

ORIGINAL SCIENTIFIC PAPER

Differences in Anthropometric Characteristics and Body Composition between Two Elite Female Basketball Clubs – Champions of Slovenia and Champions of Montenegro

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Abstract

This research aimed to determine the differences among the female basketball players of the Women's Basketball Club (WBC) Celje, which is the champion team of Slovenia, and WBC Buducnost Bemax, which is the champion team of Montenegro, in terms of their anthropometric characteristics and body composition. A sample of 26 subjects was divided into two sub-samples. The first sub-sample consisted of 12 players of WBC Celje (average age 21.75 ± 2.70), while the other sub-sample consisted of 14 players of WBC Buducnost Bemax (average age of 20.71 ± 3.15). All players were tested in Podgorica, Montenegro. Anthropometric characteristics and body composition were evaluated using a battery of eleven variables: body height (cm), body weight (kg), triceps skinfold, back skinfold, biceps skinfold, abdominal skinfold, thighs skinfold, calf skinfold, body mass index (BMI), percentage of fat and muscle mass (kg). Differences in anthropometric characteristic and composition of the body of the female basketball players of two clubs were determined by using a discriminatory parametric procedure with t-test for small independent samples ($p < 0.05$). It was found that the basketball players of Celje are slightly higher and have more body mass than the players of Buducnost Bemax. Also, there are significant statistical differences by two variables that estimate the calf skinfold and thigh skinfold, in favour of the Celje, but WBC Buducnost Bemax had better fat percentage value. These results could be helpful to other clubs and coaches in Slovenia and Montenegro, in selecting and planning of the training process.

Keywords: *anthropometric characteristics, body composition, female basketball players*

Introduction

The evolution of basketball, since its inception in 1891, and to this day, is characterized by significant changes in the demands placed on the top players (Ljubojevic & Nikolic, 2012; Vukasevic, Spaic, & Masanovic, 2018). Although the basic rules are practically the same, the characteristics of the game itself, speed, pace, energy, length of attack, number of shots scored, points scored, number of sprints, rebounds, duels, fouls, are changing very rapidly and in some way are

defined as more complicated. In such conditions, basketball places extremely high demands on athletes regarding the players' morphological characteristics and motor ability (Ben Abdelkrim, El Fazaa, & El Ati, 2007; Ochoa, Hall, Alarcon, Arrayales, & Sanchez, 2014; Popovic, Akpinar, Jaksic, Matic, & Bjelica, 2013; Masanovic, 2019), and also determines selection criteria for this sport. The morphological profile of basketball players could be defined as extremely tall, with long extremities, arm spans, large hand, wide diameters of the knee, shoul-



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der joints (Karalejic & Jakovljevic, 2009; Ljubojevic & Nikolic, 2012; Popovic et al., 2013). In contrast, although the amount of subcutaneous adipose tissue is considered to have a negative effect on player efficiency, in basketball, this may vary with the position of the player on the team, as well as the body composition and somatotype of the player.

Basketball is, second to football, the most popular sport in the Balkans. National teams from the Balkans, or locals, have often won European championships, Olympic medals, and/or European club competitions. Regarding the countries of the teams we compared in this research, Slovenia was the winner of Eurobasket in 2017, while Montenegro participated in the FIBA Basketball World Cup 2019. WBC Celje is the champion and winner of the Slovenian Cup. In its history, the team has won ten Slovenian Championships and nine Slovenian Cups. WBC Buducnost is the champion of Montenegro and the winner of the national cup. In its history, Buducnost was 12 times a winner of the National Championship and 10 times a winner of the National Cup. Also, Celje and Buducnost have twice been WABA league champions, and in recent years they have been regular participants in the Final Four WABA League (regional league). WBC Celje is also a regular participant in the European competition (EuroCup).

Due to all of the above, this research aimed to identify differences in morphological characteristics and body composition of top players from two clubs, Slovenia and Montenegro. Also, we wanted to determine the model characteristics of top players playing WABA league. Specifically, to compare variables of the best Slovenian female basketball clubs with the variables of the best Montenegro female basketball clubs. Finally, based on this outcome, potential specificities in selected variables are compared.

Methods

Sample of subjects

A sample of the subject consists of a total of 26 top-level female senior players who were members of two clubs who participated on Slovenian First League and Montenegrin First League and together participated in WABA league. The first sub-sample of the subjects consisted of 12 players of Women's Basketball Club Celje, average age 21.75 ± 2.70 , and 14 players of Women's Basketball Club Buducnost Bemax, average age 20.71 ± 3.15 . The players were tested in November 2019 in Podgorica, Montenegro, when two teams held games during the championship. All participants signed the approved con-

sent form, which was in accordance with the Declaration of Helsinki.

Sample of measures

Anthropometric measurements were taken according to the IBP-International Biology Program recommendations. For the purpose of this study, eight morphological measures have been taken: body height, body weight, triceps skinfold, biceps skinfold, back skinfold, abdominal skinfold, calf skinfold, thigh skinfold, as well as three body composition assessment variables: body mass index (BMI), fat percentage and muscle mass.

To evaluate body composition, a Tanita body fat scale (model BC-418MA) was used. 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. The Tanita scale, in its athletics mode, enables athletes to closely monitor their body weight, health condition and form with all relevant parameters. An anthropometer and calliper were used for morphological measurements.

Data processing method

Data obtained through the research are processed using descriptive and comparative statistical procedures. For each variable, central and dispersion parameters, as well as asymmetry and flattening measures, are processed. Differences in anthropometric characteristics and the composition of the body of the female basketball players of these two clubs were determined by using a discriminatory parametric procedure with t-test for small independent samples, with statistical significance of $p < 0.05$.

Results

Basic descriptive statistical parameters of anthropometric variables and body composition of the basketball players of the two clubs, for which the values of central measurements and dispersion tendencies are calculated, are presented in Tables 1 and 2: minimal (Min) and maximal (Max) values, arithmetic mean (Mean), standard deviation (SD), coefficient of curvature (Skewness) and elongation (Kurtosis). First, the central and dispersion parameters of the variables were analysed to evaluate the anthropometric characteristic and body composition of the female basketball players of WBC Celje (Table 1).

Table 1. Descriptive data for WBC Celje (Slovenia) female basketball players (N=12)

| Variable | Range | Min | Max | Mean±S.D. | Variance | Skewness | Kurtosis |
|--------------------|-------|-------|-------|-------------|----------|----------|----------|
| age | 9.0 | 17.0 | 26.0 | 21.75±2.70 | 7.30 | -.45 | -.60 |
| body height (cm) | 33.0 | 165.0 | 197.0 | 182.54±8.62 | 74.25 | -.35 | .67 |
| body weight(kg) | 33.8 | 59.6 | 93.4 | 75.48±8.94 | 79.84 | .29 | .50 |
| triceps skinfold | 7.1 | 12.1 | 19.2 | 14.84±2.37 | 5.62 | .59 | -.83 |
| back skinfold | 13.0 | 6.0 | 19.0 | 10.93±3.49 | 12.17 | 1.00 | 1.71 |
| biceps skinfold | 7.0 | 5.0 | 12.0 | 6.48±1.96 | 3.83 | 2.75 | 8.34 |
| abdominal skinfold | 11.0 | 8.0 | 19.0 | 13.09±3.29 | 10.82 | .47 | -.31 |
| calf skinfold | 8.8 | 6.4 | 15.2 | 11.81±2.91 | 8.48 | -.62 | -.85 |
| thigh skinfold | 9.0 | 8.0 | 17.0 | 13±2.94 | 8.63 | -.18 | -1.04 |
| body mass index | 9.0 | 18.0 | 26.0 | 22.57±2.61 | 6.81 | -.34 | -.39 |
| percentage of fat | 9.0 | 17.0 | 25 | 21.33±2.53 | 6.40 | -.43 | -.42 |
| muscle mass (kg) | 14.0 | 27.0 | 41 | 33.27±4.37 | 19.11 | .50 | -.37 |

As shown in Table 1, it can be noted that all the variables are placed within the normal distribution boundaries, the results of which are based on dispersion and central parameters.

In general, according to all the statistical parameters listed, we can conclude that the survey is conducted on a sample that is known for top basketball players. By the value of skewness, it can be observed that in the variables of the back skinfold (1.00) and biceps skinfold (2.75), there was a slight inclination on the side of the lower results, which is good because sub-

cutaneous fat is a disrupting factor for professional athletes. An insight into the results of the peak of the Gaussian curve (kurtosis) shows that there is no significant deviation from the normal distribution of the results for most variables. The most significant deviation from the normal values is seen in the variables biceps skinfold (8.34), and back skinfold (1.71), which for most athletes are homogeneous.

Table 2 showed the central and dispersion parameters of the variables that were analysed to evaluate the anthropometric characteristics and body composition of the female bas-

Table 2. Descriptive data for WBC Buducnost Bemax (Montenegro) female basketball players (N=14)

| Variable | Range | Min | Max | Mean±S.D. | Variance | Skewness | Kurtosis |
|--------------------|-------|-------|-------|-------------|----------|----------|----------|
| Age | 9.0 | 17.0 | 26.0 | 20.71±3.15 | 9.91 | .255 | -1.37 |
| body height (cm) | 28.0 | 168.0 | 196.0 | 181.57±8.16 | 66.57 | .089 | -.889 |
| body weight(kg) | 34.0 | 57.0 | 91.0 | 72.71±10.25 | 104.98 | .552 | -.516 |
| triceps skinfold | 9.0 | 10.4 | 19.4 | 14.36±2.8 | 7.82 | .215 | -1.04 |
| back skinfold | 14.0 | 7.0 | 21.0 | 11.27±3.65 | 13.34 | 1.42 | 3.28 |
| biceps skinfold | 10.0 | 5.0 | 15.0 | 7.59±2.58 | 6.66 | 2.08 | 5.77 |
| abdominal skinfold | 19.0 | 5.0 | 24.0 | 15.79±4.87 | 23.74 | -.347 | .673 |
| calf skinfold | 11.9 | 10.3 | 22.2 | 15.39±3.24 | 10.48 | .868 | .782 |
| thigh skinfold | 8.0 | 14.0 | 22.0 | 17.88±2.51 | 6.32 | .199 | -.904 |
| body mass index | 6.0 | 20.0 | 26.0 | 22.12±1.83 | 3.36 | .845 | -.114 |
| percentage of fat | 16.0 | 13.0 | 29.0 | 19.01±5.02 | 25.211 | .410 | -.428 |
| muscle mass (kg) | 13.0 | 25.0 | 38.0 | 32.83±3.54 | 12.55 | -.251 | .026 |

ketball players of WBC Buducnost Bemax.

Based on the central and dispersion parameters of the values of the skewness and the kurtosis of WBC Buducnost Bemax, 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 players from WBC Celje. It can also be noted that players of WBC Buducnost Bemax are younger on average. Furthermore, body height and body weight values are higher at WBC Celje. However, a comparative statistical procedure, a t-test (Table 3), shows whether this is statistically significant. By the value of the skewness, it can be observed that in the variables of the biceps skinfold (2, 08) and back

skinfold (1, 42) there was a slight inclination on the side of the lower results, which is good because subcutaneous fat is a disrupting factor for professional athletes. Similar results were obtained with WBC Celje. An examination of the results of the peak of the Gaussian curve (kurtosis) shows that there is a significant deviation from the normal distribution of results in most values. The largest significant deviation from the normal values is seen in the variables back skinfold (3.28), and biceps skinfold (5.77), where it is evident that there is a grouping of results around the mean.

To determine whether there are statistically significant differences in the analysed variables of the top basketball players

Table 3. Descriptive data and t-test of 26 female basketball players members of two female basketball clubs (Celje and Buducnost Bemax)

| Variables | WBC Celje | WBC Buducnost | t | Sig. |
|--------------------|-------------|---------------|--------|-------|
| | M±SD | M±SD | | |
| age | 21.75±2.70 | 20.71±3.14 | .903 | .376 |
| body height (cm) | 182.54±8.61 | 181.57±8.15 | .293 | .772 |
| body weight(kg) | 75.47±8.93 | 72.71±10.24 | .736 | .469 |
| triceps skinfold | 14.84±2.37 | 14.36±2.79 | .471 | .642 |
| back skinfold | 10.93±3.48 | 11.27±3.65 | -.241 | .812 |
| biceps skinfold | 6.48±1.95 | 7.59±2.58 | -1.244 | .226 |
| abdominal skinfold | 13.09±3.28 | 15.79±4.87 | -1.672 | .108 |
| calf skinfold | 11.808±2.91 | 15.386±3.23 | -2.966 | .007* |
| thigh skinfold | 13.00±2.93 | 17.88±2.51 | -4.510 | .000* |
| body mass index | 22.57±2.61 | 22.12±1.83 | .487 | .632 |
| percentage of fat | 21.33±2.53 | 19.01±5.02 | 1.503 | .148 |
| muscle mass (kg) | 33.27±4.37 | 32.83±3.54 | .274 | .787 |

Legend: * p<.05

of these two clubs, the t-test statistical procedure (Table 3) was applied.

Based on the results of the t-test (Table 3), it was found

that the players of the two clubs have statistically significant differences in the two variables that estimate the calf skinfold and thigh skinfold.

Discussion

In recent decades, basketball has undergone major changes. By changing the rules of the basketball game in terms of shortening attack time, changes in the dynamics and style of the game, basketball became more demanding for players and requires anthropological characteristics adequate to that level of quality performance, as well as functional and motor skills. Morphological characteristics occupy an increasingly important place in the primary selection of basketball players.

The results of the t-test for the values of all six tested skinfolds were in favour of WBC Celje. However, not all of them have shown statistical significance. The values of the calf skinfold significantly differ by 0.007, in favour of WBC Celje. Also, the value of the thigh skinfold has shown a statistical significance of 0.000. In addition, values of upper skinfolds (biceps, triceps, abdomen and back) are in favour of WBC Celje, but that did not show special significance. Consequently, it can be concluded that WBC Celje have less subcutaneous adipose tissue than the players of Buducnost Bemax.

If we compare the values of the height of WBC Celje and WBC Buducnost Bemax, we can conclude that results approximate the values of the height of these clubs with average height teams participating in Women Euroleague 2019/20 (Table 4), as the highest quality club competition in Europe. Also, we see that the average height of WBC Celje (182.54 cm) is taller than that of BLMA (179 cm), **Asvel (180 cm) and Praha (181 cm).

However, it approximately equals that of Castors Braine (182 cm) and is lower than all other teams on average. Players of Buducnost Bemax are taller than those of BLMA (179 cm), Asvel (180 cm), and have equal values as those of Praha (181 cm). Therefore, the average height of teams from these areas is less than most teams playing high-level European competition. This can be explained by the fact that the teams playing Women's Euroleague are made up of a large number of internationals, while the teams examined in this research are mostly made up of domestic players, which can be a good indicator of the importance of height as a morphological feature in reaching high ranges. In support of this claim, results obtained among the players of the Spanish first (183.2 cm) and second (180.2 cm) divisions are also relevant (Salgado-Sánchez et al., 2009). The difference in the level of competition is also seen in the differences in the average height of the players, in favour of a higher level of competition. The average values of WBC Celje and WBC Buducnost Bemax are lower than Spanish First division players and higher than Spanish Second division players. If we compare these with the results with other teams from this area, then we can say that the average values of the height of the players of these two teams are higher than the female players of the Bosnian First league, at 177.6 cm (Basinac, Mikic, & Pojskic, 2009), and the Greek basketball players (Bayios, Vergeles, Apostolidis, Noutsos, & Koskolou, 2006) from the second division, whose average height is 174.7 cm.

Table 4. Body height and age of teams participating in Women Euroleague 2019/20

| Team | State | Height (cm) | Age |
|-------------------------|-------|-------------|-----|
| Arka | Pol | 184 | 25 |
| Bourges Basket | Fra | 184 | 26 |
| Dynamo Kursk | Rus | 185 | 28 |
| Fenerbahce | Tur | 183 | 26 |
| Asvel | Fra | 180 | 25 |
| Venezia | Ita | 184 | 28 |
| Girona | Ita | 183 | 27 |
| UMMC Ekaterinburg | Rus | 185 | 27 |
| BLMA | Fra | 179 | 23 |
| Castors Braine | Bel | 182 | 25 |
| Famila Schio | Ita | 184 | 26 |
| Gelecek Koleji Cukurova | Tur | 183 | 24 |
| Nadezhda | Rus | 183 | 27 |
| Sopron | Hun | 185 | 26 |
| TTT Riga | Lat | 184 | 23 |
| ZVVZ USH Praha | Czech | 181 | 24 |

In comparison with the national teams participating in Eurobasket 2019, we can conclude that WBC Celje and WBC Buducnost Bemax have approximate results in body height as the five first-ranked teams (Spain, France, Serbia, whose average height is 182 cm, Great Britain and Belgium, whose average height is 181 cm). Average height values are lower than Turkey's national team, with an average height of 185 cm, the highest on the EP, as well as the Montenegro, Ukraine and Russian national teams (184 cm). In contrast, their results are higher only in comparison with the Slovenian national team (180 cm) (FIBA Women's EuroBasket 2019).

Having all this in mind, we can conclude that the average height of women's basketball players of WBC Celje and WBC Buducnost Bemax have approximate results in body height

and that their average heights are lower than most Euroleague teams. In contrast, these values are similar to the values of the most successful national teams at the last European Championship. Compared to other national leagues, the height values are higher, which also means a higher level of competition.

During the game, players move in different ways: walking, walking in different directions and with different body orientation relative to the direction of movement, walking with pivoting, straight running, running in different directions and with different body orientation with respect to the direction of movement, jump up one leg, high jump with both legs (Nazaraki, Berg, Stergiou, & Chen, 2009). In order to have the excellent motor movements mentioned above, we must em-

phasize that the value of body fat component is physiologically significant.

The average body mass values of the respondents are also approximate (WBC Celje 75.47 ± 8.93 and WBC Buducnost Bemax 72.71 ± 10.24). We can conclude that the players of WBC Celje and WBC Buducnost Bemax have approximately equal values of body height and body weight. This can be explained by the equal level of competition in which they participate (WABA league), as well as the region from which these players are selected. Results in weight of Celje and Buducnost Bemax players are similar and narrow with the values of the players in Spanish second division (Salgado-Sánchez et al., 2009).

Body mass values are lower than those of the first division basketball players of the England Basketball Division (Berdejo-del-Fresno, Lara-Sances, & Gonsales-Rave, 2012), and those of the Second Spanish League, and have approximate values with the players of the First Spanish League at 74.3kg (Salgado-Sánchez et al., 2009).

Observing the results of values of BMI for WBC Celje (22.57 ± 2.61) and WBC Buducnost Bemax (22.12 ± 1.83), we can conclude that there are no significant differences between the two clubs. We can say that these results are the same in comparison with other studies (Nunes et al., 2008; Salgado-Sánchez et al., 2009; Berdejo-del-Fresno et al., 2012).

The average fat percentage variable values are also approximate: 21.33 ± 2.53 for WBC Celje and 19.01 ± 5.02 for Buducnost Bemax. The result of the average value in the case of Celje is slightly lower compared to the results of the highest level of Spanish basketball players (Salgado-Sánchez et al., 2009), whose fat percentage was 19.01. The case of Buducnost Bemax is completely identical (19.01). It should be noted that Celje players have poor results when it comes to the fat percentage, which can affect their motor performance, since it is known that players with lower body fat content invariably perform at a higher level than those with higher body fat (Ostojic, 2002).

Results of the muscle mass value were in favour of WBC Celje (33.27 ± 4.37), Buducnost Bemax measured some low-

er results (32.83), but this did not show notable significance. However, compared to the results from the Spanish league (Salgado-Sánchez et al., 2009), that showed 44.3, we may conclude that both clubs show poorer values, which can be explained by the fact that the teams surveyed are relatively young (21.75 and 20.71), and that they have time to make progress in muscle mass value, assuming of course, if the training processes are focused on that. In contrast, the comparison with the Spanish League teams may not be the most optimal, as it is the strongest in Europe and the highest quality players play in it. Compared to results (Ljubojevic, Bojanic, Bjelica, Vasiljevic, & Vukotić, 2020) of the National team of Montenegro (32.83), Buducnost Bemax results are identical, whilst Celje is approximately the same, indicating that it is a similar sample, from the same region, from which the selection of female players is made for these clubs.

The subject of this paper was to study the morphological status of top elite female basketball players, who are members of two selections that participate in the WABA League 2019/20, and that were the champions of Slovenian and Montenegrin National leagues. The goal was also to obtain quantitative data that can be used to determine the morphological model and define the morphological status of elite basketball players.

The results showed that the players of WBC Celje and Buducnost Bemax are equal in age and height. Also, in terms of height, they are similar to the best-placed teams in the European Championship, but their average height is lower than most teams that play Euroleague. On average, they are taller than many previous subjects in research, who have been part of major international competitions but also national leagues. It was also found that WBC Celje players had better skinfolds, while Buducnost Bemax had better fat percentage value. Finally, we can conclude that the results obtained in this research can serve to compare the future selections of Celje and Buducnost Bemax. This survey can be useful for another comparison in regard to other selections, on local or national levels, in order to achieve different results than those treated here.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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