average. If we take into account that these are the most successful national teams, the small difference in height in comparison to the basketball players of the Serbian Super League (198,37), is both logical and expected. Based on this, we come to the conclusion that the selection is well done, and that, from the body height aspect, Serbians as a nation could meet the needs of modern basketball, having in mind that the general population respondents were among the tallest in Europe (Popović, Bjelica, Molnar, Jakšić, & Akpınar, 2013; Popović, Bjelica, Tanase, i Milašinović, 2015; Popović, Bjelica, Georgijev, Krivokapić, & Milašinović, 2017; Popovic, 2016; Popovic, 2017a; Bjelica, Popović, Kezunović, Petković, Jurak, & Grasgruber, 2012; Gardasevic, Masanovic, & Arifi, 2018; Arifi, Gardasevic, & Masanovic, 2018), which is an essential aspect during the selection process. Statistically significant lower height of the players from Second League of Serbia (194,88) should not worry us because it is only logical that the players of lower quality leagues should have weaker morphological predispositions (Popović et al., 2010).

The aim of this research is to describe the anthropometric characteristics and body composition of basketball players, and to determine the possible differences in relation to the rank of competitions. A sample of a total of 48 senior-age basketball players is divided into two sub-samples. The first sub-sample consists of 24 Serbian Super League players; the

average age is  $25.08 \pm 5.56$  years, while the other consists of 24 Serbian Second League basketball players, the average age is  $22.33 \pm 3.89$  years. The results were obtained by observing four variables for estimating morphological measurements and two for estimating body composition.

On the basis of the obtained results we can conclude that there is a statistically significant difference between the sub-samples in the five measured parameters, that is, the Super league basketball players of Serbia are significantly taller than the Second League basketball players; they have a significantly higher body mass, arm span and leg length while their body fat percentage is significantly lower, and there is no significant difference when it comes to body mass index. This points to a successful selection when it comes to the first of quality rankings of the competition, which is confirmed by the results of representative selection at major international competitions. Observed from the point of view of morphology and body composition, Serbian Second League Basketball players lag behind for Super League players, which is the logical consequence of successful selection of players, that is, a proof that players with the highest morphological potential are in the right place.

The results obtained by this research can serve as model parameters in evaluated variables for all other players of the same rankings in Serbia because the players of the highest quality teams of the mentioned rankings have been analyzed. It should be mentioned that those who wish to successfully play in the leagues where the highest quality basketball is played, must have characteristics defined by the standards for the sport, which is primarily reflected in the morphological dimensions and body composition.

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## Conflict of Interest

The authors declare that there are no conflicts of interest.

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