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DIFFERENCES IN MORPHOLOGICAL CHARACTERISTICS BETWEEN FEMALE VOLLEYBALL NATIONAL TEAMS OF MONTENEGRO AND KOSOVO

RAZLIKE V MORFOLOŠKIH ZNAČILNOSTIH ŽENSKIH ODBOJKARSKIH REPREZENTANC ČRNE GORE IN KOSOVA

ABSTRACT

The aim of this research was to determine the differences related to morphological characteristics and body composition among female players of Montenegro national junior volleyball team and Kosovo national junior volleyball team. A sample of the subject consists of a total of 25 top-level female junior players who were members of two national teams, participants of the European Championship qualifying 2020. The first sub-sample of the subjects consisted of 13 players of National team of Montenegro, of the average age 17.13 ± 0.54, while the other sub-sample consisted of 12 players of National team of Kosovo, of the average age of 16.35 ± 0.41. Anthropometric characteristics in the body composition were evaluated by a battery of 11 variables: body height (cm), body weight (kg), triceps skinfold (mm), back skinfold, 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 morphological characteristic of the female volleyball players of two national teams, Montenegro and Kosovo, were determined by using a discriminatory parametric procedure with t-test for small independent samples. The results showed that the female volleyball players of Montenegro are somewhat higher, also they have greater body mass index, greater muscle mass and a significantly lower percentage of fat, compared to the female volleyball players of Kosovo. When it comes to variables of skinfolds, it was demonstrated only one statistical significance in favor of the Montenegrin National team, variable skinfold thigh.

Keywords: anthropometric characteristics, body composition, female, volleyball players

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IZVLEČEK

Namen raziskave je bil ugotoviti razlike v morfoloških značilnostih in telesni sestavi med igralkami mladinske odbojkarske reprezentance Črne gore in Kosova. V vzorec je bilo vključenih 25 vrhunskih mladinskih odbojkaric, ki so bile članice dveh reprezentanc, udeleženk kvalifikacij za evropsko prvenstvo 2020. Prvi podvzorec je sestavljalo 13 igralk reprezentance Črne gore povprečne starosti 17.13 ± 0.54, drugi podvzorec pa 12 igralk reprezentance Kosova povprečne starosti 16.35 ± 0.41. Antropometrične značilnosti telesne sestave so bile ocenjene z baterijo 11 spremenljivk in sicer z meritvami: telesne višine (cm), telesne mase (kg), indeksa telesne mase (ITM), deleža maščobe (%), mišične mase (kg) ter meritvami kožne gube nadlahti (mm), subskapularisa (mm), bicepsa (mm), abdomna (mm), stegna (mm) in meč (mm). Statistično značilne razlike (p<0.05) med telesno sestavo in morfološkimi značilnostmi odbojkaric dveh reprezentanc Črne gore in Kosova smo ugotavljali z uporabo diskriminatornega parametričnega postopka s t-testom za majhne neodvisne vzorce. Rezultati so pokazali, da so odbojkarice Črne gore v primerjavi z odbojkaricami Kosova nekoliko višje, prav tako imajo večji indeks telesne mase, večjo mišično maso in bistveno manjši odstotek maščobe. Pri spremenljivkah kožnih gub se je pokazala le ena statistična značilnost v korist črnogorske reprezentance, in sicer pri kožni gubi stegna.

Ključne besede: antropometrične značilnosti, telesna sestava, ženske, odbojkarice

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INTRODUCTION

Modern 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 (Bojanic, Bjelica & Georgiev, 2016; Bojanic, Ljubojevic, Krivokapic & Bjelica, 2020a;). Achieving top results in sport is closely linked to specific anthropological characteristics and physical composition of body (Carter & Heath, 1990; Ljubojevic, Bojanic, Bjelica, Vasiljevic & Vukotic, 2020).

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). The principle of sports specialization in top volleyball game means that all potential of athlete are directed towards that gaming position in team on which athlete will achieve the best result compared to his/her body composition and morphological characteristics (Gualdi-Russo & Zaccagni, 2001). The quality selection and identification of the actual talent is very demanding and complex process which requires a good knowledge of anthropometry and body composition that are strongly linked to the high performance in sports (Srhoj, Rogulj, Zagorac & Katić, 2006; Ljubojevic et al., 2020).

The results of numerous scientific studies shows to what extent are anthropometric characteristics and its connection with basic and situational motor skills are essential for achieving superior results in volleyball (Malousaris, Bergeles, Barzouka, Bayos, Nassis & Koskolou, 2008). According to some authors the ideal time for focusing and start training volleyball, for girls who don't have some health restrictions, is between 9-11 years, considering the fact that right choice of sport is a process, not current operation and it is also necessary to follow the girls in school volleyball sections (Grgantov, Katić & Janković, 2006). There are many of the specifics in organization of female volleyball training that is associated with psychological, physiological and morphological characteristics, such as: improved joint mobility, less muscle mass, increased percentage of body fat.

Research conducted by Stamm et al. (2003) on a sample of young female volleyball players, shows that the body composition and morphological characteristics produce a major impact on the implementation of the technical and tactical elements in the game, especially when it comes to the spiking ball against the wall and blocking over the net. Morphological characteristics and body composition play a crucial role in expressing the motor performance of volleyball

players during the game, and are crucial for achieving top results (González-Ravé, Arija & Clemente-Suarez, 2011). Selection of players for a specific sport is the first methodological step in the system of sports training, so achieving top results in sports depends on this complex process. Many researchers have proven the importance of correlation between the morphological 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). 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 aim of this research was to determine the differences related to morphological characteristics and body composition among female players of Montenegro national junior volleyball team and Kosovo national junior volleyball team.

METHODS

Participants

This research was conducted on the sample of 25 top-level female junior players, members of two national teams, participants in qualifying for the European Championship 2020, which will be held in Croatia and Bosnia and Herzegovina. The first sub-sample of the subjects consisted of 13 players of National team of Montenegro, of the average age 17.13 ± 0.54, the other sub-sample consisted of 12 players of National team of Kosovo, of the average age 16.35 ± 0.41. Testing was conducted during the European Championship qualifying 2020 in Podgorica. All participants signed the consent form approved, formulated in accordance with the Declaration of Helsinki.

Sample of measures

Morphological characteristics measurements has been carried out with respect to the basic rules and principles related to the selection of measuring instruments and measurement techniques standardized in accordance with the (IBP) guidelines. For the purpose of 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.

Statistical analysis

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 morphological characteristics and body composition of the volleyball players of these two national teams 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 body composition and morphological variables of the volleyball players of the two national teams, where the values of central measurements and dispersion tendencies are calculated, are presented in tables 1 and 2. First, the central and dispersion parameters of the variables were analyzed to evaluate the anthropometric characteristic and body composition of the female volleyball players of National team of Montenegro (Table 1).

Table 1. Descriptive data junior National team of Montenegro (n=13).

Variable	Min	Max	Mean±SD	Variance	Skewness	Kurtosis
Age	16.2	17.9	17.13±0.54	0.29	-0.15	-0.97
Body height (cm)	170.0	187.0	179.54±4.7	22.10	-0.64	0.51
Body weight (kg)	59.3	76.6	68.42±4.66	21.73	-0.28	0.19
Triceps skinfold (mm)	9.1	19.4	14.17±3.01	9.07	0.31	0.20
Back skinfold	7.0	15.2	9.92±2.5	6.24	1.07	0.46
Biceps skinfold	4.1	10.4	7.01±2.28	5.20	0.49	-1.25
Abdominal skinfold	7.4	19.8	12.25±3.84	14.71	0.64	-0.62
Calf skinfold	9.1	19.2	15.61±3.53	12.43	-1.01	-0.19
Thigh skinfold	11.3	18.1	14.42±2.11	4.44	0.49	-0.68
Body mass index (kg/m2)	18.0	24.9	21.29±1.72	2.96	0.41	1.14
Percentage of fat (%)	12.8	20.2	17.02±2.59	6.73	-0.64	-1.25
Muscle mass (kg)	26.1	34.3	29.26±2.23	4.99	0.69	-0.36

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 back 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. By the value of calf skinfold variables, we notice that most of the result have higher values than the average values. The results of kurtosis shows that for most variables there is no significant deviation from the normal results, the most homogeneous results are noticed within variable body mass index, where it is evident that there is a grouping of results around the mean. The largest significant deviation from the normal values is seen in the variables biceps skinfold and percentage of fat, where it is evident that female volleyball players had the highest dispersion of the results. Table 2 showed the descriptive data for the junior national team Kosovo.

Table 2. Descriptive data junior national team Kosovo n=12.

Variables	Min	Max	Mean±SD	Variance	Skewness	Kurtosis
Age	15.8	17.2	16.35±0.41	0.17	0.41	0.26
Body height (cm)	160.0	184.0	175.17±7.43	55.24	-0.90	-0.16
Body weight(kg)	51.2	76.5	64.96±7.18	51.49	-0.15	-0.21
Triceps skinfold(mm)	8.4	20.2	14.45±3.55	12.59	-0.13	-0.83
Back skinfold	6.2	21.1	10.98±4.49	20.12	1.08	0.83
Biceps skinfold	5.1	12.1	8.13±2.58	6.68	0.64	-1.40
Abdominal skinfold	2.1	23.4	13.59±6.03	36.34	-0.10	-0.09
Calf skinfold	9.4	22.0	16.07±3.55	12.58	-0.02	-0.25
Thigh skinfold	13.1	21.0	16.74±2.28	5.18	0.42	0.37
Body mass index (kg/m2)	18.3	24.4	21.21±2.21	4.86	0.00	-1.48
Percentage of fat(%)	15.0	28.2	22.69±3.71	13.77	-0.53	0.26
Muscle mass (kg)	22.9	32.2	27.68±2.61	6.83	0.14	0.11

Based on the central and dispersion parameters of the values of the skewness and the kurtosis of the National team of Kosovo 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 Montenegrin female volleyball players. An insight into the results of the peak of the Gaussian curve (kurtosis) shows that for most variables there is no significant deviation from the normal distribution of the results. The most significant deviation from the normal values is seen in the variables biceps skinfold and body mass index where it is evident greater dispersion of results compared to the average value. In order to determine whether there are statistically significant differences in the

analyzed variables of the top female volleyball players of these two national teams, the statistical procedure t- test (Table 3) was applied.

Table 3. Descriptive data and t-test of 25 female volleyball players members of two national teams (Montenegro and Kosovo).

Variables	NT Montenegro (N=13) Mean±SD	NT Kosovo (N=12) Mean±SD	Mean difference	t-test	Sig.
Age	17.13±0.54	16.35±0.41	0.7808	4.101	0.000
body height (cm)	179.54±4.7	175.17±7.43	4.372	1.741	0.098
body weight(kg)	68.42±4.66	64.96±7.18	3.4647	1.419	0.172
triceps skinfold(mm)	14.17±3.01	14.45±3.55	-0.2808	-0.212	0.834
back skinfold	9.92±2.5	10.98±4.49	-1.060	-0.722	0.480
biceps skinfold	7.01±2.28	8.13±2.58	-1.126	-1.151	0.262
abdominal skinfold	12.25±3.84	13.59±6.03	-1.338	-0.656	0.520
calf skinfold	15.61±3.53	16.07±3.55	-0.4590	-0.324	0.749
thigh skinfold	14.42±2.11	16.74±2.28*	-2.326	-2.646	0.012
Body mass index(kg/m2)	21.29±1.72	21.21±2.21	0.084	0.106	0.917
Percentage of fat(%)	17.02±2.59	22.69±3.71**	-5.676	-4.399	0.000
Muscle mass (kg)	29.26±2.23	27.68±2.61	1.578	1.617	0.120

Based on results of t-test (table 3) it was found that female volleyball players of two national teams have statistically significant differences by the two variables that estimate the thigh skinfold and percentage of fat, in a favor of NT Montenegro.

DISCUSSION

The somatotype and the morphological profile of top volleyball players can provide useful information not only for the physical conditions of the athletes, but also for their potential performance in relation to the function that they have during the volleyball game (Gualdi-Russo & Zaccagni, 2001). Modern volleyball today is an extremely dynamic game that requires a high level of fitness, as well as technical and tactical efficiency in the game which is directly conditioned by the body composition and morphological characteristics that are said to be extremely important in top volleyball (Bojanic et al., 2020).

If we compare the mean for the heights of the national teams of Montenegro and Kosovo, we can conclude that the Montenegrins are higher but not at statistically significant level. The results in these two selections showed that the average height was higher or approximately

equal to the average height values found in other studies (Nikolaidis, Ziv, Arnon & Lidor, 2012) - 168.5 cm, Croatian volleyball league female players Grgantov et al. (2006) whose average was 174.36 ± 6.57, researched by Malá, Malý, Záhalka & Bunc (2010) - 179.1 ± 6.73 cm, Martín-Matillas et al. (2014) - 179.8 ± 7.1 cm, Carvalho, Roriz & Duarte (2020) - 176.35 ± 6.21, Noutsos et al. (2019) - 176.5 ± 5.7, Radu, Popovici & Puni (2015) - 167 ± 0.79 cm. Based on the results of a study by Almeida & Soares (2003), carried on young Brazilian female volleyball players' where the mean height was 174.0 ± 6.0 cm, we can conclude that Montenegro volleyball players are significantly higher on average, while the Kosovo selection has almost the same mean values.

Based on the above studies, we can conclude that Montenegrin female players, when it comes to height as one of the most important factors for achieving top results in volleyball, is at a very high level compared to the values of volleyball players in other national selections and leagues, while the selection of Kosovo had slightly lower values. This conclusion is, also, supported by the fact that Montenegrin female volleyball players, hold the second position in the world, when it comes to average height (169.36 cm), after Lithuanian (169.8 cm) according to the survey carried by Popovic (2018), and because of these facts coaches in Montenegro should make selection for sports where height is an important factor (volleyball, basketball, handball). The average values, when it comes to body weight in Montenegro and Kosovo (Table 3), significantly differ, but not at a statistically significant level in favor of Montenegro volleyball players, which is expected because they have a higher average value of height and the age.

If we compare the average values of the body mass of the selection of Montenegro with the results in other studies (Papadopoulou, Gallos & Paraskevas, 2002; Grgantov et al., 2006; Cabral, Batista, Fernandes-Filho & Knackfuss, 2008; Mala et al., 2010; Radu et al., 2015), we conclude that Montenegro players had higher or almost the same values in this variable, while Kosovo volleyball players had slightly lower mean values. Body mass can affect strength, speed, jump and endurance in top volleyball players, which is why athletes should aspire to ideal body weight without losing muscle mass (Marques, van den Tillaar, Gabbett, Reis & Gonzalez-Badillo, 2009).

When it comes to the skinfolds results, according to those obtained by the t-test, the Montenegrin national team achieved better results in all variables. However, there is a statistically significant difference with only one thigh skinfold variable in favor of Montenegrin female volleyball players ($p < 0.01$). Volleyball play is full of high jumps, rapid changes in

direction of movement and squats that depend directly on the large quadriceps thigh muscle, which probably contributed to the increase of muscle mass in this muscle in Montenegrin female players, due to well-designed conditioning situational and plyometric training, as indicated by the study Kollias (1997). If we compare the mean values of the skinfold of the triceps and the back of the Montenegro and Kosovo selections with the studies conducted by Grgantov et al. (2006) and Carvalho et al. (2020), we can conclude that Montenegrin and Kosovo female volleyball players achieved lower mean values for both variables. However, if we compare the results of the mean values of the skinfolds of Montenegro and Kosovo female players with the survey (Noutsos et al., 2019), we can conclude that the Greek female volleyball players had lower values in all variables when it comes to skinfolds, which can be justified by the fact that the Greece league is of higher quality and it has got a much larger player base than those of Montenegro and Kosovo.

Looking at the results of the mean values (Table 3), when it comes to BMI for Montenegro and Kosovo, we can conclude that with this variable the results are almost the same for both selections, which means that the ratio of body weight to height is almost the same and that these selections are very similar, when it comes to the nutrition index. It should, also, be highlighted that these results are the same or similar to those obtained by other studies (Malá et al., 2010; Radu et al., 2015; Noutsos et al., 2019;).

When it comes to body fat, it is evident that the NT of Montenegro has a significantly lower percentage of fat than the selection of Kosovo ($p < 0.00$), as well as that, according to studie (Geladas & Maridaki, 1996), the percentage of body fat in top women's volleyball teams is moving from (11.7-19.9 %), which is also the average value of the percentage of fat found in the Montenegrin female volleyball players. Which means that Montenegrin volleyball players do not lag behind this parameter found in the female volleyball players from Europe and the world.

A high percentage of fat is a disruptive factor in peak volleyball and according to studies (Caldarone, Giampietro, Ilardi, Spada & Tocca, 1998), a significantly lower percentage of fat indicates a good effect of training and a better knowledge of sports nutrition and supplementation, which is crucial for achieving top results in sports. The results of body composition, when it comes to adipose tissue, showed that the average value for this variable was significantly lower in the Montenegro and Kosovo selections compared to the study carried out by Nikolaidis et al. (2012), where the result of mean fat value was 25.8 %, and compared

to the study by Tsunawake, Tahara, Moji, Muraki, Minowa & Zukawa (2003), where values were 18.4 ± 3.29 %. Also comparing those results with the results found in Brazilian female volleyball players by Almeida & Soares (2003) 20.5 ± 2.4 %, Greek volleyball players by Noutsos et al. (2019) 22.8 ± 2.6 %, and Slovakian ones (Malá et al., 2010) - 18.26 ± 3.0 %. Differences seen in these two selections Montenegro and Kosovo in the percentage of fat could be the result of better selection, specialization in relation to playing positions, a better concept of the training process and better knowledge of sports nutrition in Montenegrin, since the increase in muscle mass leads to a decrease in the percentage of fat in the body and therefore affects high performance in the game.

The results in the variable evaluating muscle mass indicate that Montenegrin selection had a higher mean value of results than Kosovo selection, but not at a statistically significant level. However, if we would compare the results of muscle mass in Turkish volleyball players by Acar & Eler (2019) 24.9 ± 3.0 kg and muscle mass results in Spanish players by Martín-Matillas et al. (2014) 27.3 ± 2.9 kg, we will conclude that both national teams of Montenegro and Kosovo also has greater or approximately the same values. The t-test results show that Montenegro and Kosovo players are approximately the same when it comes to years, as well as that the Montenegrin female volleyball players had higher values of height and body mass than those playing for the selection of Kosovo. It was also found that the Montenegrin volleyball players had lower values of skinfolds, significantly lower percentage of body fat and higher amount of muscle mass, while BMI was at the same level. These results show that the researched national teams are no different in this parameter than players competing in much stronger leagues.

Limitations of the study

The limitation of this study can be found in a smaller sample of volleyball players, due to the fact that other national teams participating in the tournament did not allow measurements of their selections. We believe that the results would be even better if the next research included a larger sample of national teams.

CONCLUSION

These results support the fact that the selection of Montenegro qualifying for the European Championship 2020 ended with all the victories within the group, while the selection of Kosovo recorded one victory, so it can be concluded that the results of this study can serve coaches for

comparison with other selections, and coaches in Montenegro and Kosovo as model characteristics used in order to carry out the selection process with younger ages and to better conceive the training process in order to achieve top results.

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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