Anthropometric and Jumping Profiles of U19 Boys' Volleyball Players in the World Championship 2019

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ABSTRACT

Background: The identification of anthropometric and jumping characteristics is crucial for the selection, guidance, and training of talents in volleyball. This study aimed to determine the profiles of anthropometric characteristics and jumping ability of boys' volleyball players who participated in the 2019 U19 World Championships from five different continents and compare these characteristics based on their technical position (blocker, spiker, opposite, setter, libero), continents, and team standings.

Methods and Materials: An analysis was conducted on the anthropometric characteristics of volleyball players who participated in the Fédération Internationale de Volleyball (FIVB) U-19 World Championship for Boys 2019. Data, including spike height, height, weight, and block height, were obtained from the FIVB website for all teams and players who participated in the championship. The 348 players among 20 teams were divided into categories based on their playing position (five ranks), rank (20 ranks), class rank (five ranks), nation (20 countries), and class (five continents). Body mass index (BMI) was calculated using height (cm) and weight (kg).

Results: This study presents data on the physical characteristics and jumping ability of boys' volleyball players at different levels in the 2019 championship according to their final ranking and technical playing positions. The information can be used as an index of average weight, height, BMI, spike height, and block height to select talents and improve the selection and training process for various technical playing positions in volleyball.

Conclusion: Our findings revealed a statistically significant correlation between height, weight, spike, and block of first-place teams. Boys' volleyball players under the age of 19 at different locations had different anthropometric and jumping characteristics, with height being a factor that differs depending on the player's location. Based on our findings, we conclude that jumping ability is essential in volleyball.

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INTRODUCTION

Volleyball has several performance characteristics different from other sports, which has increased its global popularity, and the sport has expanded significantly to compete for four Olympic medals. Therefore, before beginning with theory, strategies, and educational methods, it is important to understand the nature of volleyball, as it helps us improve teaching principles and methods and train fundamental skills.

The International Volleyball Federation holds world championship competitions for young people and seniors of both sexes every two years to help develop the rising popularity among young people, helping to fuel its growth (Ebrahim et al., 2005). Due to the nature of volleyball, volleyball players enjoy some of the human and physical characteristics that play an important role in reaching the peak of effective sporting performance in various competitions (Kioumourtzoglou et al., 2000).

Volleyball is a highly technical and physically demanding sport with many distinct features. To better react to the methods and tactics of winning play (Reeser, 2003).Among the important indicators in the selection of elite athletes are material and physiological factors. So understanding these factors for young athletes is important in identifying sports talents. Accordingly, studying these factors helps coaches to determine the appropriate role for each player according to his talent, especially among elite players, in addition to his good selection and planning for the appropriate training programs for him to achieve the desired goals in sport (Younis et al., 2020).

The specialization of the volleyball player, which is the player's technical position, is a specific and long-term process that depends on the characteristics and capabilities of the player, and during this process, it is important to distinguish between training and non-training training qualities for the player, so coaches must give the player a role on the field that increases the effectiveness of performance Team (Pocek et al., 2021). To evaluate the performance of the players, coaches must monitor some of the physiological and morphological characteristics to reach for a good performance (Reeser, 2003).

Studies of anthropometric measurements have been published, which determine jumping ability, body shape, height and other physical and physiological characteristics of elite volleyball athletes (Gualdi-Russo et al., 2001). One of the factors of superiority is "the height above the net". One of the effectiveness factors is the player's ability to "height above the net". Relatively long arms add to the height at which a player can compete above the net and therefore reach importance. Long arms also give players a mechanical advantage in spiking due to longer lever lengths (Qian et al.,2009&Volleyball Australia,2018). Research has shown that there is a difference in significance between elite volleyball players in different technical situations in terms of height, body formation, strength and strength of the lower limbs (Marques et al. 2009).

Volleyball is characterized by repeated short performances of high-intensity exercises, followed by periods of low-intensity exercises and short periods of rest. The total duration of the match (approximately 60-90 minutes) indicates that volleyball players require an anaerobic energy system (ATP-CP) and lactic anaerobic (anaerobic glycolysis), as well as an appropriately developed aerobic capacity(Sheppard et al., 2009). Jumping is an essential ability in volleyball, especially for net players (forwards and blocks) (Turner, 2018).

The relationship between anthropometrics and vertical jumping was evaluated in elite male volleyball players and found that players with longer lower limbs had better vertical jump performance and higher anaerobic power (Aouadi et al., 2012). The positive relationship between anthropometric characteristics and vertical jumping has been cited as one of the most important functional movements in volleyball. (Sattler et al., 2012). The positive relationship between the maximal jump during the slam and the athlete's height was confirmed (Salimi Avansar et al, 2010).

In volleyball, jumping activities and movement skills are complex, moving in every direction by diving, rolling, running, shuffling, lateral stepping, cross-stepping, and other combinations of movement. The coach works with his players so that these skills become second nature for them, in addition to the jumping skills to hit and block the ball (FIVB, 2011).

Depending on the technical position, the jumping activity can include a maximum of 100 to 150 jumps of effort per match, while the batter will often perform an additional 20 jumps per combination (about 60-100 per match), generally at less than the maximum intensity, in the process of preparing the ball for a striker on their team, a skill called team jumping (Sheppard et al., 2009). Muscular strength is an important contributor to most athletic activities. Therefore, good planning and execution of resistance training can alter the neuromuscular system to improve the athlete's ability to produce force and improve athletic performance (Bompa, 2019).

Therefore, the purpose of this study is to determine the anthropometric profiles and jumping ability of the boys' volleyball players who participated in the 2019 U19 World Championships from five different continents and to compare these characteristics based on their technical position (blocker, spiker, opposite, setter, libero), their continents and the team's standings.

MATERIALS AND METHODS

An analysis was conducted on the anthropometric characteristics and jumping ability of volleyball players who participated in the FIVB U-19 World Championship 2019. Data, including spike height, height, weight, and block height, were obtained from the FIVB website (FIVB,2019) for all teams and players who participated in the tournament. A total of 348 players from 20 teams were included in the study, and they were categorized based on their playing position (five positions), rank (20 ranks), class rank (five ranks), nation (20 countries), and class (five continents). BMI (kg/m^2) was calculated using height (cm) and weight (kg).

The statistical analysis was performed using the SPSS software package (version 20.0). Descriptive statistics were presented as mean ± standard deviation. Variations in weight, height, BMI, block height, and spike height were examined between groups (G1-G5), technical playing positions, and continents. The LSD test was used to determine the significance of differences when a significant difference was found. Correlation coefficients were generated to analyze the relationship between team rank, anthropometric characteristics, and technical position.

RESULTS

Table 2 displays the results of a one-way analysis of variance, which showed a significant difference in weight, height, block height, and spike height values between the groups. Players in group G1 had the highest average height, weight, block height, and spike height, while there was no significant difference in BMI values.

Anthropometric traits of players according to their position are presented in Table 3. ANOVA findings showed that the values for height, weight, spike height, and block height varied significantly. Blockers had the highest averages for height, weight, spike height, and block height. There were significant differences in height, weight, spike height, block height, and BMI according to playing technical positions.

Table 4 displays the anthropometric characteristics of players by continent. European players had the highest height and spike height, while South American players had the highest BMI. Norseca players had the highest block height.

Moreover, technical position correlations showed a negative relationship between team rank and the height (r=-0.226, P=0.000), spike height (r=-0.235, P=0.000), and block height (r=-0.190, P=0.000) of the players.

Table 1: The demographic characteristics of participants for all teams (Mean ± SD) of the 2019 FIVB Volleyball Boys U19 World Championships grouped according to their ranks.

Team	n	Weight (Kg)	Height (cm)	BMI (Kg/m2)	Spike Height (cm)	Block Height (cm)
Italy	12	84.8 ± 9.8	195.1 ± 8.3	22.3 ± 1.8	344.4 ± 12.2	324.4 ± 16.3
Russia	20	89.3 ± 4.8	201.4 ± 5.5	22 ± 0.7	336 ± 8.2	323 ± 8.6
Argentina	20	81.4 ± 10.5	189.5 ± 6.1	22.7 ± 2.7	335.3 ± 8.4	304.3 ± 72.1
Egypt	20	83.4 ± 12.5	190.2 ± 8.8	23 ± 2.4	312.5 ± 15.8	299.4 ± 15.1
Iran	20	82.4 ± 8.2	197.3 ± 9	21.2 ± 1.8	339.1 ± 17.5	318.6 ± 16.8
Japan	18	75.6 ± 10.5	186.6 ± 7.4	21.6 ± 2	322.7 ± 10.6	308.9 ± 12.1
Bulgaria	20	75.6 ± 8	194.1 ± 10	20.1 ± 1.6	323.5 ± 15.9	312.6 ± 15.3
Belarus	16	77.7 ± 6.3	195.1 ± 6.7	20.4 ± 1.3	327.9 ± 18.6	307.8 ± 18.5
Brazil	16	87.8 ± 10.1	194.8 ± 9.2	23.1 ± 2.3	335.7 ± 16.5	316.1 ± 22.8
Czech Republic	13	81.2 ± 5	195.5 ± 5.9	21.2 ± 1	337.9 ± 8.5	323.8 ± 8.1
Korea	20	77.9 ± 8.3	189.8 ± 7.9	21.6 ± 1.8	305.3 ± 15.2	295.4 ± 15.8
Cuba	13	78.1 ± 7.2	196 ± 4.5	20.3 ± 1.5	342.8 ± 6.9	336.8 ± 8.7
Germany	20	83.1 ± 6.9	194 ± 5.8	22 ± 1.1	315.1 ± 7.5	305.3 ± 8
Nigeria	19	73.4 ± 8	189.9 ± 7.7	20.4 ± 2.4	312.5 ± 31.3	292.5 ± 33.2
U.S.A.	20	95.5 ± 58.5	196.6 ± 10.7	24.6 ± 14.2	340 ± 12.3	323.1 ± 11.8
Chinese taipei	12	75.8 ± 9.3	186.5 ± 7	21.8 ± 2.3	305.5 ± 16.3	293.9 ± 17.4
Tunisia	20	79.2 ± 7.8	191 ± 6.2	21.8 ± 2.5	319.7 ± 12.6	302.6 ± 13.7
Mexico	12	79.8 ± 6.2	190.5 ± 6.9	22 ± 1.8	318.3 ± 11.6	314.4 ± 9.7
Dominican Republic	18	70.4 ± 8.5	181.7 ± 12.4	21.6 ± 5	243.1 ± 35.4	237 ± 34.4
Colombia	19	76 ± 5.3	191.7 ± 6.7	20.7 ± 1.6	312.2 ± 76.8	297.4 ± 73.1
total	348	80.5 ± 16.9	192.4 ± 8.9	21.7 ± 4.1	320.9 ± 32.1	306 ± 34.9

Table2: The demographic characteristics of participants for all teams (Mean ± SD) of the 2019 FIVB Volleyball Boys U19 World Championships categorized into five groups.

Group Rank	n	Weight (Kg)	Height (cm)	BMI (Kg/m2)	Spike Height (cm)	Block Height (cm)
G1	72	84.7 ± 10.1	193.9 ± 8.6	22.5 ± 2	330.7 ± 16.3	311.5 ± 40.4
G2	74	77.9 ± 8.7	193.3 ± 9.2	20.8 ± 1.8	328.5 ± 17	312.3 ± 16
G3	62	81.2 ± 8.8	193.6 ± 7.6	21.7 ± 2	327.8 ± 20.4	315.4 ± 21.9
G4	71	82.7 ± 32.4	192.4 ± 8.7	22.3 ± 7.7	319.8 ± 22.8	304.9 ± 23.3
G5	69	76.1 ± 7.9	188.7 ± 9.3	21.5 ± 3.1	297.4 ± 54.8	286.1 ± 51.7
total	348	80.5 ± 16.9	192.4 ± 8.9	21.7 ± 4.1	320.9 ± 32.1	306 ± 34.9

G1: Ranks 1 through 4; G2: Ranks 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: The demographic characteristics of participants for all teams (Mean ± SD) of the 2019 FIVB Volleyball Boys U19 World Championships according to their positions.

Team	n	Weight (Kg)	Height (cm)	Spike Height (cm)	Block Height (cm)	BMI (Kg/m2)
setter	63	77.2 ± 8.6	189 ± 6.9	316.7 ± 24.9	303.8 ± 23.5	21.7 ± 1.9
spike	112	82.6 ± 26.8	192.6 ± 7.8	326.3 ± 21	312.6 ± 19.4	22.1 ± 6.5
block	88	83.8 ± 8.7	198.5 ± 6.4	328.8 ± 26.9	315.1 ± 24.8	21.2 ± 2.1
opposite	47	83.7 ± 9.3	195.6 ± 7.1	318.6 ± 57.2	298.4 ± 70.3	21.8 ± 2.2
libero	39	71.8 ± 6.9	180.3 ± 7.8	300.6 ± 28.9	285.6 ± 29.1	22 ± 1.5
Total	349	80.9 ± 17.2	192.5 ± 9	321.4 ± 32.2	306.8 ± 34.8	21.7 ± 4.1

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

Table 4: The demographic characteristics of participants for all teams (Mean ± SD) of the 2019 FIVB Volleyball Boys U19 World Championships according to their continents

Team	N	Weight (Kg)	Height (cm)	Spike Height (cm)	Block Height (cm)	BMI (Kg/m2)
Europe	101	81.9 ± 8.2	196 ± 7.6	329.3 ± 15.6	315.3 ± 14.9	21.3 ± 1.5
Africa	59	78.7 ± 10.4	190.4 ± 7.5	314.9 ± 21.2	298.3 ± 22.3	21.7 ± 2.6
Asia	70	78.2 ± 9.3	190.5 ± 9	319.4 ± 20.6	305.2 ± 18.3	21.5 ± 1.9
South America	55	81.4 ± 9.9	191.8 ± 7.5	327.4 ± 46.8	305.3 ± 61.7	22.1 ± 2.4
Norsica Federation	63	81.7 ± 34.4	191 ± 11.4	308.7 ± 47.4	299.7 ± 45.2	22.4 ± 8.5
total	348	80.5 ± 16.9	192.4 ± 8.9	320.9 ± 32.1	306 ± 34.9	21.7 ± 4.1

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

DISCUSSION

Body composition measurement is an essential tool for tracking the health and performance of athletes. Since various factors can influence an individual's body composition, it is critical to evaluate this information in the context of the athlete. Although body composition is not the only factor in athletic performance, it is a critical component of health and performance (Millán-Sánchez et al., 2019).

Anthropometric factors are among the success factors in sports performance, and evaluating them can help in selecting the right player for the appropriate position in a sport (Duncan et al., 2006, Gualdi-Russo et al., 2001).These factors may indicate a tendency to height through success, as there was a significant difference in the weight and height of players in different technical positions (Marques et al., 2009). In volleyball, success requires the ability to play over the net, making height an important requirement for performing and competing over the net. This is particularly true for all positions except for the libero player, and the exact height will depend on the technical position they play and other characteristics, including technical, physiological, and anthropometric factors that the athlete possesses (Volleyball Australia, 2018).

According to the results, the libero is shorter in height and weighs less than other players. This is consistent with the findings of (Sattler et al., 2012, Chavandi and Sarmi, 2012, Marquis et al.,2009, Duncan et al.,2006, Shavandi et al., 2012). The shorter height and lower weight of libero players correspond to the nature of their technical position's performance in the game, which depends on the execution of defensive skills (reception and defense). To improve the defense process, the libero position was introduced into the volleyball game (Miller B, 2005).

Measuring and evaluating anthropometric factors can help select the right player for the appropriate position in a sport, particularly in volleyball. While height is critical for most positions, it is not as crucial for the libero position, which relies more on defensive skills. One of the factors for the success of the libero in his technical performance is his low center of gravity, which is an important factor for fast movement with more balance (Tokuyama et al., 2005)

The libero is a technical position that emphasizes defensive skills, with shorter players having some advantages in movement and speed. However, the technical capabilities of the receiver and defense are of paramount importance (Volleyball Australia, 2018). These results are consistent with the analysis of the libero's technical performance, as his performance depends on defensive skills in the backcourt only, by performing through diving, rolling, running, shuffling, side step, cross step, and other movement groups, where he is required to move in and out of positions for performance (Turner, 2018, FIVB, 2011).

The results showed that middle blockers are typically taller players, as they are exposed to offensive formations that require blocking movement on both sides of the field. Height is an important element that enables them to climb above the net with the highest height to cover the largest area of the field, helping the team build the defensive formation behind the block (Millán-Sánchez el at., 2019). In addition, to blocking jumps in a net-middle position, the middle is often required to move quickly to the sides of the field to assist outsiders in their blocking (Turner, 2018).

According to the data, the opposite technical allocation takes second place after the height of the blocks, followed by the attackers and setters. The results of the current study indicated that the teams that achieved the first four places in the World Championship for boys under 19 years old have long and high jumps while hitting and blocking, consistent with modern volleyball, which considers identifying talents in jumping and speed as essential elements (Trajkovic, 2011). The ability to jump and height are key indicators that affect volleyball performance. The competition is based on height and performance on the net, making the best way to gain dominance through the use of players with higher vertical jumps, as well as certain physical measurements, including taller heights and wider hands (Shondell, 2002, Qian el at., 2009, Salimi Avansar, 2010).

The jumping indices of the top-ranked teams in the world are increasing, with average spike heights of 328.0 ± 7.9 cm and 314.5 ± 11.1 cm, respectively, at the 2009 Junior Boys World Cup. In 2011, these values increased to 330.8 ± 10.2 cm for spike height and 317.0 ± 12.3 cm for block height (Salimi Avansar, 2010)). For simplicity, a guide for heights in different positions is as follows: men's setters (185+), spikes (190+), blocks (200+), and opposites (195+) (Bompa el at, 2019).

It can be seen that the performance requirements for volleyball are primarily related to jumping, with the exception of the libero. Volleyball players are generally tall and must be fast as they move in every direction. Moving through diving, rolling, running, shuffling, skipping, stepping across, and other combinations of motion are the second natural moves volleyball

players rely on for high performance. Volleyball players are among the best vertical jumpers in the world (Turner, 2018, FIVB, 2011).

CONCLUSION

The study revealed that boys' volleyball players under the age of 19 in different technical positions had varying anthropometric advantages, with overall height being a factor that varied depending on the player's position. In practice, the ability to jump is a key competency in volleyball, allowing players to perform over the net. These results suggest that the talent selection process is based more on anthropometric characteristics and players' jumping ability, as training is planned according to these needs.

Availability of data and materials

The data sets generated and analyzed during the current study are available on request due to privacy/ethical restrictions.

Declaration of interest statement

The authors declare that they have no competing interests.

Compliance with ethical standards

All procedures performed in study were in accordance with the ethical standards of the institutional and/or national research committee

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