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Anthropometric Profile of FIVB Volleyball Girls' U18 World Championship Volleyball Players According to the Playing Position- World Championship 2017

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Abstract

Identifying the anthropometric characters of adolescent elite players may be useful in developing the recognition of volleyball talents and key physical abilities needed to perform at a high level. The purpose of this study was to describe anthropometric characteristics, including height, weight, body mass index (BMI), spike height, and block height in elite volleyball youth players participating in the 2017 FIVB Volleyball Girls' U18 World Championship. Also, comparisons of these parameters were evaluated based on individual game position (libero, setter, middle blocker, outside hitter, opposite), team continent, and team rank. The variables studied in this study were extracted from the list of players registered on the website of the International Volleyball Federation (FIVB) and included 240 players of 20 teams. The results of one-way ANOVA showed that players in the G1 group (rank 1 to 4) had higher height, weight, spike height, and block height than other groups (rank 5 to 20). Also, the middle blockers had the tallest height (185.9 cm), weight (71.4 kg), spike height (294.5 cm) and block height (282.7 cm). This study presents anthropometric data that show different levels of success for elite girls' volleyball players in the 2017 championship. This information should serve as a reference for average body height, weight, BMI, spike height, and block height for identifying athletic talents for various positions in volleyball.

Keywords: Volleyball, Elite, Championship, Position, Talent Identification.

INTRODUCTION

Having a sufficient understanding of different sport sciences is necessary to get success. However, applying these sciences without determining the basic needs may limit the application of these sciences. Regarding this fact, coaches should gain the ability to select talented athletes for each sport. Moreover, they should have proper knowledge of sports science and the role of each factor in success. These factors are recognized by most experts as very important factors to get success in sports. It should be noted that ignoring some of these factors, and primary and determinant needs – known as talent identification - reduce the probability of success in sport, although it does not eliminate it [1].

Volleyball is recognized as an enjoyable and exciting sport with a great number of fans around the world. Due to the nature of this sport and the environment of the game, volleyball players have some special physical characteristics that play an important role in reaching the peak of athletic performance and becoming successful in different competitions [2]. On that account, determining these characteristics, especially in basic and elite players may help coaches to identify the right role for each player according to their right talent, in addition to planning the right training programs to achieve the desired goals in sports. On the other hand, players can understand the characteristics of their sport and exercise with more motivation. Anthropometric, as well as, physical and physiological factors are the most important indicators in identifying elite athlete and achieving success in a specific sport [3-7].

Assessment of morphological and physiological features is a routine task of coaches and the teams' evaluation [8]. Important characteristics of volleyball players include tall height, having the maximum reaching height while spiking and defending, two-handed long range, and high length of Achilles tendon, high length of lower limbs and Soleus muscle [9]. Research has shown that there is a significant difference between elite volleyball players in different positions in terms of height, body composition, strength and

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power of lower limb muscles [2]. It has also been indicated that volleyball teams with optimal body characteristics are more likely to win the matches [10].

Moreover, due to the nature of the volleyball which needs high speed and explosive movements, especially in world competitions (an average of 11 seconds per rally), as well as the duration of a full game (about 90 minutes), players need to have a good capacity in different energy systems, especially anaerobic [11, 12]. Aouadi et al. (2012) evaluated the relationship between anthropometric measurements and vertical jump in elite male volleyball players [13]. Their results showed that anaerobic power was significantly higher in tall players compared to short players. Sattler et al (2012) showed that there is a positive correlation between anthropometric characteristics and vertical jump as one of the most important functional movements in a volleyball game [14]. Salimi Avansar et al (2010) showed that there is a positive relationship between the height of the player and the maximum jump while spiking and defending in world competitions [15].

On the other hand, Marques et al. (2009) indicated that volleyball coaches shall use different players with different physical structure characteristics in different positions to get the best results. They showed that the middle blocker and opposite had higher height and weight, while liberos had the lowest weight [2].

Although the popularity of volleyball is growing and the coaches and players are becoming more professional, there is little information on the performance and physiological characteristics of elite volleyball players [16]. This issue is due to two main reasons including first, a major number of coaches have a traditional and unscientific perspective toward planning for talent identification in volleyball and training them. Second, gathering information about elite athletes, especially in team sports is a challenging issue [17].

Since it is important to identify the physiological and physical characteristics of juvenile players to determine their talents for finding the best position for them, and body structure and physiological characteristics are widely used to select new juvenile players, understanding these factors in different positions and introducing them to coaches can provide the information needed for them to choose different positions and plan training programs.

Therefore, the main purpose of this study was to describe the anthropometric profile of elite female volleyball players who have participated in the 2017 FIVB Volleyball Girls' U18 World Championship from 4 different continents and compare these characteristics according to the game position (libero, setter, middle blocker, outside hitter, opposite), team continent, and team rank.

MATERIAL AND METHODS

The anthropometric characteristics of the volleyball players who participated in the 2017 FIVB Volleyball Girls' U18 World Championship were analyzed. All variables including height, weight, spike height, and block height were obtained from the International Volleyball Federation website [18] for all teams and players who were registered for the tournament. This comprised a total of 20 teams including 240 players. They categorized according to their playing position (5 positions), rank (20 ranks), rank category (5 rank groups), country (20 countries) and continent (3 continents). Body mass index (BMI) were calculated as height (cm)/weight^2 (kg).

Statistical analysis

All values are presented as mean±SD. The Kolmogorov-Smirnov test was used to verify the normality of the distribution. Also, differences in height, weight, BMI, spike height and block height between groups (G1–G5), playing positions and continents were analyzed using one-way analysis of variance (ANOVA). When a significant difference was revealed, the Bonferroni post hoc test was used to pairwise comparing. Playing position-adjusted partial correlation coefficients were calculated to investigate the association between team rank and anthropometric characteristics. The level of significance was set at p≤0.05. All data were analyzed by the SPSS software version 20.

RESULTS

The anthropometric characteristics of girl's athletes of U-18 years old in 2017 world championships are presented in Table 1 according to their rank. The team of the United States (rank 8) had the highest average height (187.8±5.1 cm) and average spike height (314.0±7.9 cm); Italy, the champion, had the highest block height (297.4±7.4 cm).

The results from one-way analysis of variance demonstrated that there was a significant difference in the values of height, weight, spike height and block height among the groups (Table 2). Players in G1 had the highest average of height, weight, spike height, and block height.

The anthropometric characteristics of the players according to their position are presented in Table 3. The results for the ANOVA demonstrated that there was a significant difference in the values of height, weight, and the height of spike and block. The middle blocker players had the most height, weight, weight, BMI, and spike and block height (Table 3).

By subtracting the height of the spike and block from the height of the players, insignificant difference was shown between positions.

For further analysis of data, the teams were divided into 4 groups based on geographical location (Table 4). The European players had the highest height, the spike height, and South American players had the highest block height.

Furthermore, position-adjusted partial correlations showed that there were a negative relationship between the rank of the team and the height (r=-0.23, P=0.000), weight (r=-0.18, P=0.005), BMI (r=-0.007, P=0.91), spike height (r=-0.32, P=0.000) and block height (r=-0.27, P=0.000) of the players.

Table 1: Anthropometric characteristics (mean±SD) of the 2017 FIVB Volleyball Girls' U18 World Championships grouped according to their ranks

Rank	Team	n	Height (cm)	Weight (Kg)	BMI (Kg/m²)	Spike Height (cm)	Block Height (cm)
1	Italy	12	183.7±6.7	72.2±7.7	21.4±1.8	310.4±14.9	297.4±7.4
2	Dominican Republic	12	183.4±7.1	70.7±8.6	21.0±1.9	282.8±8.10	267.8±13.3
3	Russia	12	185.8±5.9	68.8±9.0	19.9±2.3	301.9±6.00	293.2±5.9
4	Turkey	12	183.8±6.0	69.1±4.8	20.5±1.6	293.7±13.7	289.0±9.3
5	Japan	12	173.3±7.7	61.8±7.9	20.5±1.7	289.0±13.0	276.7±11.8
6	Germany	12	184.6±7.5	69.2±7.5	20.2±1.1	297.3±9.26	287.5±7.4

Rank	Team	n	Height (cm)	Weight (Kg)	BMI (Kg/m²)	Spike Height (cm)	Block Height (cm)
7	Argentina	12	179.9±8.2	66.2±7.4	20.4±1.7	286.3±4.97	269.7±3.0
8	USA	12	187.8±5.1	71.7±6.1	20.3±1.4	314.0±7.86	296.8±7.6
9	Belarus	12	179.4±9.5	67.1±12.7	20.7±2.3	281.8±13.9	244.3±8.2
10	Brazil	12	185.5±6.0	70.7±6.3	20.5±1.3	293.6±9.51	284.3±8.2
11	South Korea	12	176.8±7.1	65.6±7.3	21.0±1.7	269.0±12.7	260.9±12.6
12	Peru	12	178.8±6.6	64.8±5.5	20.3±1.6	284.9±12.4	288.9±7.0
13	Serbia	12	181.3±6.5	66.3±5.9	20.2±1.2	289.8±11.0	279.7±12.0
14	Colombia	12	178.2±8.0	63.1±8.3	19.9±2.0	288.6±14.3	277.9±13.0
15	Slovenia	12	180.6±5.2	63.2±5.6	19.3±1.0	288.1±7.00	264.7±5.3
16	Poland	12	180.7±7.2	68.2±7.1	20.9±1.6	296.8±7.13	282.4±7.8
17	china	12	186.3±4.0	67.9±3.9	19.6±1.3	303.1±13.8	294.8±12.2
18	Cuba	12	181.0±6.5	69.7±6.2	21.3±2.3	263.7±38.2	258.3±35.1
19	Mexico	12	177.1±3.9	65.0±8.5	20.7±2.4	269.4±15.8	257.7±17.0
20	Thailand	12	171.1±6.0	63.4±7.6	21.6±1.7	283.3±12.0	271.33±10.3
Total		240	181.0±7.7	67.2±7.7	20.5±1.8	289.4±18.3	277.2±18.9

Table 2: Anthropometric characteristics of the 2017 FIVB Volleyball Girls' U18 World Championship categorized into six groups

Group	n	Height (cm)	Weight (kg)	BMI (kg/m²)	Spike height	Block height
G1	48	184.2±6.3	70.2±7.6	20.7±1.9	297.2±15.0	286.9±14.7
G2	48	181.4±8.9	67.2±8.0	20.4±1.5	296.6±14.1	282.6±13.5
G3	48	180.1±7.9	67.0±8.5	20.6±1.7	282.3±14.8‡	269.6±20.4*‡
G4	48	180.2±6.7	65.2±6.9*	20.1±1.6	290.8±10.6	276.2±11.9*
G5	48	178.9±7.6*	66.5±7.0	20.8±2.1	279.9±26.7*‡#	270.5±25.4*‡
Total	240	181.0±7.7	67.2±7.7	20.5±1.8	289.4±18.3	277.2±18.9

G1: Rank 1 through 4; G2: Rank 5 through 8; G3: Rank 9 through 12; G4: Rank 13 through 16; G5: Rank 17 through 20. All values are expressed as mean±SD. *significantly different from G1; ‡significantly different from G2; #significantly different from G4;

Table 3: Anthropometric characteristics of the 2017 FIVB Volleyball Girls' U18 World Championship according to their positions

Position	n	Height (cm)	Weight (kg)	BMI (kg/m²)	Spike height (cm)	Block height (cm)	Block height- Height	Spike height- Height
Setter	42	177.7±6.5	65.0±6.5	20.6±1.6	283.9±17.1	272.5±18.5	94.8±15.5	106.3±13.9
Libero	22	170.0±6.6*	59.7±6.7*	20.7±1.9	275.3±20.8	265.5±21.6	95.5±18.8	105.3±18.4
Middle Blocker	63	185.9±5.5*‡	71.4±7.5*‡	20.7±1.9	294.5±17.0*‡	282.7±17.9‡	96.8±17.0	108.6±15.9
Wing Spiker	77	180.8±6.8‡#	66.6±6.3‡#	20.4±1.7	291.0±17.2‡	277.9±17.8	97.1±16.0	110.3±14.8
Opposite Spiker	34	183.9±5.7*‡	68.76±8.4‡	20.3±2.0	291.7±19.0‡	278.4±18.9	94.5±16.6	107.8±16.2
Total	238	180.96±7.7	67.2±7.7	20.5±1.8	289.3±18.4	277.1±18.9	96.1±16.4	108.3±15.5

All values are expressed as mean±SD. *significantly different from setter; ‡significantly different from libero; #significantly different from middle blocker.

Table 4: Anthropometric characteristics of the 2017 FIVB Volleyball Girls' U18 World Championship grouped according to their continents

Continent	n	Height (cm)	Weight (kg)	BMI (kg/m²)	Spike height	Block height
Europe	96	182.5±7.0	68.0±8.0	20.4±1.7	295.0±13.3*	279.8±18.2
Asia	48	176.9±8.5*	64.7±7.0	20.7±1.7	286.1±17.5	275.9±16.8
South America	48	180.6±7.6	66.2±7.3	20.3±1.7	288.4±11.0	280.2±11.0
North America	48	182.3±6.8‡	69.3±7.7‡	20.8±2.0	282.5±28.6*	270.1±25.9*
Total	240	181.0±7.7	67.2±7.7	20.5±1.8	289.4±18.4	277.2±18.9

All values are expressed as mean±SD. *significantly different from Europe. ‡Significantly different from Asia.

DISCUSSION

Success in sports is determined by many factors and assessing some anthropometric factors is not enough. Knowing the position-specific morphology in sports helps us to select the right player for the right position and sport [19, 20]. In this case, in volleyball, these factors may be determinants of team success because they play a key role in the main skills including jumping, spike, and block which are needed for success [19].

A volleyball team with optimal anthropometric characteristics is most likely to win the games [10]. Recent research on elite male players

indicated a tendency of tallness by success, as well as, there was a significant difference in the height and weight of players in different positions [2]. In this regard, we also, found that liberos have shorter height and lower weight, as well as less spike and block height compared to other players. These results are consistent with the results of Sattler *et al.* (2012), Duncan *et al.* (2006), Marques *et al.* (2009), and, Shavandi and Saremi (2012) [21]. The shorter height of liberos, as well as their lower weight, compared with players of other positions, is consistent with the nature of their position in the game and, these are the reasons that libero position is added to volleyball game [22]. Shorter height brings a lower gravity center that is a necessary factor for the success of libero, thus, it is an important factor for rapid movement with more balance [9]. On the other hand, regarding the fact that players in the front row need quick side movements to perform defensive acts, it is clear that the middle blockers must be taller and heavier. This advantage is important for conducting the right techniques and physical training of middle blockers. This is particularly important for the training of decision-making for identifying offensive moves to be effective. Our results showed that middle blockers are taller players. Also, international-level and elite setters are tall players. This property makes them able to set better, also, to have a better defence performance [23]. Our results showed that the average height of the elite girl's setter volleyball players was high, so this factor should be taken into notice in selecting setters.

By categorizing the teams into five groups based on their results, we found that teams in the ranks first to fourth place had higher average height compared with other teams.

There was no significant difference in BMI between players according to their position which is consistent with Sattler *et al.* (2012) and Trajkovic *et al.* (2011). Trajkovic *et al.* (2011) reported that the BMI values for all positions were in the range of 20.1 to 22.21 kg/m², and our results showed that the BMI was in a range of 14.5 (for player number 11 of Russia) to 24.6 kg/m² (for player number 1 of Italy) [24]. Moreover, the average BMI for all positions was between 20.3 and 20.7 kg/m². This indicates that BMI can be considered as one of the best indicators for selecting teenagers at the national level.

One of the most important indices of physical fitness in volleyball which has been studied by researchers is the height of spike and block [15, 25] because the success of the team is depended on the passing or blocking the ball over the net. In modern volleyball, the focus of the competition is dominance over the net. The best method to get dominance is using players with a higher vertical jump, as well as using those who have taller height and wider hands [15, 26]. These indicators are increasing in top-ranking teams of the world so that at the 2009 Junior Boys' World Cup, the average height of the spike and block were 328.0±7.9 cm and 314.5±11.1 cm, respectively; and in 2011, these values were increased to 330.8±10.2 cm for spike height and 317.0±12.3 cm for the block height [15]. The results of the present study indicated that to reach the top rank places (first to fourth) in the World Junior Championships, the teams should reach up high above the net as possible during spiking and blocking.

Players perform intense activities while spiking and/or blocking. It has been reported that elite male players perform 250 to 300 intense explosive movements during 5 sets of the game [27]. The results showed that middle blockers, wing spikers, and opposite spikers have the highest spike height [28]. The results from Sheppard *et al.* (2009) [29] also indicated that middle blockers need to do more jumps during defencing in comparison to wing spikers and setters. Also, the highest rate of spike height observed in the middle blockers. These results showed that reaching the highest values for spike height, block height and landing are more necessary for middle blockers than players in other positions. In volleyball, good defence skills are necessary to get success in the game. During the defensive performance, vertical jump

and the more extended arms, in addition to the right time for defencing are important factors. In the present study, middle blockers, opposite spikers, and wing spikers had the most height of blocking, which seems reasonable according to the technical and tactical requirements of these positions. Also, the significantly lower block height of liberos in comparison to other players is interpretable due to the physical characteristics of the liberos, not participating in the defence on the net and lesser jumping.

When the players were divided according to their continent, the results showed that European players were taller and had a higher spike height compared to players of other continents, which, it was significant in comparison to Asian players; North American players had a significantly lower spike and block height compared to the Europeans.

For further analysis, a position-adjusted partial correlation was performed which showed that there was a negative correlation between the rank of the team and height, weight, BMI, spike height and block height. Therefore, it can be stated that the height of the players, the spike height and the block height have the most effect on the team's rank in the world championships, and this should be considered in talent Identification programs, as well as, training programs of the teams.

CONCLUSION

The study revealed that young elite female volleyball players in different positions have different anthropometric characteristics. Height is a factor that has some variability according to the player's position. Practically, these findings suggest that sports professionals and coaches conducting talent identification and selection need to focus more on anthropometric characteristics, body composition, and explosive power of lower limb of the players and individualize training depending on these needs.

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