

# An Analysis On The Relationship Between Serving Strength And Anthropometric Properties And Tennis Serving Success In Young Women Volleyball Players

Yıldırım Gökhan GENCER <sup>1A</sup>, Beyza ÖĞE <sup>1B</sup>

<sup>1</sup> Mersin Universtiy, Faculty of Sport Sciences

Address Correspondence to Y.G. GENCER: ygokhangencer@hotmail.com

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A:Orcid ID: 0000-0001-5511-2374- B:Orcid ID: 0000-0001-7202-5555

## Abstract

Although there are many basic techniques in volleyball, the serving technique can change the direction or result of the game. The aim of the study is to examine the relationship between some isometric strength and anthropometric properties of elite female volleyball players aged between 15 and 17 with their capability to serve to the point. 33 female volleyball players aged between 15 and 17 [16,09], playing in three different teams in the Turkish Volleyball 2nd League participated in the study. Some anthropometric and serving arm isometric force measurements, such as serving arm length and circumference, were made on the players participating in the study, and the relationship between the serving points in tennis was evaluated. Descriptive statistics and Pearson correlation test were performed in the SPSS package program. Although a positive relationship is found between the serving hit rate of the players and licensing age ( $r = 0.35$ ), body mass index ( $r = 0.36$ ), extension arm circumference ( $r = 0.59$ ), flexion arm circumference ( $r = 0.53$ ) and forearm circumference ( $r = 0.49$ ), no statistically significant relationship was observed with other variables. Consequently, it has been noted that the past of the players as the licensed player and some anthropometric properties are related to tennis serve hit rate in female volleyball players aged between 15 and 17.

**Keywords:** Volleyball, serving arm strength, anthropometric properties, serving hit rate.

## INTRODUCTION

Firstly, serving performance is one of the factors determining success in volleyball that has been originally played for fun under the name of "Mintonette" and has undergone many changes until today (31,33). The serving that is defined as hitting the ball for the start is a significant factor for the team to earn a point and be successful (18). Since serving in the desired area is important for reducing the effectiveness of the opponent's offensive and defensive systems during the game, a good serving can be evaluated as a good attack (15). Serve is divided into two basic groups as the serves rotating

around the axis of the ball and the serves not rotating around the axis, and there are variations among the groups (33,6,17). In the tennis serve widely used in the staging of the jump serve as an important technique of offensive in the game system in volleyball, the player faces the net, the right foot is behind and the left foot is ahead for the players using the right hand. The ball is tossed into the air from the level of the foot in the front. The right hand is moved back to the back of the trunk. When the ball reaches a sufficient level for striking, the wrist is fixed in half flexion forward and is hit

directly behind the ball with the palmar face of the hand. Hitting hand does not follow the ball (17,4,23). In order to apply the serve technique, players need good coordination, timing, ball tracking ability and sufficient strength (3). Hence, the implementation of tennis serve can be pretty challenging for young players (14).

Since it is known that sports performance depends on technical, tactical, physical, psychological and anthropometric factors, it can be stated that the anthropometric properties of players are significant determinants of success in volleyball (7,28). For the acquisition of specific volleyball-specific movements, the player needs good physical fitness and some performance factors, such as elasticity, strength, power, and quickness to develop (2). The type of strength used in volleyball may differ from the other sports branches. Since powerful muscle groups are required against the maximum load, it can be perceived that the speed of the ball reaches 100 miles per hour with a strong slam dunking to a volleyball weighing 255 gr if the muscular power is at the optimal level. Having sufficient strength in volleyball offers the opportunity to reach a high speed in arm swing, which ensures a relatively harder hit on the ball compared to the other players (2,20).

Depending on the above explanations and previous research findings; it is intended to investigate the relationship between the biometer and anthropometric properties of the players and tennis serving hit rate.

## **METHOD**

### **Study Group:**

33 female volleyball players, playing in the Turkish Volleyball 2nd League as a licensed player for  $4.42 \pm 1.93$  years, having an age average of  $16.06 \pm 0.9$ , voluntarily participated in the study.

### **Method:**

Volunteers and their families were informed about the scope and purpose of the study, and their families were asked to sign the "Informed Voluntary Consent Forms".

### **Measurements Used in the Study:**

Some anthropometric measurements and arm strength tests were implemented to the participants in the laboratory.

## **Anthropometric Measurements**

Seca 213 model stadiometer was used to measure the length of the participants and the Seca 750 model weight scale was used to measure body weights. The results obtained were recorded with a precision of 1/10 cm and 1/10 kg.

Other anthropometric measurements were measured as determined by the International Society for the Advancement of Kinanthropometry (ISAK) using the Holtain brand anthropometric set on the right side as mentioned below and recorded at a sensitivity level of 1/10 cm (27).

**Arm circumference in flexion:** The measurement was taken from the halfway between acromion and olecranon when the participant was standing and the arm was at the maximum flexion (22).

**Arm circumference in extension:** The measurement was taken from the halfway between acromion and olecranon when the participant was standing and the arm was at the anatomic position and in the extension (22).

**Forearm circumference:** The measurement is taken from the maximum bulges of the forearm in the proximal when the participant was standing, and the arm was in extension at an anatomical posture (9).

**Wrist Circumference:** The tape is applied around the wrist while not applying any pressure to the distal to the styloid processes of the radius and ulna (9).

**Arm length:** With the participant standing and the arm is at the anatomic position at extension, the midway between the acromion and olecranon is measured (24).

## **Strength Measurements**

Isometric strength measurements of the right arm Biceps Branchii, Triceps Branchii and M. Deltoidus muscles of the participants were performed with Lafayette branded Manual Muscle Tester (01165).

## **Serve Hit Rate Test**

In serve hit rate test, to limit the variables such as field, net, and ground, the competition ball in international standards was used in the fields, complying the international volleyball game rules. The serve technique is limited to the tennis serve.

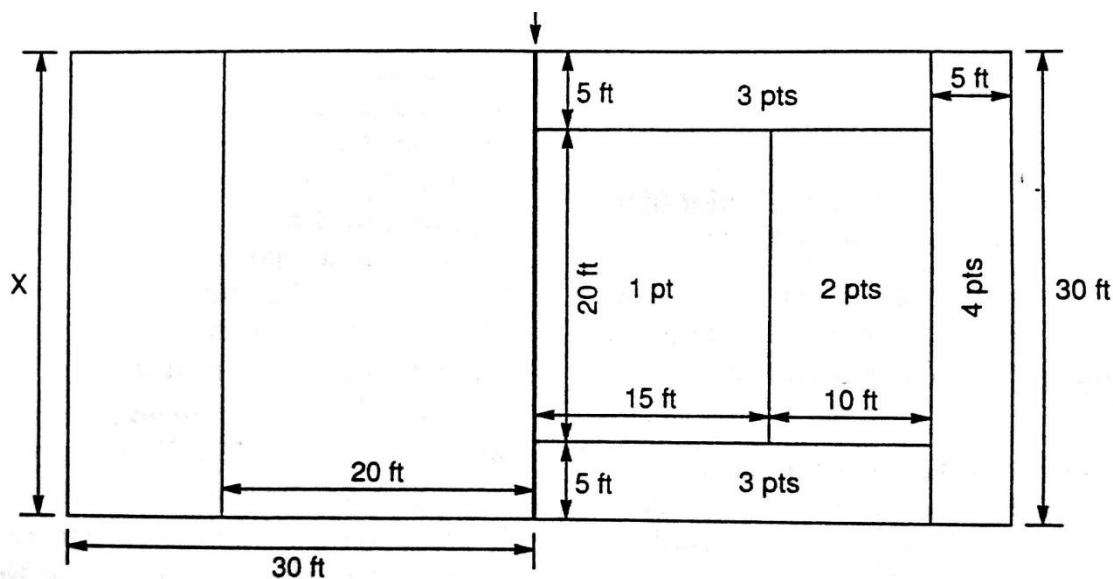


Figure 1. AAHPER Scoring Zones

AAHPER Serve Test: The lengths in the original of the test have been converted into meters (1 ft = 30.48 cm) and the scoring sections are marked on the volleyball court with a white band. The players participating in the study were presented in Figure 1 with serve hit scores, and according to this score, the participant was asked to make valid serves to the areas for getting the most points. As the trial, 20 serves were allowed and after the trial serves, the test of 10 serves was initiated. Points are awarded for the balls falling in the areas shown in Figure 1. However, no points were awarded to the balls hitting the net or to the balls falling outside the scoring area. The scores of the test were collected and recorded as the total score (32).

### Statistical Analysis

The data obtained by the measurements were transferred to the computer environment and SPSS 23 package program was used for the analysis. The distribution of the data was analyzed by the Shapiro-Wilk test and normal distributions were reflected. Using the parametric Pearson correlation test for the analysis, the data were evaluated according to their significance levels ( $p < 0.05$ ). Cronbach Alpha internal consistency coefficient was used to determine its reliability. The Cronbach Alpha reliability coefficient for 14 parameters was determined as .75.

### RESULTS

According to the data obtained, descriptive statistics of the participants are presented in Table 1.

Parameters	N	Min.	Max.	Avr.±Ss
Age (year)	33	15	17	16.06±0.90
Body weight (kg)	33	46	63	55.61±4.71
Height (cm)	33	154	180	164.06±7.00
BMI (kg/m <sup>2</sup> )	33	13.65	23.49	18.91±2.63
Licensing age (year)	33	2	7	4.42±1.94
Arm's length (cm)	33	61	80	70.58±3.64
Extension arm circumference (cm)	33	21	27	24.21±1.60
Flexion arm circumference (cm)	33	24	30	27±1.82
Forearm circumference (cm)	33	22	27	23.73±1.46
Wrist circumference (cm)	33	14	17	15.82±0.73
Deltoid strength	33	29.2	43.1	35.60±3.62
Biceps strength	33	21.3	39.4	27.81±4.84
Triceps strength	33	21.4	30.4	26.18±2.53
Serve hit points	33	8	38	23.67±9.25

It is stated in Table 1 that 33 female volleyball players participating in the study, who have been involved in sports for  $4.42 \pm 1.94$  years and have an average age of  $16.06 \pm 0.90$ , are  $164.06 \pm 7.00$  cm height and  $55.61 \pm 4.71$  kg, and their arm circumference and strength measurements and service hit points averages are shown in Table 1.

Correlation analysis results performed to reveal the relationship between the age, the age for performing sports, anthropometric characteristics and strength parameters of the volleyball players participating in the study and the scores of the tennis serve shots are displayed in Table 2.

**Table 2.** Correlation Table Between Serve Hit Points and Some Parameters

Parameters	N	Serve Hit Points	
Licensing age	33	r	0.352
		p	<b>0.045*</b>
BMI	33	r	0.356
		p	<b>0.042*</b>
Arm's length	33	r	-0.023
		p	0.899
Extension arm circumference	33	r	0.592
		p	<b>0.000**</b>
Flexion arm circumference	33	r	0.533
		p	0.001**
Forearm circumference	33	r	0.490
		p	<b>0.004**</b>
Wrist circumference	33	r	-0.056
		p	0.758
Deltoid strength	33	r	0.167
		p	0.354
Biceps strength	33	r	-0.189
		p	0.293
Triceps strength	33	r	0.180
		p	0.317

(\* p<0.05, \*\* p<0.01)

According to the correlation analysis of the serving hit point of the players participating in the study and the other parameters, a positive relationship is found between the serving hit rate of the players and licensing age ( $r = 0.35$ ), body mass index ( $r = 0.36$ ), extension arm circumference ( $r = 0.59$ ), flexion arm circumference ( $r = 0.53$ ) and forearm circumference ( $r = 0.49$ ), while no statistically significant relationship was observed with other variables.

## DISCUSSION

In this study, the relationship between arm strength and anthropometric characteristics of volleyball players and tennis serve achievement was investigated and a positive relationship was determined between BMI, the age for performing the sports, forearm circumference, flexion and extension arm circumference parameters.

Since the BMI of the volleyball players who participated in the study was found to be  $18.91 \pm 2.63$ , it was observed that it was within the normal values according to the World Health Organization Data

[18.5-24.9 kg/m<sup>2</sup>] (34). In numerous studies in the literature, the effect of body mass index (BMI) on performance in volleyball has been examined and some of these studies, some of these studies state that it has a negative level of impact (19,25) while some of the studies allege a positive level of impact, in parallel with this study (13,29). In this study, it is perceived that the tennis serve hit has a positive relationship with the ideal ratio of height and weight. It can be stated that height and weight should be between ideal rates to ensure the tennis serve accuracy.

In terms of the age of getting the license, similar to this study, Atan and Ünver (5) considered that as the age of performing the sports as licensed, the sportive performance also increases. Considering that the volleyball serving skill is highly complex (10), it is expected to have more practice time for the serving skill to be completely learned and to be performed effectively. In this context, it is expected that the successful rate of serve hits will increase when the number of age to perform the sports and the trainings increase.

Information about bone, muscle and adipose tissue can be obtained from anthropometric measurements used to measure body composition (1). No studies investigating the relationship between arm circumference and forearm circumference parameters and serve hit in the literature were observed. In studies investigating the effects of anthropometric characteristics on sportive performance, an ectomorphic somatotype characteristic, as well as the long arms and legs, are considered as advantageous in volleyball (30,26). Kamuk (18) has examined the effect of arm's length on serve success in volleyball and asserted that there is a positive significant relationship ( $r = 0.92$ ;  $p < 0.01$ ) between the right arm length of the girl volleyball players aged between 10 to 11 and the ASPeT serve scores. In another study, Kamuk et al. (19) assert that there is no relationship between the anthropometric properties of female volleyball players aged between 19 and 21 and the serving performance. The difference between the study and the study of Kamuk (18) is thought to be due to the age group and the use of the serving test from the bottom. Kamuk (18) mentions that arm length can be an essential variable in tossing the ball against the other field for the girls aged between 10 and 11. In the study examining the first years of the adolescent period, Kamuk (18) declared that the arm length was related to the serve hit, while in adulthood Kamuk et al. (19), on the other hand, could not find a comparable relationship. It can be interpreted that the relationship existing in the serve hit rate at the beginning of the adolescent period disappeared statistically in the late adolescent period and adulthood with the adaptation of the players to the training.

Contrary to the findings implying that the effect of the isometric strength of the muscles of Triceps Branchii on the tennis serve hit is not at a significant level, Eskiyecek et al. (12) performed explosive power studies with a medicine ball on the female volleyball players aged between 14 and 16 and found a significant difference between pre-test and post-test ( $p < 0.05$ ). They also pointed out that the triceps strength may affect performance of the serve. Braatz's study (8) studied the effect of the wrist and arm strength on serving speed and found that there was no significant relationship ( $p < 0.05$ ). In a study conducted in the Volleyball 2nd League, where our participants of the study compete, it was found that M. Deltoids, Biceps, Triceps Branchii muscles work

effectively in the float service in the shoulder and arm areas in 12 female volleyball players with an average age of  $20.4 \pm 1.6$  f (11). Yarım and Orhan (35) conclude that other elements are necessary besides muscle strength; Jain et al. (16) stated that the technical and tactical skills should be coordinated in order to use them at a high level, Kula (21) stated the importance of coexistence of physical skills that determine the sports performance with cognitive and coordinative skills.

## CONCLUSION

As a conclusion, while the tennis serve is more successful in female volleyball players aged between 15 and 17, having BMI in the normal range and at least 4 years of athletics experience, strength and anthropometric characteristics (excluding forearm and upper arm circumference) do not have a considerable effect on the achievement.

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