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Comparison between vertical jumps of high performance athletes on the Brazilian men's beach volleyball team

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Aim. **The aim of this paper was to compare the anthropometric profile and the vertical jumps of two groups of Brazilian male high performance beach volleyball players.**
Methods. **The sample consisted of 38 male beach volleyball players from the Brazilian Beach Volleyball Circuit of 2006, allocated to two groups according to national ranking of their teams. Anthropometric measures and performance in vertical jumps were assessed using a specific methodology.**
Results. **The anthropometric results of the groups showed no statistically significant differences. The players of group 1 (G1) were better in the spike jump ($P<0.01$), block jump ($P<0.01$) and block difference ($P<0.01$) than the players of group 2 (G2). The prediction model of the spike jump for G2 included body mass and standing spike reach (adjusted R2=0.77) while for the block jump model it was body mass and standing block reach (adjusted R2=0.73). The regression models for G1 were not statistically significant.**
Conclusion. **It is likely that vertical jump height (spike and block) influences the performance of beach volleyball players, and consequently the performance of their teams, since the present study found higher values in G1 than in G2 for the spike jump, block jump and block difference. However, an athlete's success is not related only to the variables investigated in this study; technical skill, tactics, psychology and physical conditioning can also play a role.**

KEY WORDS: Anthropometry - Volleyball - Athletic performance.

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Beach volleyball is characterized by the intensive use of vertical jumps. In high level competitions, the aerobic and anaerobic demands on the neuromuscular system are considerable,[1] as a result of short fast runs, high intensity countermovements and the work involved in serving, spiking and blocking, where vertical jumps are widely used.[2] Previous research has sought to determine some of the characteristics of beach volleyball players.[3-7] Although beach volleyball has been included in the last three Olympic Games (Atlanta 1996, Sydney 2000 and Athens 2004), there are few published studies on the sport.

Beach volleyball matches are played on various types of sand, classified as compacted and uncompacted, each with its particularities. Sand has high absorptive qualities and ground reaction force is an important determinant in jump height,[8] which may explain the great difficulty the players have in jumping on uncompacted sand. The firm surface of compacted sand may produce higher jumps. It is likely that the type of sand influences the players' jumps, although Bishop [9] states that jumping ability is only a general quality and is not strongly influenced by the surface.

Several studies have approached the anthropometric and physiological characteristics of volleyball play-

TABLE I.—*Anthropometric characteristics and vertical spike and block jumps of players from the Brazilian Beach Volleyball Circuit of 2006 (mean±SD).*

Variable	Group G1 (N=10)	Group G2 (N=28)	t
Age (yrs)	31.0±4.5	27.9±4.3	1.9
Weight (kg)	91.3±5.6	87.6±6.4	1.6
Height (cm)	194.9±5.0	191.9±5.6	1.5
Standing spike reach (cm)	253.7±8.3	249.9±7.5	1.3
Standing block reach (cm)	248.6±8.4	244.9±7.4	1.4
Spike jump (cm)	334.4±7.9	326.3±10**	2.3
Block jump (cm)	317.9±7.7	308.4±9.1**	2.9
Spike difference (cm)	80.7±8.0	76.3±5.3	1.9
Block difference (cm)	69.3±7.8	63.6±4.8**	2.7

Significant difference from G1, *P<0.05; **P<0.01.

ers,[10-13] but so far little is known about high-performance beach volleyball players. The vertical-jumping ability in sand of Brazilian beach volleyball players is unknown, despite their high ranking in the International Volleyball Federation. The purpose of this paper is to compare the anthropometric profile of the vertical jumps of two groups of high performance Brazilian male beach volleyball players.

Materials and methods

Subjects

The sample comprised 38 male beach volleyball players from to the Brazilian Beach Volleyball Circuit of 2006. The players were grouped according to the ranking of their teams on the Brazilian Circuit in 2006. The first group (G1) was composed of 10 players from the top seven teams. This group represented the elite of Brazilian beach volleyball, since it contained two Olympic Champions, four World Champions, two World Champion runners-up, one under-21 World Champion and one Brazilian Champion. The second group (G2) consisted of 28 players from teams who were ranked between eighth and seventeenth on the circuit. The study was approved by the Ethics Committee of the Universidade Federal da Paraiba (Approval no. 426).

Anthropometry

Body height was measured with a stadiometer (Seca 220, UK) accurate to 0.1 cm and body mass was recorded using a portable scale (Seca Alpha 770, UK) accurate to 0.1 kg. To obtain standing spike reach (SSR), the individuals stood beside a wall, with their heels together and in contact with the floor, their non-spiking arm extended along the side of the body and the spiking arm and hand extended to make a mark with their fingers at the highest point they could reach. For easier identification of the marks, the subjects' fingers were covered with chalk powder. To obtain standing block reach (SBR), the individuals extended both arms and hands.

Measures of vertical jump height

An adaptation of Smith and colleagues' Block and Spike Jump Test were used.[1] A basketball backboard in the sand and a scale were used to measure height in centimetres.

The individuals were tested for two types of vertical jumps. The first was the spike jump, where players take a three-step approach and jump, touching the backboard with one of their hands at the highest point of the jump. The difference between spike jump and standing spike reach will be denominated spike difference. The second was the block jump, where from an erect position the individuals perform a countermovement jump, touching the backboard with their two hands extended at the highest point of the jump, thus reproducing the act of blocking. The difference between block jump and standing block reach will be denominated block difference.

The players performed three repetitions in the sand of each type of jump randomly; only the best result was recorded. The tests were completed barefoot. After the three repetitions, the sand was raked to maintain an equal level for all the participants. The subjects warmed up individually before the test and rested between jumps until they felt no residual fatigue. The surface consisted of dry uncompacted sand.

Statistical analysis

All values are reported as mean ± standard deviation (SD). Significant mean differences were calculated using an independent Student's t-test for independent samples with Bonferroni's adjustment. Two multiple regression analyses were used to determine the relative effect of the anthropometric variables on spike jump and block jump performance. The first was between the dependent variable spike jump and the independent variables body mass, body height and standing block

TABLE I.—*Correlation coefficients between anthropometric variables and spike jump and block jump in players from the Brazilian Volleyball Circuit of 2006.*

Group	Variable	Weight	Height	SSR	SBR	SJ	BJ	Spike difference	Block difference
1	Weight (kg)		0.85**	0.91**	0.86**	0.53	0.45	-0.42	-0.49
	Height (cm)			0.88**	0.79**	0.34	0.24	-0.57	-0.53
	Standing spike reach (cm)				0.97**	0.51	0.39	-0.53	-0.52
	Standing block reach (cm)					0.55	0.53	-0.39	-0.55
	Spike jump (cm)						0.95**	0.45	0.26
	Block jump (cm)							0.26	0.41
	Spike difference (cm)								0.93**
2	Weight (kg)		0.63**	0.52**	0.46*	0.65*	0.57**	0.50**	0.38*
	Height (cm)			0.89**	0.86**	0.81**	0.77**	0.29	0.14
	Standing spike reach (cm)				0.97**	0.86**	0.85**	0.24	0.14
	Standing block reach (cm)					0.85**	0.85**	0.25	0.08
	Spike jump (cm)						0.94**	0.70**	0.48**
	Block jump (cm)							0.59**	0.60**
	Spike difference (cm)								0.73**

Significant correlation coefficient, *P<0.05; **P<0.01. SJ: spike jump; BJ: block jump; SSR: standing spike reach; SBR: standing block reach.

reach. The Pearson's product-moment correlation coefficient was used to examine the relationship between selected variables. The level of statistical significance was set at $P<0.05$.

Results

The anthropometric characteristics of the players and the vertical jump measures of the groups are listed in Table I. G1 and G2 had statistically significant differences in the variables spike jump, block jump and block difference. Block difference was the variable that showed the greatest difference between the groups (~8%).

The correlation coefficient between the anthropometric variables and vertical jumps of G1 and G2 are shown in Table II. All the G1 anthropometric variables show significant correlations among themselves, but no significant correlations were found between any anthropometric variable (body mass, height, standing spike reach and standing block reach) and spike and block jump. All the anthropometric variables of the G2 players showed correlations among themselves. Moreover, the G2 anthropometric variables correlated with spike jump and block jump.

Multiple regression analysis was carried out for the dependent variables of spike jump and block jump, with anthropometric variables as independent variables. The significance level of the G1 regression models was not significant at a level of 5%; however, the significance level of the G2 regression models was significant ($P<0.05$) and is shown in Table III.

TABLE III.—*Multiple regression analysis of the G2 players from the Brazilian Volleyball Circuit of 2006.*

Parameters	Spike jump	Block jump
Variable(s) selected	Standing spike reach (cm) Body mass (kg)	Standing block reach (cm) Body mass (kg)
R^2	0.89	0.87
Adjusted R^2	0.77	0.73

Discussion

Anthropometry

The anthropometric results of Brazilian male high performance beach volleyball players (Table I) are similar to those of published studies on volleyball players. In Russian male players Viitasalo [13] found body height of 192.7±5.4 cm and body mass of 85.7±6.8 kg; in Italian players Gualdi-Russo and Zaccagni [12] found body height of 193.9±6.5 cm and body mass of 88.4±7.7 kg, and in Belgian players Forthomme *et al.* [14] found body height of 193.9±2.8 cm and body mass of 89.5±6.3 kg. Therefore, it is likely that there is a natural tendency for Brazilian male high performance beach volleyball players to have similar characteristics to those of volleyball players.

Anthropometry x vertical jumping

The relations between anthropometric variables (body mass, body height, standing spike reach and standing block reach) and vertical jumps (spike and block) of G2 showed a higher positive correlation than that found by Viitasalo [13] in volleyball. He found a positive correlation between block jump and body height (r=0.65) and with this he suggested that body height be an important criterion in athlete selection.

The first multiple regression analysis in G2 selected body mass and standing spike reach in the prediction model of spike jump, and this model explains 77% of the total variability (Table III). The second multiple regression analysis in G2 selected body mass and standing block reach for the prediction model of block jump, which explains 73% of the total variability (Table III).

With respect to G1, no significant correlations were found between the anthropometric variables and spike jump and between the anthropometric variables and the block jump. On the other hand, the regression models for G1 were also not significant. Spike jump and block jump performance is likely associated to other variables that were not investigated in this study and which caused G1 to have better results than those of G2 in spike jump and block jump height (Table I).

Spike jump and block jump

The significant differences found between G1 and G2 in the spike jump ($P<0.05$) and block jump ($P<0.05$) show that the G1 players have a slight advantage in their offensive (spike) and defensive (block) system when compared to G2 players. Furthermore, the spike jump may be an important criterion for offensive actions, given the positive correlation (r=0.51) between the height at ball impact and ball velocity,[14] which could demonstrate the likelihood that G1 players have a more powerful spike than that of G2 players. The result found for the G1 block jump was lower (~2.5%) than the G2 spike jump, which shows that there might be a slight equilibrium between the G2 spike and the G1 block.

One of the particularities that differentiates beach volleyball is the fact that the player is not required to spike at a great height in all offensive plays. This occurs because beach volleyball consists of only two players (blocker and defender) and the areas of responsibility become greater for the defenders, facilitating the execution of pokey or cut shots designed to fall close to the net or just over the blocker's hands. It is also likely that G1 players have technical and tactical skills that, when added to the spike jump, make it easier for them to attain their objectives more effectively.

Although these tests were performed on sand, which absorbs nearly 100% of impact energy,[15] the spike jump and block jump results are similar to those found in the literature for male volleyball athletes and performed on the ground.[1, 13, 14] It is likely that if the tests of the present study had been conducted on hard ground, the results would have been higher, since several studies have shown that the absorption and instability of sand results in a reduction of maximum force and of take-off velocity. This has resulted in significantly lower jump heights in beach volleyball players than those of players jumping on hard ground.[9, 16, 17]

Although some studies showed no significant correlations between spike jump and block jump,[1, 13] this study found significant positive correlations ($r>0.90$) in the two groups assessed. New studies are needed to determine if the correlations found are characteristic of beach volleyball players. A positive correlation (r=0.71) between spike jump and spike difference was found by Viitasalo;[13] in the present study this correlation was found in G2 and not in G1.

The number of steps may influence jumping action,[18, 19] and in beach volleyball the number of steps before the spike can vary according to the game situation. The statistical differences between G1 and G2 in block difference, along with the strong correlation found between the spike difference and block difference of G1 (Table II), may show that the G1 players have better technique in the countermovement jump.

Conclusions

In summary, the anthropometric characteristics of G1 and G2 showed no statistically significant differences, but they differed in some important beach volleyball characteristics. It is likely that vertical jump height (spike and block) influences the performance of beach volleyball players, and consequently that of their teams, since the present study found higher values in G1 than in G2 for the spike jump, block jump and block difference. However, an athlete's success is not related only to the variables investigated in this study, as technical skill, tactics, psychology and physical conditioning can also play a role.

No anthropometric variable in G1 was predictor of spike jump or of block jump, while in G2, standing spike reach and body mass were predictor of spike jump, and standing block reach and body mass were predictor of block jump. New studies are needed to identify the variables that can predict vertical jump performance in high-level beach volleyball players.

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