

## Differences in morphological characteristics and body composition between of two elite volleyball players in Montenegro

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### Abstract

Contemporary volleyball is a very popular sport, as some kind of recreational activity, but also as a professional sport which is played by a very large part of both male and female population. The aim of this research was to determine the differences related to morphological characteristics and body composition among two top volleyball players in Montenegro participants of the Cup Finals 2018-19. The sample of 29 subjects was divided into two sub-samples, the sub-sample of the subjects consisting of 12 players of VC Budva, of the average age 26.23±4.2, the champions of Montenegro 2018-19, the other sub-sample of 17 players of VC Buducnost, of the average age 18.19±1.4, the participant in the European Challenge Cup 2018-19. Anthropometric characteristics in the body composition were evaluated by a battery of 11 variables: body height (cm), body weight (kg), triceps skinfold (mm), skinfold of the back, biceps skinfold, abdominal skinfold, thigh skinfold, calf skinfold, body mass index (BMI), percentage of fat (%) and muscle mass (kg). Statistically significant differences ( $p<0.05$ ) between body composition and anthropometric characteristics of the top two volleyball clubs, was determined by using a discriminatory parametric procedure with a t-test for small independent samples. The results showed that the volleyball players of the two mentioned clubs have statistically significant differences by the four variables that estimate the triceps skinfold, calf skinfold, thigh skinfold, and muscle mass, in favor of VC Budva. These results could be helpful to the other coaches and clubs in Montenegro, dealing with the selection and planning of the training process.

**Key words:** anthropometric characteristics, body composition, competition, differences, volleyball.

### Introduction:

Volleyball is a very popular sport, as some kind of recreational activity, but also as a professional sport which is played by a very large part of both male and female populations (Bojanic, Bjelica, & Georgiev, 2016). A great number of authors (Bojanic, Petkovic, Gardašević, Muratović, & Vasiljević, 2015) highlighted the importance of having a high level of skills critical for those volleyball players who perform this sport professionally. Achieving top results in sport is closely linked to specific anthropological characteristics and physical composition of the body (Carter & Heath, 1990). Morphological characteristics of athletes are most dependent on the rank of the competition and on the level of athletic performance and have a large effect on the basic and situational motor abilities (Martín-Matillas et al., 2014; Noutsos, Meletakos, & Bayios, 2019; Ljubojevic, Bojanic, Bjelica, Vasiljevic, & Vukotic, 2020). The principle of sports specialization in top volleyball is recognized by the authors (Gualdi-Russo & Zaccagni, 2001; Bojanic, Ljubojevic, Krivokapic, & Bjelica, 2020) and defined as the principle according to which players in team sports prepare exclusively for the position in which they will achieve best results. The results of numerous scientific studies show to what extent are anthropometric characteristics and its connection with basic and situational motor skills are essential for achieving superior results in volleyball (Okazaki, Alves, Silva, Keler, & Coelho, 2006; Malousaris, et al., 2008; Acar & Eler, 2019). The anthropometric characteristics, as well as body performance of the volleyball players, are said to be crucial for achieving the very best results (González-Ravé, Arija, & Clemente-Suarez, 2011; Çon, Akyol, Tural, & Taşmektepligil, 2012). Many researchers have proven the importance of the correlation between the anthropometric characteristics with the chosen sport (Eston, Rowlands, Charlesworth, Davies, & Hoppitt, 2005). In volleyball sports training is an adaptive complex process in which the most important are those morphological characteristics that will allow athletes to achieve superior results (Santos et al., 2014). A large number of authors researched the anthropological characteristics in volleyball players, morphological differences between team, various playing positions, different levels of competition, precisely because they are of great importance for achieving the excellent results (Malousaris et al., 2008; Sheppard, Borgeaud, & Strugnel,

2008; Palao, Gutiérrez, & Frideres, 2008). The results of the researches carried on specific sports skills indicated that each sport requires specific morphological characteristics and body composition of the players performing it professionally (Carvajal et al., 2012; Mala, et al., 2015). The body composition may greatly affect the strength, flexibility and the physiognomy of the player, which is of great importance for achieving the excellent results (De Oliveira-Junior, et al., 2016). The two clubs that are at the top of First Montenegrin League VC Budva, as current champion and winner of Cup of Montenegro in the season 2018-19, played the qualification for the Champions League and VC Buducnost was a vice-champion and participated in the European Challenge Cup in season 2018-19. This research aimed at analyzing the differences in some morphological characteristics and body composition among top volleyball players, members of the VC Budva and VC Buducnost, Montenegro Cup finalists in the season 2018-19.

## Material and methods

### Sample of subjects

This research has been carried on the sample of 29 respondents and was divided into two sub-samples. The first sub-sample of the subjects consisted of 12 players of VC Budva, of the average age  $26.23 \pm 4.2$ , while the other sub-sample consisted of 17 players of VC Buducnost, of the average age  $18.19 \pm 1.43$ . The volleyball players were tested after the 2018/19 season ended. All participants signed the consent form approved, formulated by the Declaration of Helsinki

### Sample of measures:

Anthropometric characteristics measurements have been carried out concerning the basic rules and principles related to the selection of measuring instruments and measurement techniques standardized by the (IBP) guidelines. For this study, eight morphological measures have been taken: body height, body weight, triceps skinfold, biceps skinfold, skinfold of the back, abdominal skinfold, calf skinfold, thigh skinfold, and three-body composition assessment variables: body mass index, fat percentage, and muscle mass. Anthropometer, caliper, and measuring tape were used for morphological measurements. To evaluate the body composition, Tanita body fat scale – model BC-418MA, was used. The Tanita Scale, thanks to its athletics mode, enables athletes to closely monitor their body weight, health condition, and form with all relevant parameters. The principle of this scale is based on indirect measurement of the body composition; a safe electrical signal is transmitted through the body via electrodes located in the standalone unit.

### Method of data processing

The data obtained through the research were processed by descriptive and comparative statistical procedures SPSS 20.0, adjusted for use on personal computers. For each variable, central and dispersion parameters have been processed. Differences in anthropometric characteristics and body composition of the volleyball players of these two national teams were determined by using a discriminatory parametric procedure with a t-test for small independent samples, with a statistical significance of  $p < 0.05$ .

## Results

Basic descriptive statistical parameters of body composition and anthropometric variables of the volleyball players of the two clubs, where the values of central measurements and dispersion tendencies are calculated, are presented in tables 1 and 2. The arithmetic mean (Mean), Standard deviation (Std. Dev.), Variance (Variance), Minimal (Min) and Maximal (Max) values, coefficient of Curvature (Skewness) and Elongation (Kurtosis). First, the central and dispersion parameters of the variables were analyzed to evaluate the anthropometric characteristic and body composition of the volleyball players VC Budva (Table 1).

**Table 1:** Variables for the assessment of morphological characteristics and body composition of players VC Budva (N=12)

Variable	Min	Max	Mean±SD	Variance	Skewness	Kurtosis
Body height (cm)	181.2	201.4	192.5±5.96	35.55	-.24	-.14
Body weight(kg)	74.3	100.4	84.92±8.51	72.40	.38	-.85
Triceps skinfold	3.1	8.3	5.7±1.69	2.87	-.17	-1.01
Skinfold of the back	7.2	11.1	8.84±1.53	2.35	.47	-1.33
Biceps skinfold	2.4	5.6	3.25±0.89	.78	.81	.12
Abdominal skinfold	6.2	13.1	8.68±2.47	6.09	.74	-.82
Calf skinfold	2.4	10.4	4.89±2.25	5.05	1.40	2.23
Thigh skinfold	5.4	8.2	6.99±1.05	1.09	-.12	-1.04
Body mass index (BMI)	20.2	28.5	22.96±2.59	6.70	.69	-.76
Percentage of fat(%)	4.6	19.1	10.28±4.04	16.32	.88	1.03
Muscle mass (kg)	37.4	49.1	43.03±3.57	12.71	-.13	-.77

As shown in table 1 it can be noted that all the variables are placed within the normal distribution boundaries, which results are based on dispersion and central parameters. By the value of skewness, it can be noticed that in the variables of calf skinfold there is more results with lower values than the average values, which is a good result considering that subcutaneous fat is disrupting factor for the top volleyball. The results of kurtosis show that for most variables there is no significant deviation from the normal results, the most homogeneous results are noticed within variable calf skinfold and percentage of fat, where it is evident that there is a grouping of results around the mean. Based on the central and dispersion parameters of the values of the skewness and the kurtosis of the VC Buducnost (Table 2), it can be stated that all the variables are within the normal distribution boundaries and that the values are very similar to those of the volleyball players of VC Buducnost. By the value of skewness, it can be noticed that in the variables of skinfold of the back, biceps skinfold, abdominal skinfold, and calf skinfold there are more results with lower values than the average values, which is a good result considering that subcutaneous fat is disrupting factor for the top volleyball.

**Table 2:** Variables for the assessment of morphological characteristics and body composition of players VC Buducnost (N=17)

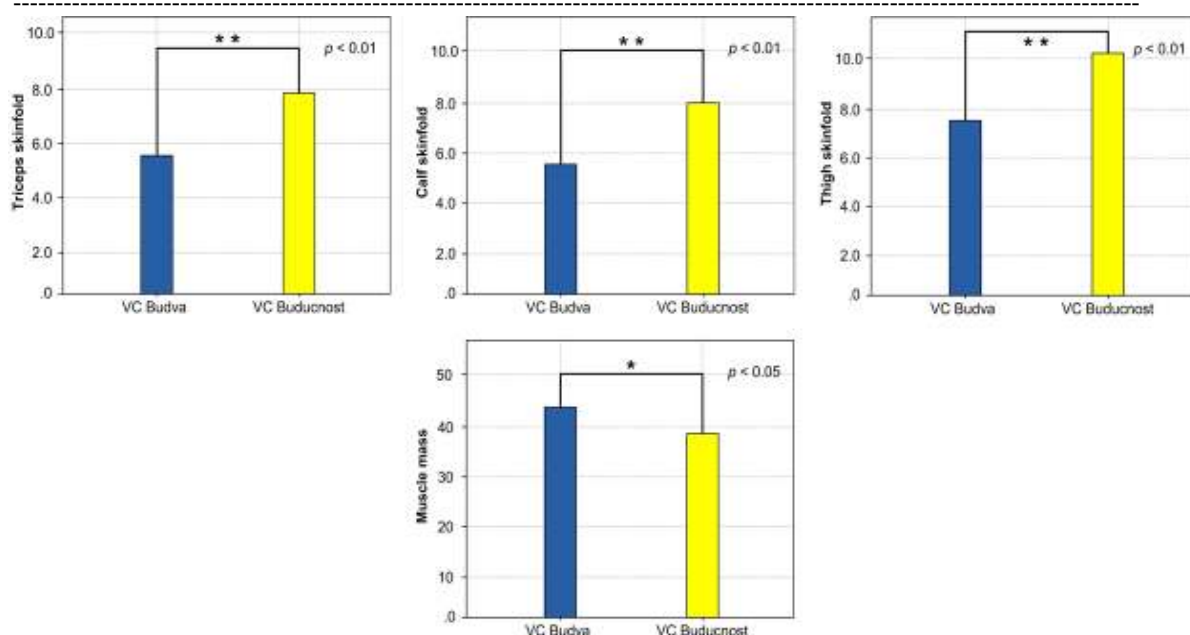
Variables	Min	Max	Mean±SD	Variance	Skewness	Kurtosis
Body height (cm)	182.2	198.5	192.41±5.55	30.76	-.85	-.75
Body weight(kg)	64.7	89.2	79.6±6.68	44.62	-.37	-.14
Triceps skinfold	5.3	11.4	8.37±1.83	3.34	.08	-1.00
Skinfold of the back	6.1	14.3	8.78±2.05	4.19	1.29	2.29
Biceps skinfold	3.1	11.4	4.21±2.01	4.04	2.90	8.75
Abdominal skinfold	6.0	16.1	9.82±2.64	6.97	1.05	.72
Calf skinfold	5.4	15.2	8.29±2.68	7.19	1.02	1.13
Thigh skinfold	7.2	16.3	10±2.58	6.66	.89	.41
Body mass index	18.0	26.3	21.34±2.09	4.38	.53	-.14
Percentage of fat(%)	3.3	22.5	11.57±5.05	25.54	-.06	-.18
Muscle mass (kg)	33.6	47.2	39.59±4.72	22.31	.32	-1.30

**Table 3:** T-test values between the arithmetic mean of variables for the evaluation of anthropometric characteristics and body composition of top volleyball players of VC Budva and VC Buducnost

Variables	VC Budva (N=12)		VC Buducnost (N=17)		t-test	Sig.
	Mean±Std	Mean±Std	Mean±Std	Mean±Std		
Body height (cm)	192.5±5.96	192.41±5.55	192.41±5.55	192.41±5.55	-0.0880	0.968
Body weight(kg)	84.92±8.51	79.6±6.68	79.6±6.68	79.6±6.68	-5.3167	0.086
Triceps skinfold**	5.7±1.69	8.37±1.83	8.37±1.83	8.37±1.83	2.6647	0.000
Skinfold of the back	8.84±1.53	8.78±2.05	8.78±2.05	8.78±2.05	-0.0590	0.930
Biceps skinfold	3.25±0.89	4.21±2.01	4.21±2.01	4.21±2.01	0.9560	0.095
Abdominal skinfold	8.68±2.47	9.82±2.64	9.82±2.64	9.82±2.64	1.1430	0.244
Calf skinfold**	4.89±2.25	8.29±2.68	8.29±2.68	8.29±2.68	3.4025	0.001
Thigh skinfold**	6.99±1.05	10±2.58	10±2.58	10±2.58	3.0080	0.000
Body mass index	22.96±2.59	21.34±2.09	21.34±2.09	21.34±2.09	-1.6170	0.088
Percentage of fat(%)	10.28±4.04	11.57±5.05	11.57±5.05	11.57±5.05	0.766	0.451
Muscle mass (kg)*	43.03±3.57	39.59±4.72	39.59±4.72	39.59±4.72	-2.233	0.034

\* -  $p < 0.05$ , \*\* -  $p < 0.01$

To determine whether there are statistically significant differences in the analyzed variables of the top volleyball players of these two clubs, the statistical procedure t-test (Table 3) was applied. The results of the t-test (Table 3) showed that volleyball players of the top two clubs have been statistically significantly different by the variables related to the triceps skinfold, calf skinfold, thigh skinfold, and muscle mass, in a favor of VC Budva. The significant differences of three skinfold and muscle mass among the volleyball players of these two clubs are shown in (Fig. 1)



**Fig.1** Statistically significant differences between volleyball players of VC Budva and VC Buducnost in four variables, \*\* p<.01;\* p<.05.

### Discussion

This research aimed at analyzing the differences in some morphological characteristics and body composition among top volleyball players, members of the VC Budva, and VC Buducnost, Montenegro Cup finalists in the season 2018-19. The group of 29 examinees has been partitioned into two sub-groups comprising of 12 players of VC Budva, of the average age 26.23±4.2, who were a statistically significantly older than those of the other group of 17 players of VC Buducnost, of the average age 18.19±1.4. The results in this study were obtained by using a battery of 11 tests in the area of body composition and morphological characteristics. The t-test results showed statistically significant differences in four variables, three variables of skinfolds and one variable of muscle mass, in favor of VC Budva. These results are not surprising because the team of VC Budva has several international players who come from strong European Volleyball League, while the team VC Buducnost mainly consists of domestic players who create squad from their base.

If we compare the mean values of height, as one very important factor in top volleyball between these two clubs, we will inform that players of VC Budva and VC Buducnost have the same values. These results are not surprising given that these are the two most trophy clubs in Montenegro where the highest quality players compete in European competitions. If we compare the individual results of the most trophies volleyball clubs in Montenegro VC Budva and VC Buducnost and team VC Vojvodina from Serbia - champions of Superleague in season 2018-19, we notice that the players of VC Vojvodina slightly higher 194.24cm (Popovic, Bjelica, Jaksic, & Hadzic, 2014). Very similar results regarding volleyball anthropometry have been made by researchers worldwide (Aytek, 2007; Palao, Gutiérrez, & Frideres, 2008; Madeiros et al., 2010; Muniz, Gomez-Campos, Cossio-Bolaños, & Gonçalves, 2017).

Regarding the average height of the top two volleyball players in Montenegro and when we compare them with the average results of the world's best volleyball teams such as Brasil (194.4cm), Italy (195.81cm), Russia (201.81cm), Argentina (194.75 cm), USA (196.2cm), Spain (195.9cm), Netherland (198.7cm) and Cuba (197.3cm). The results indicate that the Montenegrin players are, mainly, as tall as those who play this sport professionally worldwide, which is said to be a very important factor for top volleyball. It, also, has to be pointed out that the Montenegrin player base is far smaller than those of top volleyball in the world. Concerning skin folds, we can conclude that VC Budva achieved better results in all variables, while for three variables triceps skinfold, calf skinfold, thigh skinfold statistically significant differences were achieved at the level (p <0.00). If we compare the meanings in the research conducted by Muniz et al. (2017) skinfolds of Brazilian and Montenegrin players in the following variables: biceps (5.2%), triceps (10.9%), back (11.8%), abdominal (15.3%), thigh (12.9%) and calf (9.4%), We can conclude that the players of the two mentioned teams in Montenegro have lower values.

When it comes to a variable that evaluates the BMI, we notice that the players of both teams have approximately the same mean values and are in the area of normal weight. Also, when it comes to the variable for the evaluation of body fat, we can see that the results are very similar, but still VC Budva has a slightly lower percentage of fat. This result is expected because these are top teams participating in European competitions,

which implies good sports nutrition, supplementation, and a continuous training process. A study conducted by Caldarone, Giampietro, Ilardi, Spada, & Tocca, (1998) states that a good knowledge of sports nutrition and supplementation results in a decrease in the percentage of fat in athletes, which in turn results in top results.

According to the results of the t-test, the values of the variable muscle mass, we can conclude that VC Budva players in this variable have significantly better scores than VC Budva players at a statistically significant level of ( $p < 0.05$ ). This result should not be surprising if we know that few internationals are playing in Budva VC and that they have a significantly higher average year than Budva VC, in which most players from Montenegro play. The extent to which muscle mass is an important factor in the development of strength and performance in sports shows studies that have been conducted by Nikolaidis & Vassilios-Karydis (2011). If we compare the values of the muscular mass of volleyball players in Montenegro with studies focused on this problem (Aytek, 2007; Madeiros et al., 2010; Popovic et al., 2014; Muniz et al., 2017), we notice that the average values of muscle mass are very similar, statistics show that Montenegrin volleyball players in this variable do not deviate from the volleyball players in the world.

### Conclusion

These results could be helpful to other clubs and coaches in Montenegro, dealing with the selection and planning of the training process, to have an insight on what level their athletes are, and also to have some model characteristics and good guidance for creating top young volleyball players. One of the next researchers will focus on analyzing differences between these clubs in body composition and morphological characteristics concerning the position they cover in the team on a larger sample of volleyball players.

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### Conflict of Interest

The authors declare that there are no conflicts of interest.

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