

## **Investigation of Relationship of Strength and Size of Different Body Parts to Velocity of Volleyball Serve and Spike**

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### **I. Introduction**

The modern game of Volleyball puts a great deal of emphasis on the fact that in this game a player is required to play in all the positions during a match due to obligation of the rule concerned with rotation. At one time, a player became a Spiker, the next moment a blocker, attack builder, server, a deep defender and so on. Therefore, a wide variety of techniques have been evolved which have their own and different physical requirements. As a consequence a player is expected to work on a wide ranging programme designed to improve his strength, speed, power, agility, flexibility etc. along with possessing a specific body type, height, limb length, upper body size etc.

Once the above qualities and characteristics are ensured that the game of volleyball has its tactics which are either individual or collective in nature. The collective i.e. team tactics are based on the total teams play which necessitates certain combinations of techniques, understanding among the players of the teams, understanding of the opponents play etc. The individual tactics have their roots in the players themselves which needs mastery of the techniques as well as tactical application. There are mainly two techniques which have their tactical utility during the game and which are individual based. These are “the serve” and “the spike”. The service which happens to be an act of putting the ball in play, if executed tactically by the server can foil the opponents. Organization of the attacks and the spike executed tactically can fetch a point or get a rally change during play. But these two techniques have their basis in the strength of certain body parts as well as the size of certain body parts including the player’s total height.

Serve has become a weapon of attack and its tactical use is important. Generally speaking it is organized an effective attack. When service is constitutes the other five players in the serving team prepare to defend. Such of this defend will largely depend on the service. If the service succeeds in putting pressure on the opposition, it is likely that they will on easy return, which then allow the serving team to build on effective counter attack. Spike is the finishing touch to the team’s play. It is the shot designed to win the rally for the team. As a result the spiker has the spot light during a game and every players want to be a specialist spiker, unfortunately, the physical requirement for top level spiker are more limiting than for any other role in volleyball. The player must be tall (over 2mts.is usual), and have a good vertical jump, must have sufficient amount of strength and a definite degree of strength of wrist and shoulder

It is also felt that to hit the ball during spiking and service with a maximum possible velocity one must have sufficient amount of strength. A definite degree of strength of wrist and shoulder muscle is required for service, and for spiking. There is need to develop the strength of wrist, shoulder, body, thigh and leg muscles. Strength development of the lower extremity of the players increases jumping ability which is basic to spiking.

From the bio-mechanical point of view if the arm length is longer, then one will have greater radius of rotation. As we know at the moment of ball is contacted, the greater linear velocity in the direction of the flight of the ball is desired. Greater linear velocity is only possible when the radius of rotation is sufficiently longer. So if the person has longer arm length he can produce greater linear velocity.

The top level performance in particular event demands particular type of body size and shape, other aspects being similar. A strong relationship between structure of an athlete and specific task has been found. Clear physical prototypes exist for optimal performance at the level of Olympic Games. So emphasis should be given to find out the relationship between anthropometric measures and the specific task (event) of an athlete for high level of performance. Thus realizing the importance of selected strength and body segments variables to the velocity of the Tennis Service and straight arm spike in volleyball the research scholar undertook the present study.

### **Purpose Of The Study**

The purpose of the study was to investigate the relationship of strength and size of different body parts to velocity of volleyball serve and spike.

## II. Methodology

For the purpose of the study 30 University represented male volleyball players from Gwalior District were taken randomly, age ranged from 18 to 26 years. For this study there were two types of variables, namely Dependent Variable and Independent Variable. Dependent variable was Velocity of Tennis Serve and Straight Arm Spike (smash) and Independent variables were Arm Strength, Grip Strength, Leg Strength, Back Strength, Total Arm Length, Hand Length, Leg Length, Foot Length and Length of the Upper Body. Electronic stop watches were used for taking the time of the ball during service and spiking, the steel tape was used for measuring the body size and distance of spiked and served ball. To determine the relationship between dependent variables (velocity of the tennis serve and straight arm spike) and independent variables (strength and body parts size) Correlation statistics was applied and the Regression Equation was developed.

The level of significance to check the relationship obtained by Pearson's Product Movement Correlation and Multiple Correlation was set at 0.05 level of significance.

The scores of each of the dependent variables i.e. selected strength and size of the different body parts were correlated with dependent variables i.e. the velocity of volleyball service and spike in order to find out relationship between the dependent and independent variables, these have been presented in table 1, 2, 3 and 4

**Table – 1:** Representing the relationship of selected strength variables to the velocity of volleyball service

Variables Correlated	Correlation Coefficient
Arm Strength (1) and Volleyball Serve	0.83*
Grip Strength (2) and Volleyball Serve	0.48*
Leg Strength (3) and Volleyball Serve	0.60*
Back Strength (4) and Volleyball Serve	0.53*

$r_{0.05(28)} = 0.361$ , \* indicating significant, NS indicating not significant.

The Table-1 shows that there is significant relationship between velocity of service in volleyball and arm strength, grip strength, leg strength and back strength.

**Table – 2:** Representing the relationship of selected body parts size to the velocity of volleyball service

Variables Correlated	Correlation Coefficient
Arm Length (5) and Volleyball Serve	0.63*
Hand Length (6) and Volleyball Serve	0.59*
Leg Length (7) and Volleyball Serve	0.57*
Foot Length (8) and Volleyball Serve	0.24 <sup>NS</sup>
Upper Body Length (9) and Volleyball Serve	0.37*

$r_{0.05(28)} = 0.361$ , \* indicating significant, NS indicating not significant.

The Table-2 indicates that there is significant relationship between velocity of service in volleyball and arm length, hand length, leg length and upper body length. On the other hand no significant relationship exists between velocity of service in volleyball and foot length.

**Table – 3:** Representing the relationship of selected strength variables to the velocity of volleyball spike

Variables Correlated	Correlation Coefficient
Arm Strength (1) and Volleyball Spike	0.75*
Grip Strength (2) and Volleyball Spike	0.36*
Leg Strength (3) and Volleyball Spike	0.62*
Back Strength (4) and Volleyball Spike	0.52*

$r_{0.05(28)} = 0.361$ , \* indicating significant, NS indicating not significant.

The Table-3 clearly shows that there is significant relationship between velocity of spiked ball in volleyball and arm strength, grip strength, leg strength and back strength.

**Table – 4:** Representing the relationship of selected body parts size to the velocity of volleyball spike

Variables Correlated	Correlation Coefficient
Arm Length (5) and Volleyball Spike	0.51*
Hand Length (6) and Volleyball Spike	0.57*
Leg Length (7) and Volleyball Spike	0.63*
Foot Length (8) and Volleyball Spike	0.17 <sup>NS</sup>
Upper Body Length (9) and Volleyball Spike	0.40*

$r_{0.05(28)} = 0.361$ , \* indicating significant, NS indicating not significant.

The Table-2 indicates that there is significant relationship between velocity of spiked ball and arm length, hand length, leg length and upper body length; whereas the relationship between the velocity of spiked ball and the foot length is not found to be significant.

The combined effect of independent variables i.e. selected strength variables and size of various body parts with the velocity of volleyball service was examined by using Multiple Correlation Method. The result pertaining to this has been presented in table 5.

**Table – 5:** Representing Combined Contribution of Strength and Body Parts Size to Velocity of Volleyball Service

Independent Variables	Dependent Variables	Multiple Correlation
Arm Strength (1) Arm Length (5) Leg Strength (3)	Service Velocity (C <sub>1</sub> )	R <sub>C<sub>1</sub></sub> 0.364      0.927*

$r_{0.05} (26) = 0.37$ , \* indicating significant, NS indicating not significant.

The Table-5 discloses the combined contribution of arm strength, arm length and leg strength to the velocity of volleyball service. It is significant at 0.05 level of confidence as the computed value of  $r = 0.927$  is much greater than 0.37 required for the Multiple Correlation Coefficient to be significant at 0.05 level with 26 degree of freedom. From the obtained value of multiple correlations it can be concluded that the arm strength, arm length and leg strength taken together contribute significant to velocity of volleyball serve.

The combined effect of independent variables i.e. selected strength variables and size of various body parts with the velocity of volleyball spike was examined by using Multiple Correlation Method. The result pertaining to this has been presented in table 6

**Table – 6:** Representing Combined Contribution of Strength and Body Parts Size to Velocity of Volleyball Spike

Independent Variables	Dependent Variables	Multiple Correlation
Arm Strength (1) Leg Length (7) Leg Strength (3)	Service Velocity (C <sub>2</sub> )	R <sub>C<sub>2</sub></sub> 0.354      0.843*

$r_{0.05} (26) = 0.37$ , \* indicating significant, NS indicating not significant.

The findings of Multiple Correlation from Table-6 revealed the combined contribution of arm strength, leg length and leg strength to velocity of volleyball spike. It is significant at 0.05 level of confidence as the computed value of  $r = 0.843$  was much higher than 0.37 required for the Multiple Correlation Coefficient to be significant at 0.05 level with 26 degree of freedom. From the obtained value of Multiple Correlation it can be concluded that the arm strength, leg length and leg strength taken together significantly contribute to the velocity of the spiked ball.

### Multiple Regression Equation

To predict the velocity of the service and the velocity of the spiked ball with the help of selected independent variables i.e. selected strength variables and size of the body parts separate regression were drawn. The resulted equations have been presented as follows:

$$X_1 = 0.023 (\text{Arm Strength}) + 0.40 (\text{Arm Length}) + 0.45 (\text{Leg Strength}) - 36.53$$

**Where  $X_1$  = Service Velocity of the ball**

$$X_2 = 0.029 (\text{Arm Strength}) + 0.133 (\text{Arm Length}) + 0.062 (\text{Leg Strength}) - 14.86$$

**Where  $X_2$  = Spiking Velocity of the ball**

### III. Discussion And Findings

The velocity of service and spiking in volleyball depend upon many bodily and mechanical factors. But it is the general observation that a tall and a well built player have an extra advantage as compared to a short and average built player while executing this technique. This makes us to say that the tall player can develop greater amount of force as compared to the short player. This basis for this statement lie in strength characteristics as well as the mechanical factors which are mainly dependent upon the internal body mechanics like the body leverage, length of power arm, relationship of linear and angular motion etc.

The findings of the present study also fall in line with the above mentioned lines. The main findings of the study are:

- There is significant relationship between selected strength variables to the velocity of volleyball service and spike.

- There is significant relationship between body parts size namely leg length, arm length, upper body length and hand length to the velocity of volleyball service and spike
- There is no significant relationship between foot length and velocity of volleyball service and spike.
- Arm strength, arm length and leg strength together contribute to velocity of service ball.
- Arm strength, leg length and leg strength together contribute to the velocity of spiked ball.
- Result of multiple regression analysis indicates that it is possible to make prediction regarding velocity of volleyball service and spike in volleyball on the basis of strength and body parts size.

From the above mentioned findings we can say that to service and spike with a high velocity a person must have optimum level of strength not only in his arm but in his back to make an arch, and in his leg for jump during spike and to provide affirm ground supporting during service.

That is why significance positive relationship between all the four strength variables namely grip strength, arm strength, back strength and leg strength with the velocity of volleyball service and spike was found on the other hand significance relationship between arm length with spiking and service velocity is attributed to the fact that greater the arm length at the time of contact with the ball, greater will be the force, a contributory factor for the velocity of service and spike. The basis for this is that if the length of the power arm is more that more force can be generated. Also if the arm length is longer than one will have greater radius of rotation. As we know at the moment the ball is contacted the greater linear velocity in the direction of the flight of the ball is desired. The greater linear velocity is the only possible when radius of rotation is the maximum possible. That is why significance relationship between arm length, leg length, upper body length and hand length to service and spiked velocity in volleyball was found. But the insignificance relationship of foot length to service and spiking velocity was found. Probably there is no direct impact of foot length on the velocity of volleyball service and spike. The findings also show that the independent variables of arm strength, arm length and leg length has got high relationship with velocity of service where as the arm strength, leg length and leg strength all together influence the velocity of the spiked ball. These findings may be attributed is the fact that the arm strength is the principal factor for force generation which ultimately contribute to hitting the ball with a maximum possible in both cases. From the findings it can also be said that leg strength also be helpful for powerful vertical jump in case of spike and for service it helps to maintain affirm base of support on the other hand the length of the power arm (arm length) helps to generate more force at the time of service and at the same time leg length contributed to force generation to reach high during take-off at the time of spiking. As described before the length of the power arm as well as radius of rotation provides the basis for developing the greater amount of force.

#### **IV. Conclusion**

The following conclusions have been drawn after statistical calculation.

- There is significant relationship between selected strength variables namely arm strength, grip strength, leg strength, back strength to the velocity of volleyball serve and spike.
- There is significant relationship between body parts size namely leg length, arm length, upper body length, hand length to the velocity of volleyball serve and spike.
- The relationship between foot length and velocity of volleyball serve and spike is not significant.
- Arm strength, arm length and leg strength together contributed significantly to the velocity of service.
- Arm strength, leg length and leg strength together contributed significantly to the velocity of spike.
- It is possible to make predictions regarding velocity of service and spiked ball on the basis of strength and body parts size.

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