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Morphological Characteristics of Elite Female Volleyball Players Under 19

Características Morfológicas de Jugadoras de Voleibol de Élite Menores de 19 Años

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SUMMARY: The aim of the article is to determine the differences in morphological characteristics and jumping abilities between female volleyball players who play for different national teams. The sample consists of 48 elite female volleyball players from four different national teams which participated in European championship qualifications. The variables studied were: body height, mass, body mass index, standing reach and spike reach. The results show differences in body mass index, standing reach and spike reach. These differences are related to the needs of the different positions with regard to the actions they execute. In conclusion morphological parameters are important components of performance in many sports (volleyball). Different sports disciplines require different body parameters and body structure for maximum performance.

KEY WORDS: Morphology; Elite female players; Success in game; Vertical jump.

INTRODUCTION

Volleyball is one of the most popular team sports in the world. The game is characterized by short, explosive movement patterns, quick, agile positioning, jumps, and blocks. Although a match may last for up to 3 hours, volleyball is considered an anaerobic sport, with metabolic demands met mainly by phosphagen energy processes (Goranovic *et al*., 2022). Successful participation in this sport requires a high level of technical and tactical skills, which should reflect the influence of training and suitable anthropometric characteristics (Carvalho *et al*., 2020).

Anthropometric research conducted on women participating in volleyball has been investigated frequently and is often related to different levels of women's skills (Duncan *et al*., 2006). A few studies examine the anthropometric measurements for evaluating the specific body build of female volleyball players (Bayios *et al*., 2006). The majority of research confirms that volleyball pre-selection is based on previously determined, basic somatic criteria, such as body height and mass. Such morphological selection results in significantly higher body height of volleyball players in comparison to their non-practicing peers and women practicing other sports. The results of much of the research point to a certain diversification of volleyball players' body build, which depends on the playing position on the court (Pietraszewska *et al*., 2015).

Morphological predispositions frequently determine a player's functional abilities. In the case of volleyball, strength and speed training lead to changes in muscle mass, endurance, strength, power and jumping abilities. The height of vertical jump in volleyball players is determined by a certain level of strength, which also influences their efficiency (Sheppard *et al*., 2008).

Volleyball spike reach movement is unique and characterized by using arm swings during the last two or three counter movement steps. The essence of the spike reach is transferring the horizontal momentum of the body into the vertical acceleration, where a rapid consecutive eccentric and concentric contraction of the lower limb muscles is employed. This course of stretching and shortening the muscle is referred to as the stretch-shortening cycle (SSC). The complexity of spike reach performance results in a

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different pattern of SSC function, which may vary between athletes, depending on their sports training and age (Slovák *et al*., 2021). In the spike, the goal of an offensive player is to achieve great jumping height to be unpredictable and ensure diverse actions. The higher the player's jumping height during the spike, the larger the effective field size and the steeper the ball trajectory at high ball velocity. In previous studies, it was found that jumping performance correlates with competition level (Sattler *et al*., 2015). Consequently, achieving great jumping height is a determining factor in female and male volleyball performance (Fuchs *et al*., 2019).

The aim of the article was to determine the differences in morphological characteristics and jumping abilities between female volleyball players who play for different national teams.

MATERIAL AND METHOD

Sample of participants. The research is done on the sample of 48 elite female volleyball players, divided in four sub-samples, which participated in European championship qualifications. The first sub-sample included 12 female volleyball players, national team of Austria, average height 176.75±5.32 cm; the second sub-sample included 12 female volleyball players, national team of Finland, average height 176.33±7.82 cm; the third sub-sample included 12 female volleyball players, national team of France, average height 179.0.75 cm, and the fourth sub-sample included 12 female volleyball players, national team of Montenegro, average height 180.08±6.00 cm.

Research design

Anthropometry. All anthropometric variables (body height, body mass, standing reach, and body mass index) were measured according to standard procedures of the International Society for the Advancement of Kinanthropometry (ISAK) (Marfell-Jones *et al*., 2006). To measure the body height, standing reach and body mass of female volleyball players, a stadiometer and a calibrated scale were used with a precision of 0.1 cm and 0.1 kg, while BMI was calculated by dividing the body mass with the square height of the body in meters (Joksimovic *et al*., 2019).

Jump performance. The height (m) achieved during the spike was measured using an optojump device. The participants were instructed to perform each test with accuracy. Additionally, key feedback was provided during the tests to ensure a proper jump technique. In the event of a clear error, the test was disregarded, and another attempt was allowed. The vertical jump protocol consisted of three countermovement jumps using arms, with individual technique and coordination (spike). Three-minute rest intervals were given between the two sets of different jumps (Carvalho *et al*., 2020).

Statistical analysis. All data collected through research were processed with descriptive and comparative statistics. Regarding descriptive statistics, mean and standard deviation were calculated for each variable. The normality of the distribution of the variables was derived through two procedures: the asymmetries of the skewness results and the homogeneity of the kurtosis results. Regarding comparative statistics, a discriminant parametric procedure was used: analysis of variance with one-factor Anova and PostHoc, which determined the differences between morphological characteristics and vertikal jump. The statistical program for personal computers SPSS for Windows version 26.0 was used for data processing. Statistical significance was set at $p<0.05$.

RESULTS

Table I shows descriptive parameters of morphological characteristics and spike reach in female volleyball players of different national temas.

Table I. Descriptive data of morphological characteristics and spike reach.

Variables	Team	Mean±SD	95% CI
Body heigh (cm)	Austria	176.75±5.32	173.36-180.14
	Finland	176.33±7.82	171.36-181.30
	France	179.75±0.75	175.83-183.67
	Montenegro	180.08±6.00	176.27-183.90
Body mass (kg)	Austria	68.17±6.11	64.28-72.05
	Finland	68.58±5.43	65.13-72.04
	France	68.5±5.99	64.69-72.31
	Montenegro	65.67±6.27	61.68-69.65
BMI (kg/m^2)	Austria	21.86±2.34	20.37-23.35
	Finland	22.05±0.95	21.45-22.66
	France	21.22±1.80	20.07-22.37
	Montenegro	20.20±1.10	19.50-20.90
Standing Reach (cm)	Austria	231.33±8.07	226.20-236.46
	Finland	231.25±14.32	222.15-240.35
	France	232.25±7.61	227.41-237.09
	Montenegro	241.83±14.72	232.48-251.19
Spike Reach (cm)	Austria	283.25±19.76	270.69-295.81
	Finland	286.58±11.95	278.99-294.18
	France	295.25±12.81	287.11-303.39
	Montenegro	270.08±19.89	257.44-282.72

Table II. Differences between different national team.

Variables	Team	Mean±SD	F	Anova	Cohen's *d*
Body heigh (cm)	Austria	176.75±5.32	1.128	.348	.07
	Finland	176.33±7.82			
	France	179.75±0.75			
	Montenegro	180.08±6.00			
Body mass (kg)	Austria	68.17±6.11	.649	.588	.04
	Finland	68.58±5.43			
	France	68.5±5.99			
	Montenegro	65.67±6.27			
BMI (kg/m^2)	Austria	21.86±2.34‡	3.065	.038	.17
	Finland	22.05±0.95‡			
	France	21.22±1.80			
	Montenegro	20.20±1.10			
Standing Reach (cm)	Austria	231.33±8.07‡	2.318	.049	.13
	Finland	231.25±14.32‡			
	France	232.25±7.61			
	Montenegro	241.83±14.72			
Spike Reach (cm)	Austria	283.25±19.76	4.789	.006	.24
	Finland	286.58±11.95*			
	France	295.25±12.81†			
	Montenegro	270.08±19.89			

Note: BMI: Montenegro vs Finland‡, Austria‡ p<.05; Standing reach: Montenegro vs Finland‡, Austria‡ p<.05; Spike reach: France vs Montenegro† p<.05; Finland vs Montenegro* p<.05.

Anova shows a statistically significant difference ($p < .05$) in the three variables BMI, Standing reach and Spike reach (Table II). The analysis showed that the Montenegrin national team has statistically significantly lower BMI values compared to the Finland and Austria national team ($F = 3.065$, $p < .038$). Furthermore, the results show that the Montenegrin national team had a statistically significant difference in Standing reach compared to Austria and Finland ($F = 2.318$, $p < .049$). It is interesting to point out the results in the Spike reach, where it is evident that the national team of Montenegro had the lowest results compared to the national team of Finland and France ($F = 4.789$, $p < .006$). Figures 1 to 5 graphically shows the values of morphological characteristics and Spike reach.

DISCUSSION

The aim of the article is to determine the differences in morphological characteristics and jumping abilities between female volleyball players who play for different national teams. Morphological parameters are important components of performance in many sports. Different sports disciplines require different body parameters and body structure for maximum performance. The morphological and body composition (body fat, body mass, muscle mass) of athletes, physical characteristics and technical-tactics capacity significantly affect success and performance. Knowledge of these characteristics is necessary to determine their significance for success in competitive sports. Research on the influence of morphological characteristics on sports games (volleyball) is particularly complex, because success in the game, among other things, depends on how the individual characteristics of each player fit into the whole, thus creating a coherent team. The position of the team is extremely important in the interpretation of morphological data because there are different requirements for a particular sport. Over the last few decades, there has been a growing interest in analysis of morphological status and physique for success in a particular sport (Goranovic *et al*., 2021). Although many studies have shown that specific anthropometric characteristics are significantly related to success in sports, different sports require different types of morphological characteristics to achieve maximum performance (Khanna & Koley, 2020). Body height is crucial because volleyball players have to overcome the height of the net (2.24 cm for women) and the block of the opposing team. The highest body height values were recorded in volleyball players from Montenegro (180.08±6 cm) and France (179.79±0.75 cm), while somewhat lower values were recorded in volleyball players from Austria (176.75±5.32 cm) and Finland (176.33±7.82 cm) (Fig. 1). Malousaris *et al*. (2008) compared the morphological characteristics of volleyball players in the A1 and A2 divisions of the Greek National League and found that A1 players were more than players competing in the A2 division. It is interesting that the body height values of the elite volleyball players in their study are (180±0.06 cm), which is in accordance with the body height obtained in this study for the national teams of France and Montenegro.

Greater body height in the volleyball players of the national team of Montenegro and France may be attributed to the fact that elite volleyball players are required to have greater height and strength in the wrist and fingers due to the nature and type of the sport. Also, height is an important factor for selection of players in volleyball. High stature has been recorded as a differential factor between successful and non-successful teams. Greater height in players provides an advantage in that they can reach over the top of the net as well as perform both offensive and defensive actions over the net (Khanna & Koley, 2020). Stamm *et al*. (2003) state that body height is a significant determinant in elements of volleyball performance in the game such as serves, receptions, blocks and attacks. In a study by Faraji *et al*. (2014), it was found that height and BMI were the most important anthropometric variables in junior female players,

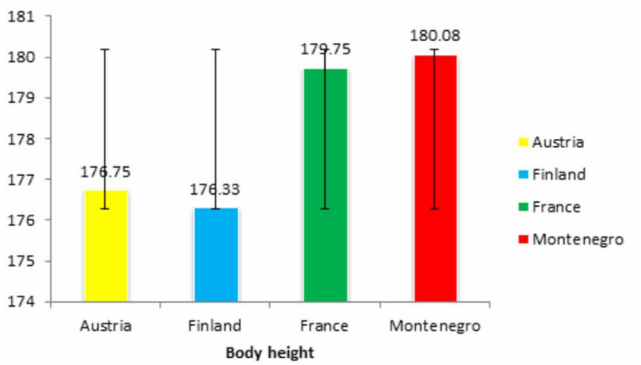

Fig. 1. Body height.

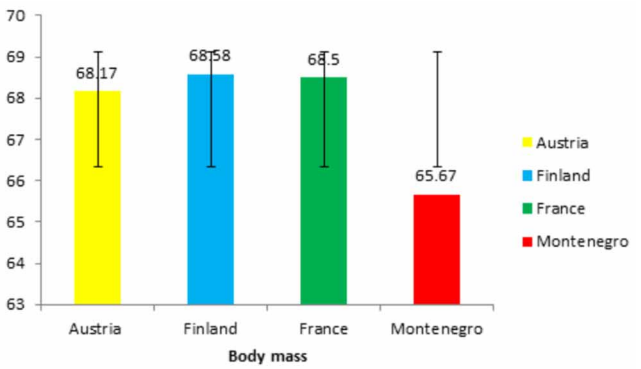

Fig. 2. Body mass.

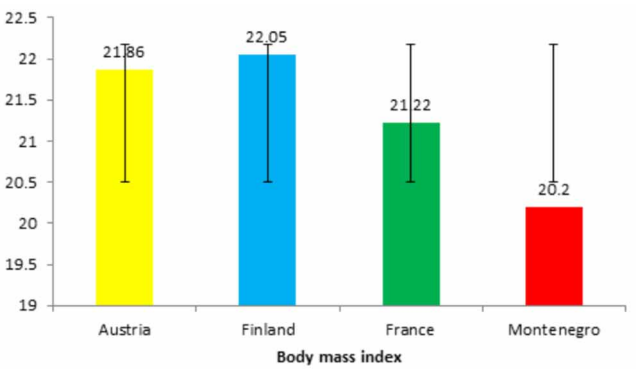

Fig. 3. Body mass index.

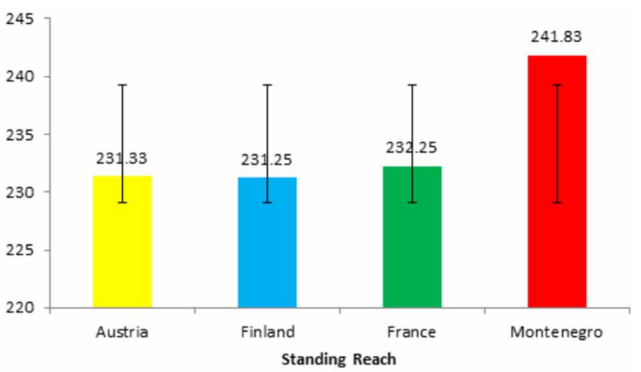

Fig. 4. Standing reach.

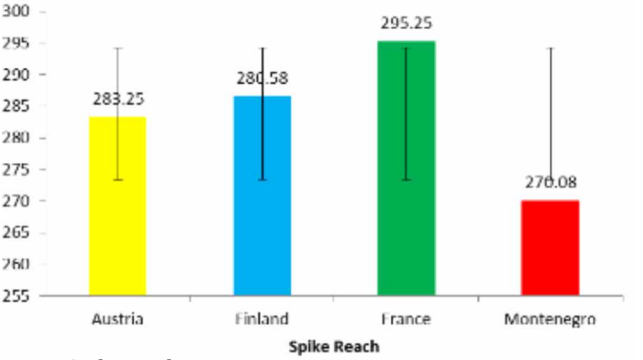

Fig. 5. Spike reach.

suggesting that taller volleyball players would have better strength. Body height is considered a determinant factor for good performance in volleyball and, together with its relation to body mass, is used as a criterion for the selection of promising volleyball players. On the other hand, excessive body mass of the athlete is usually not a particular problem, while the excess of the body fat usually has a negative effect on the athletic performance (Shchepotina *et al*., 2021). The results of body mass recorded in four national teams (Fig. 2), indicate that the lowest body mass was the female volleyball players of the national team of Montenegro (65.67±6.27 kg), while the female volleyball players of the national team of Austria, Finland and France had approximately the same body mass values of 68 kg. Significant greater body mass among volleyball players might be disadvantageous for them in attaining a good jumping height as they have to lift a greater weight (Khanna & Koley, 2020). Therefore, the lack of body contact during volleyball matches supports the idea that female players do not need a large body mass to improve their performance. Comparison of the obtained results on body height and mass indicate that the results obtained in this study do not differ from the morphological characteristics of leading national teams and volleyball clubs (Abazi *et al*., 2017; Konstantinos *et al*., 2019). The lowest values of body mass index were recorded in female volleyball players from Montenegro (20.2 kg/m2), while in female volleyball players from France, Finland and Austria, the value of body mass index was recorded in the range of (21.22 - 22.5 kg/m^2) (Fig. 3). Results obtained in our studies are in agreement with previous studies conducted with elite athletes (Busko & Lipinska, 2012). It is important to keep in mind that the larger values of BMI of the top-level players could be the result of higher development of skeletal muscles.

Standing reach volleyball players indicated the relevance of this anthropometric characteristic in volleyball, where most players are involved in offensive and defensive actions (Pena *et al*., 2018). Figure 4 shows the standing reach values for four national teams. Analyzing the standing reach

results in this study, it is noticeable that the volleyball players of the national team of Montenegro had the highest standing reach values (241.83 cm). In the case of female volleyball players of the national team of Austria, Finland and France, the standing reach values are in the range of (231.33 – 232.25 cm). In contrast to the standing reach, the results in the spike reach show different results (Fig. 5). The volleyball players of the national team of Montenegro had the lowest values in the spike reach (270.08 cm). Approximately the same results were recorded in the female volleyball players of the national team of Finland (286.58 cm) and Austria (283.25 cm), while the female volleyball players of the national team of France recorded the highest values in spike reach (295.25 cm). To explain the spike reach results obtained in this study, a possible reason can be found in the different jump technique performed by volleyball players, which leads to large intra-individual variations. Some players, when performing the spike reach, use different arm swings to increase the height of the jump. Arm swing together with counter movement increases jump height (Kristicevic *et al*., 2016). In addition, volleyball players use two jumping techniques, starting from an upright position and from a squat jump position. The type of these jumps affects the power generation during the game. If the muscles are loaded, with a quick jump, the athlete performs a faster block jump because he is in a submaximal effort. On the other hand, from an upright position, the player can put more strain on her muscles and achieve a higher jump. These statements lead to the conclusion that the spike jump technique is individual among female volleyball players, due to the fact that the spike jump is more challenging than other jumps used in the volleyball game (Kristicevic *et al*., 2016).

A limitation of this study is the lack of results for explosive power, in order to accurately determine the results obtained in the spike jump.

CONCLUSION

Morphological characteristics have a vital role in determining the success of athletes, and especially for the realization of motor assignments, which confirms research that morphological characteristics in specific motor capabilities participate with 42 % of variability, so that bigger players have greater strength and better precision of kick balls. Based on all of the above, the role of a trainer is to pay attention to these characteristics when creating a team, because it is necessary to adjust the configuration of his team and the style of play to his players who do not have adequate physical attributes of the conventional positions in the team, which are compensated by superior knowledge, skill and motivation.

JOKSIMOVIC, M.; GORANOVIC, K.; PETKOVIC, J.; BADAU, D. & HANTANU, C. G. Características morfológicas de jugadoras de voleibol de élite menores de 19 años. *Int. J. Morphol., 41(4)*:1203-1208, 2023.

RESUMEN: El objetivo del artículo fue determinar las diferencias en las características morfológicas y habilidades de salto entre las jugadoras de voleibol que juegan en diferentes selecciones nacionales. La muestra consta de 48 jugadoras de voleibol de élite de cuatro equipos nacionales diferentes que participaron en las clasificaciones del campeonato europeo. Las variables estudiadas fueron: altura corporal, masa, índice de masa corporal, alcance de pie y alcance de remate. Los resultados muestran diferencias en el índice de masa corporal, el alcance de pie y el alcance de punta. Estas diferencias están relacionadas con las necesidades de los distintos cargos en cuanto a las acciones que ejecutan. En conclusión, los parámetros morfológicos son componentes importantes del rendimiento en muchos deportes (voleibol). Las diferentes disciplinas deportivas requieren diferentes parámetros corporales y estructuras corporales para un rendimiento máximo.

PALABRAS CLAVE: Morfología; Jugadoras de élite; Éxito en el juego; Salto vertical.

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