Correlation Between Body Composition and Power Performance in Beach Volleyball Athletes

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Abstract. Beach volleyball players need to have a good explosive power performance between the lower limbs and upper extremities as support in jumping and smash-hitting techniques. The purpose of this study was to analyze the correlation between body composition on explosive power of lower limbs and upper extremities in beach volleyball athletes. This research is correlational research with a descriptive correlation method. The samples used were beach volleyball athletes who underwent training camps ahead of the Indonesia National Games. A total of 8 athletes participated in this study. Body composition data that has been taken is the percentage of body fat, muscle mass, and body mass index while for power performance, it is vertical jump and seated medicine ball. The non-parametric test of data analysis through Spearman's rank correlation was used to analyze the relationship between variables. The results showed that there was a correlation between body fat and vertical jump ($p<0.05$). In addition, related results were also shown in muscle mass and arm power ($p<0.05$) and body mass index and arm power ($p<0.05$). This study shows that there is a significant relationship between body composition on the explosive power of lower limb muscles and upper extremities in beach volleyball athletes.

Keywords: body composition, explosive power, beach volleyball

1. Introduction

Beach volleyball is an example of a modified indoor volleyball game. Modifications can be seen from the number of players who only number 2 players per team, and are played on the beach sand. This makes beach volleyball players more involved or higher coherence in the team. Performing in the sport of beach volleyball requires excellent physical condition and good basic volleyball technique skills [1]. Beach volleyball can be analyzed as a multitude of movements ranging from short explosive, speed and multidirectional. Rauch et.al [2] suggest that muscle strength and power are the most important foundations for beach volleyball game performance. Physical ability is the ability to function the organs of the body in performing physical activities [3]. Physical ability is very important to support and develop psychomotor activities, game skills can be done if physical abilities are adequate and good [4].

Physical condition is necessary for the body's readiness to complete the match that is carried out [5]. In addition, physical condition is very determinant for athletes to optimize the techniques learned in beach volleyball games [6]. Physical conditions will also affect body composition. According to Tomaç et.al [7], explosive power and

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strength factors are very influenced by the body composition of each athlete. Therefore, the beach volleyball game requires a good physical in terms of body composition. An exercise program to increase explosive power and physical endurance. Because the beach volleyball game requires good physical performance. Body composition greatly affects the level of the physical capacity of athletes, and also in terms of explosive power can be determined on the body composition, especially on muscle mass and body fat [8]. The physiological character of volleyball relies on the performance of players' specific specialties, such as batting, sudden changes in speed in various directions up to 10 meters, and jumping to hit a vertical ball. All these techniques are achieved through good anaerobic and aerobic energy [9].

Maximum power and performance characteristics, as well as body composition, are the main factors that influence explosive power and performance [10]. However, no data are available for the relationship between body composition, strength, and power characteristics as well as jumping ability, or endurance. In addition, there are no consistent findings regarding the effects of body composition on physical performance in beach volleyball players [11–13]. Understanding the relationship between body composition, strength, and power characteristics relative to power and performance in beach volleyball can provide a more comprehensive picture of what characteristics should be considered to assess performance ability.

According to Sinovas et al [14], that body composition there is a significant development to do vertical jump and also explosive power, seen from muscle mass. In the aspect of body composition, sand volleyball, and indoor volleyball are very different, because it can be analyzed from the shape of the training aspect and also the weather, how beach volleyball is directly under the hot sun and also sand with such a depth of sand, so that the physical performance of beach volleyball is better than indoor. Body composition is significant to see performance and power. Therefore, this study provides a new thing, namely seeing the performance and power of athletes in terms of body composition. Therefore, the purpose of this study was to analyze the relationship between body composition, lower limb muscle power, and arm power performance in terms of body composition through body fat percentage, muscle mass, and BMI. We hypothesized that (a) body composition would be strongly correlated with arm power performance, and (b) body composition would be moderately correlated with lower limb power performance.

2. METHOD

2.1 Study design and Participant

This research design is correlational research. A correlation study is a study that aims to show whether there is a relationship between one variable and another. This correlation method is done cross-sectionally. The sample used was provincial beach volleyball athletes in preparation for the National Sports Games. A total sample of 8 athletes participated in this study with a composition of 4 male athletes and 4 female athletes. Accidental sampling was used in this research sampling technique.

2.2 Data Collection

The data collection technique used is by giving physical performance test items, especially explosive power and body composition. Data collection of lower limb explosive power (power leg) using a vertical jump instrument. Then the arm explosive power data collection uses a seated medicine ball test instrument with a mass weight on the ball of 5 kg. Body composition (Body Mass Index) (kg.m2), Body Fat (%) estimated muscle mass (kg) measured by Inbody 270 body analysis device.

2.3 Statistical Analysis

The data that has been obtained is then processed by displaying descriptive statistics on each variable. Data analysis was calculated using Spearman rank correlation between vertical jump, seated medicine ball, and body composition measures. The interpretation of the correlation coefficient is classified as follows; (r = 0.00 - 0.1), low (r = 0.1 - 0.3), moderate (r = 0.3 - 0.5), high (r = 0.5 - 0.70), very high (r = 0.7 - 0.9), and near perfect (r = 0.9 - 1.0). A significance level of 0.05 was used in determining a significant relationship.

3. Results and Discussion

Table 1. Statistic Descriptive Power and Body Composition of volley ball athlete

Item		Mean	Standar deviation	Min	Max
Power	Vertical jump	74.6	5.75	67	80
	Medicine ball	9.48	1.25	7.10	11.0
Body Composition	Body mass index	21.7	2.87	17.7	25.9
	Body fat	15.1	4.19	7.70	20.4
	Muscle mass	55.6	13.2	39.90	70.50
	Bone mass	3.30	0.48	2.50	3.80
	Body water	55.8	4.18	52.90	64.80
	Basal metabolic rate	1763.6	394.5	1255	2174
	Visceral fat	3.81	2.98	1	9

Tabel 2. Correlation between body composition and power perfomance

		Vertical Jump	Seated Medicine Ball
Body fat	R	- 0.708*	- 0.419
	p-value	0.050*	0.301
Muscle mass	R	0.293	0.743*
	p-value	0.482	0.035*
Body mass index (BMI)	R	0.244	0.826*
	p-value	0.560	0.011*

*significantly ($p<0.05$), **coefficient correlation

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Descriptive statistics on vertical jump had a mean value of 74.6 ± 5.75 while for medicine ball 9.48 ± 1.25. body composition had a mean value of 21.7 ± 2.87 on body fat 15.1 ± 4.19 and for muscle mass 55.6 ± 13.2 (Table 1). The results of the relationship

between power performance and body composition are shown in Table 2 where there is a significant relationship between body fat and leg power with p-value = 0.050 and r = - 0.708, but no relationship with arm power. Different results were found in muscle mass and power arm with p-value = 0.035 and r = 0.743. Furthermore, in the BMI variable with power arm there is a significant relationship with p-value = 0.011 and r = 0.826.

This study found a variety of different results on each variable. This correlation study found a relationship between body composition and power performance in beach volleyball athletes. Physical performance indicators in this sport are the same as in indoor volleyball. Aspects of good biomotor components are indispensable in supporting good play. in this research focuses on the performance of lower limb and arm explosive power. Explosive power plays a very important role in volleyball players. This explosive performance is related to the results of strength and speed. Vertical jump is done to determine the level of lower limb muscle explosiveness in beach volleyball athletes. Jumping ability is probably one of the key components of performance in volleyball, and the best way to achieve maximum height in jumping is to increase concentric force and the rate of change of eccentric force. [15]. Jumping height is very influential on jumping smash in volleyball games. Of course, good power is needed in doing the jump smash. Leg muscle explosive power contributes to the ability of an athlete to jump in order to direct the ball during a smash [16,17]. Besides being supported by jumping performance or lower limb explosiveness to smash and serve, of course, you must also have good arm muscle explosiveness so that the resulting shots are hard. According to Marpaung & Priyonadi [18] leg muscle power and arm muscle power make a positive contribution to the ability to smash results.

Body composition is one of the predictors that can affect the performance of volleyball athletes. In body composition plays an important role in the main performance is body fat and also muscle mass. Previous research suggests that body composition has a relationship with physical performance in volleyball athletes [19]. According to Ilic' [20] there is a significant correlation between body composition parameters and motor skills of female volleyball players in explosive strength and agility. Statistical results found that there was a significant relationship in body fat and leg muscle explosiveness (power leg). The previous study also had the same results on body fat and vertical jump indicators, there was a positive relationship between the two [21]. Another study mentioned that there is a significant result between body fat and Counter Movement Jump (CMJ) performance. [21,22]. In contrast to the vertical jump results, we did not find significant results on body fat and arm muscle explosive power. Research conducted by Burtch and Madison [24] found that increased body fat was associated with reduced performance among certain physical fitness components, including muscle power and strength and aerobic endurance. Previous studies have not addressed the relationship between body composition and arm muscle explosiveness. On the other hand, another study found that there was a negative correlation and significant results between body fat and handgrip strength but in young female judo athletes.

According Legg et al [25] that there is a relationship between muscle mass and jump performance (lower limb explosive power). The study showed that there was a significant relationship in muscle mass and arm muscle explosiveness but not in lower limb explosiveness. Kushkestani et al [23] found that a significant positive correlation between muscle mass and lower limb explosive power. Resistance training along with

volleyball¯specific strength training can increase muscle mass at the same time. On the other hand, one of the predictors of power in CMJ and medicine ball throwing is muscle mass [26]. The result similar with Bayram and Cerrah [22] that was no significant correlation was observed between CMJ and total lean body mass weight or other regions. While on the other hand the Body mass index (BMI) variable in the study had an association with arm muscle explosive power, but not with jump. Fatahi et.al [15] mentioned that the analysis of variables in the concentric phase showed a significant correlation between peak power (PP), average power (AP), maximum landing force (F Max L) and peak force landing time (TPFL) with body mass index. We did not find much research on these variables in volleyball especially BMI and power performance. We recommend for further research in examining body composition on arm power in beach volleyball athletes in particular.

4. Conclusion

This study shows that there is a significant relationship between body composition on the explosive power of lower limb muscles and upper extremities in beach volleyball athletes. The results found that there was a significant correlation in body fat percentage to vertical jump, muscle mass and power arm as well as body mass index and power arm. However, in some parts the results show a positive and negative coefficiant correlation. Further research must examine more related to arm muscle explosive power and physical performance in beach volleyball athletes because literature is still rare to find in the scope of this sport.

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