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EFFECTS OF SERVE TYPE, POSITION, AND GENDER ON THE SERVE SPEED OF ELITE VOLLEYBALL PLAYERS

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ABSTRACT

Assessing and monitoring body composition is important for health. It is believed that in the future, wearable devices measuring the body composition, will be more common. The purpose of this study is to compare a wearable bioelectrical impedance measuring device, designed as a band, with a laboratory type of bioelectrical impedance device in order to investigate its reliability and validity. A total of 322 healthy people, 199 men, and 123 women participated in the study. The participants' body compositions were measured with the laboratory type of bioelectrical impedance device and recorded. Following these measurements, participants' body compositions were measured three times with the wearable bioelectrical impedance measuring device and data were recorded. The results of the measurements by both the laboratory type device and the wearable measuring device demonstrated a very high degree of correlations with each other. There were no significant differences between two devices' fat mass measurements in men, in women and in the whole group. When muscle mass data were evaluated, there were no significant differences between two devices' measurements in men and in the whole group, but there was a significant difference in women ($p < .001$). When wearable measuring device was compared with laboratory type of bioelectrical impedance device, fat mass measurement results were valid. However, in muscle mass measurements, there was a difference in women. When the wearable bioelectrical impedance measuring device's reliability was evaluated, it was demonstrated that the device yielded valid results. Therefore, it is concluded that the device will be useful for self-monitoring the body composition.
Keywords: Body Composition, ideal body weight, wearable electronic devices

ELİT VOLEYBOLCULARDA SERVİS ÇEŞİDİ, POZİSYON VE CİNSİYETİN SERVİS HIZINA ETKİSİ

ÖZET

Voleybolda sıçrayarak kullanılan servisler en sık kullanılan servislerdir. Servis çeşitleri arasında en hızlısı smaç servistir. Bu çalışmaya 120 kadın ve 134 erkek voleybol oyuncusu dahil edildi. Toplamda kadın oyuncular 2872 servis (smaç servis (SS)=163, sıçrayarak yüzen servis (SY)=2163, durarak servis (DS) =546) kullanırken, erkek oyuncular 3296 servis (smaç servis (SS)=1546, sıçrayarak yüzen servis (SYS)=1745, durarak servis (DS) =5) kullandı. Servis hızları radar tabanca ile ölçüldü. Erkek ve kadın oyuncuların kullandığı servis çeşitlerinin dağılımındaki fark $\chi 2$ testi ile değerlendirildi. Servis hızına cinsiyet, oyuncunun pozisyonu ve servis çeşidinin etkisinin belirlenmesinde varyans analizi kullanıldı. Erkek ve kadın oyuncuların kullandığı servis çeşitleri birbirinden farklıydı ($p<0,05$). Servis hızı ile cinsiyet, oyuncunun pozisyonu ve servis çeşidinin etkileşimi anlamlıydı [$F(6,6166)=70,622$, $p<0,0001$]. Cinsiyet, oyuncunun pozisyonu ve servis çeşidinin servis hızı üzerindeki ana etkileri de anlamlı bulundu [sırasıyla, $F(1,6166)=22,848$, $p<0,0001$; $F(3,6166)=4,369$, $p=0,004$; ve $F(2,6166)=150,916$, $p<0,0001$]. Erkekler kadınlara göre daha etkili servisleri tercih etmişlerdir ($p<0,0001$). Erkeklerde SS hızı SY hızından daha yüksek bulunmuştur ($p<0,0001$). daha önceki çalışmalarda kadınlar tarafından en sık kullanıldığı bulunan DS yerine SY servisi tercih etmişlerdir. Sonuç olarak kadın voleybolu daha güçlü bir oyun stiline dönüşmektedir. Kadın pasör çaprazları SS ve SY servislerinin geliştirilmesi için eğitilmelidir çünkü servis hızları diğer kadın sporculardan genel olarak daha düşüktür.
Anahtar kelimeler: Atletik performans, erkek, kadın, spor, teknik performans

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INTRODUCTION

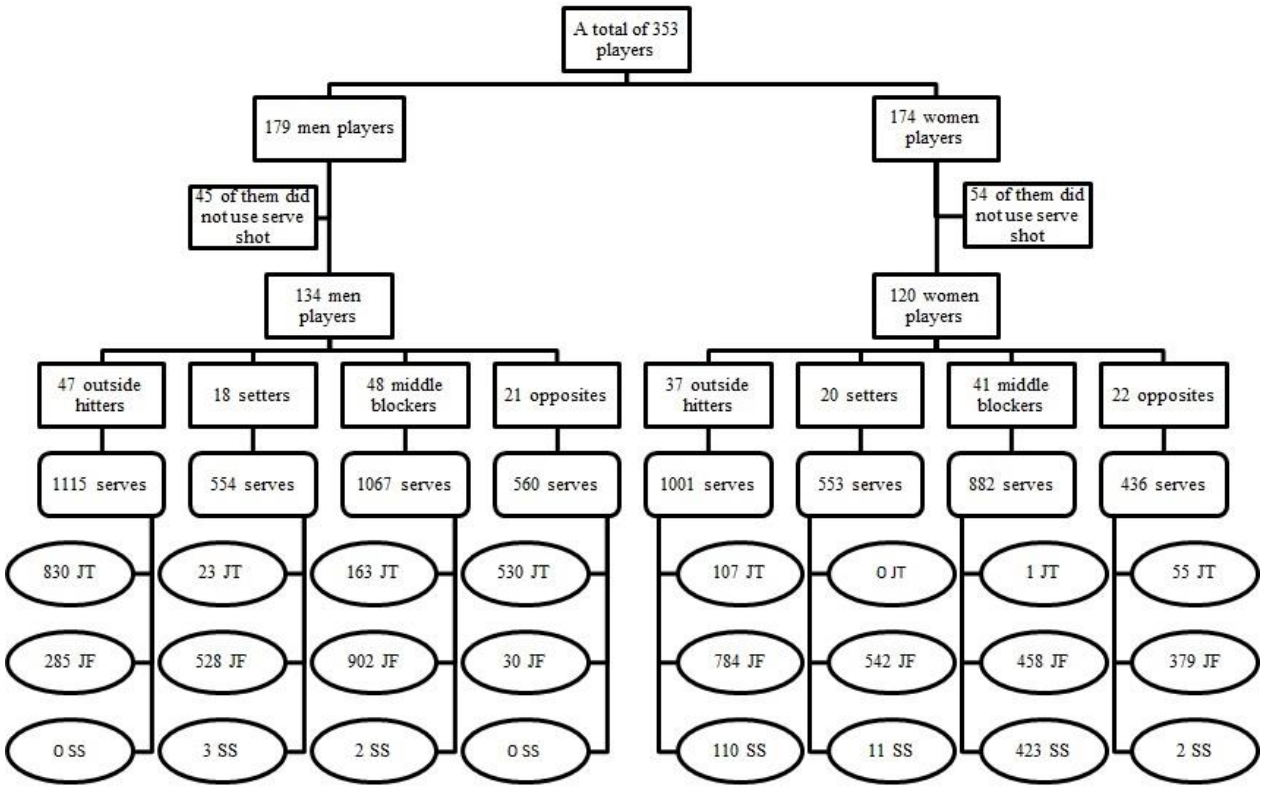
Volleyball exerts complex tactical, technical, and athletic demands [1]. An important attack skill in volleyball is the serve. Three forms of volleyball serves are jump topspin (JT), jump float (JF), and standing (SS) [2,3]. Jump serving is the most commonly used serve type in team volleyball and its use in games has been noted to increase from 20.8% to 99.2% between 1992 and 2002 [1]. Jump serves were reportedly used 75% of the time in the 1992 European Championship [4], 85.3% of the time in the 1994 World Championship [5], and 84.9% of the time in the 2004 Men's Olympic Qualification tournament [3]. Studies related to volleyball have mostly focused on male performance, and comparisons of male versus female players are limited [6-8]. In studies that compare these players, males were found to generally perform jump serves while females mostly performed SS.[6] Serve types between males and females were found to differ during the 2007 World Championships [7]. Costa, Afonso, Brant, Mesquita [7] classified serve types into five categories and found that female players performed ground serves more often than males. In other studies [2,3,9], volleyball serves were generally classified as SS (or float serve), JF, or JT (or jump serve) serves. No study comparing gender differences in serve type according to this classification is available in the literature.

Jump service is a powerful serve type and produces greater power output [2,10]. Among serve types, the speed of JT serves is the fastest [2,9], and serve speeds between ~13.06 and ~28.06 m/s [3] for men and 40–89 km/h [11] for women have been reported. Quiroga, García-Manso, Rodríguez-Ruiz, Sarmiento, De Saa, Moreno [11] found that a player's position effects his or her serve type and serve speed. Given this information, detailed analysis of the effects of gender, position, and serve type on serve speed may be important to establish differences between male and female volleyball. Thus, the aims of this study are (1) to detect differences in the distribution of serve types used during games by national high-level volleyball male and female players and (2) to detect the effects of gender, serve type, and player position on the serve speed of these players.

MATERIALS AND METHODS

An observational study was conducted during the 2016–2017 men's and women's national leagues (Sultanlar League and Efeler League) in Turkey. Twelve women's (174 players) and twelve men's (179 men players) teams played a total of 264 games (females, 132 games;

males, 132 games). Players who did not use serve shots (54 women, 45 men) were excluded from the study. In total, 120 female players (age: 25.67 ± 1.61 years) and 134 male players (age: 28.17 ± 1.47 years) performed 2872 and 3296 serves, respectively, during the games (Figure 1). In each game, serve speeds were measured with a radar gun (Radar Ball Coach Pocket, Santa Rosa, CA, USA) that had been used in previous studies [12,13].



JT: Jump topspin serve JF: Jump float serve SS: Standing serve

Figure 1. Flow chart of serve types used by male and female volleyball players.

Two experts classified the serves used by players into three categories: SS, JF, and tennis serve. In the SS, a player hits the ball without jumping. In the JF serve, a player takes a few steps, jumps, and then hits the ball. In this case, whether the ball spins is not important; the ball is hit with a floating technique. A player jumps and hits the ball with his or her hand, stopping shortly after contact to prevent rotation of the ball. In the JT serve, the player hits the ball after jumping, and his or her arm movement is similar to that when spiking. The ball spins along a parabolic path [2,3].

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 20.0 software (IBM Corp. Released 2011. Armonk, NY: IBM Corp.). The normality of all data was tested with a one-sample Kolmogorov–Smirnov test. A χ^2 test was performed to analyze differences in the distribution of serve types used by male and female volleyball players. To calculate effect size, Cramer's V was used. Post-hoc χ^2 analysis was performed with Bonferroni correction (p value was set at 0.008). Comparisons were performed via analysis of variance to detect the effects of gender (male, female), position (outside hitter, setter, and middle blocker), and serve type (JT, JF, tennis) on serve speed. Post-hoc analysis was performed using the *t*-test. A p value of 0.05 was set as the threshold for significance.

RESULTS

Table 1. Serve types used by male and female volleyball players during games

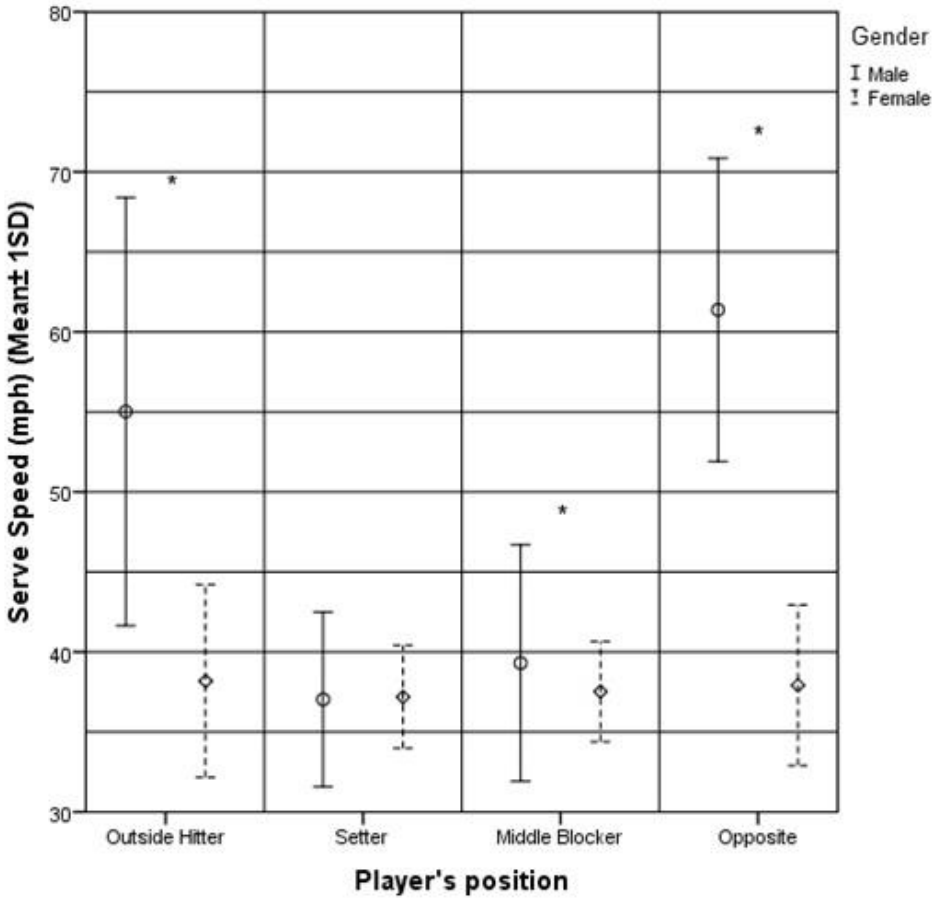
		Jump Topspin Serve	Jump Float Serve	Standing Serve
Males	n (%)	1546 (46.9%)	1745 (52.9%)	5 (0.2)
	z score	36.1	−18.2	−25.9
	p value	<0.0001*	<0.0001*	<0.0001*
Females	N	163 (5.7%)	2163 (75.3%)	546 (19.0%)
	z score	−36.1	18.2	25.9
	p value	<0.0001*	<0.0001*	<0.0001*

*Significant difference was found.

Figure 1 illustrates that female players of all positions mostly preferred the JF serve type. Among males, opposites and outside hitters generally preferred the JT serve type while setters and middle blockers preferred the JF serve type. Serve type was further found to be dependent on gender (Pearson $\chi^2_{(2,6168)} = 1673.84$, $p < 0.001$) with moderate strength (Cramer's V = 0.52, $p < 0.0001$). Post-hoc χ^2 analysis demonstrated that each cell in the table interpreted difference ($p < 0.008$) (Table 1). Females performed JF and SS the most and JT serves the least ($p < 0.008$) (Table 1). Males performed SS for a small percentage and mostly performed JF and JT serves ($p < 0.008$) (Table 1).

Serve speeds of males were 60.57±9.50 mph for JT, 36.88±3.92 mph for JF, 37.80±3.03 mph for SS and 47.99±13.79 mph for all. Serve speeds of females were 48.57±7.60 mph for JT, 37.08±3.55 mph for JF, 37.18±3.12 mph for SS and 37.75±6.65 mph for all. The interaction of gender, player position, and serve type on serve speed was significant ($F_{(6,6166)} = 70.622$, $p <$

0.0001). The main effects of gender, player position, and serve type were also significant ($F_{(1,6166)}$ = 22.848, p < 0.0001; $F_{(3,6166)}$ = 4.369, p = 0.004; and $F_{(2,6166)}$ = 150.916, p < 0.0001, respectively). Males as outside hitters, middle blockers, and opposites produced more powerful serves than their female counterparts (p < 0.001 for all); however, the influence of gender on serve speed could not be observed among setters (p > 0.05) (Figure 2).

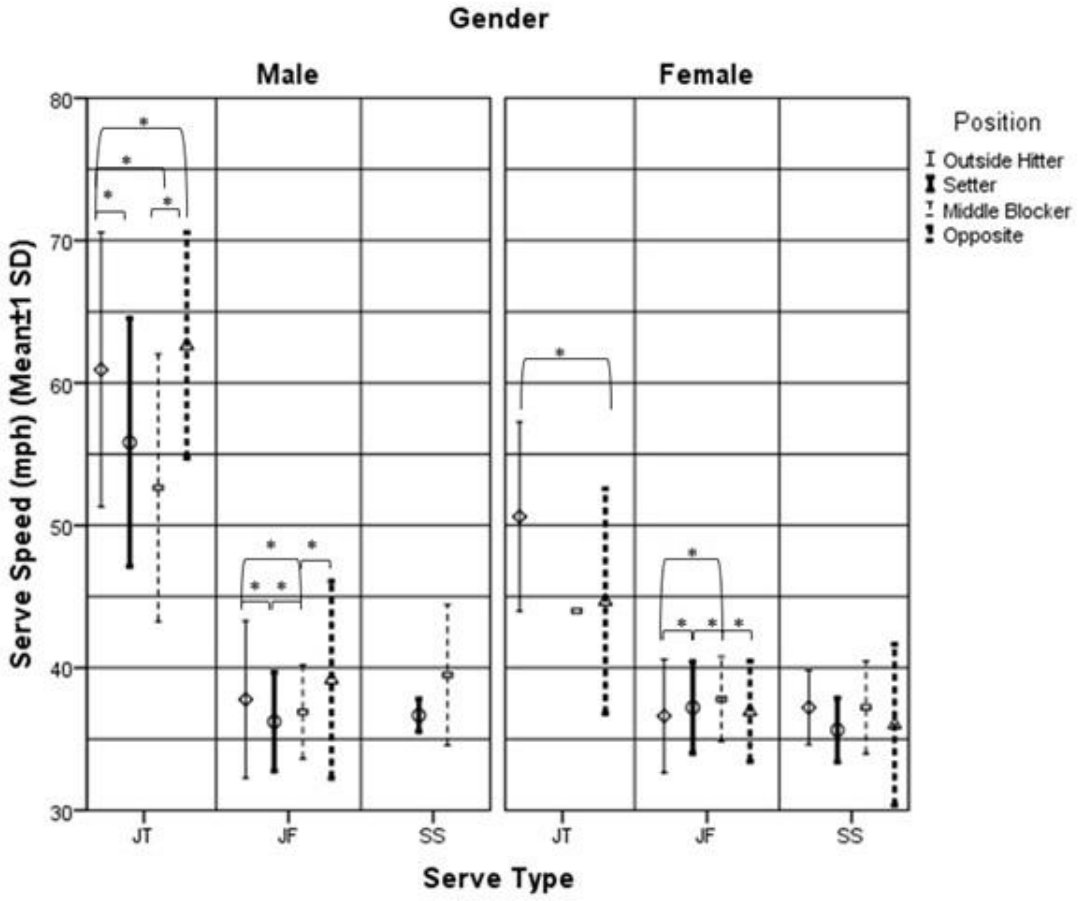


***Significant difference was found (p < 0.05).**

Figure 2. Comparison of serve speeds according to position between male and female volleyball players.

According to the *t*-test results, the serve speed of male players was generally higher than that of females for JT serves of outside hitters (p < 0.0001) and opposites (p < 0.0001) and for JF serves of outside hitters (p < 0.0001), setters (p < 0.0001), middle blockers (p < 0.0001), and opposites (p = 0.003). The JT serves of males and females as setters and middle blockers and SS serve speeds could not be compared statistically because of the low serve numbers of male players (Figure 1). The effect of player position on serve speed with respect to serve type between males and females is depicted in Figure 3. The speeds of JT serves were

higher than those of JF ($p < 0.0001$) and tennis ($p = 0.04$) serves among females, and the speeds of JT serves were higher than those of JF serves among males ($p < 0.0001$).



JT= Jump topspin serve JF= Jump float serve SS= Standing serve

***Significant difference was found ($p < 0.05$).**

Figure 3. Comparison of the serve speeds of volleyball players with respect to their position and serve type.

DISCUSSION

This study confirmed that female volleyball players performed SS more often than male players and used JT serves rarely when compared with males, consistent with findings in previous studies [6,7]. However, Costa et al.'s study [7] revealed that 87.9% of the serves performed by females were of the SS type, a ratio that is much higher than our findings (19%). Other studies reported female SS ratios of 48% [6] and 59.08 % [11], which are also higher than our findings. In this study, the percentage of JF serves used by females increased up to 75.3 being the most used serve type when compared with observations of the 2007 World Championships (38.4%) [7] and the 15th Mediterranean Games of Almeria in 2005 (37%) [6].

This finding indicates that the use of SS by females decreased and that the characteristics of female volleyball continue to evolve.

In previous studies, males performed JT serves the most and SS the least [3,6,7]. In Palao et al.'s study,[6] the percentages of JT, JF, and SS serves were 71%, 25%, and 3%, respectively, and another study [7] found JT, JF, and SS serve ratios of 58.5%, 38.4%, and 4%, respectively. The present study confirmed once more that SS serves are used rarely in men's volleyball. JF serves were performed about 6% more often than JT serves, which may be attributed to the fact that the games observed were performed only in the national league.

The serve speeds of male players in the present work were higher than those reported in Moras et al.'s study [3], which reported speeds of ~51.51 mph for JT, ~25.65 mph for JH, and ~26.95 mph for SS during the 2004 Olympic games. For women we could not find any study reporting serve speeds according to serve types. However, mean value of serve speed including all serve types of this study was higher than a previous study which reported that female players' serve speed was mostly in the range of 50-50 km/h (~31,06-36,06 mph) [11].

While gender differences in muscular strength and muscle fiber characteristics [14,15] are expected to produce male players with more powerful serves than female players, the influence of gender on the serve speeds of players could not be detected among setters. Male outside hitters, middle blockers, and opposites used more powerful serve types than females. However, setters among both male and female players mostly preferred the JF serve, which could explain the absence of a gender difference in this regard.

We could not reach any article about serve speeds of volleyball players according to in-game role. While a previous study [11] investigated the influence of player position on serve speed, it only classified serve speeds by 10 km/h intervals. In addition, while most of the serve speeds recorded in this previous work were in the range of 50–59 km/h, it did not compare mean values. As such, comparing our results with this previous work is unfeasible. The influence of position on serve speed may be related to the serve types performed by the players. Because male outside hitters and opposites preferred the JT serve type, their serve speeds were generally higher than those of other male players. By contrast, because female players preferred the JF serve, very small differences were seen among female in-game roles. While female opposite players performed slower JT and JF serves among other female players, male opposite players performed the fastest JT and JF serves among other male players. This

difference may be attributed to variations in opposite player training programs between males and females. Unfortunately, because the present study is only an observational one, information about each team's training program is not available.

One limitation of this study is that serve efficacy was not investigated. As the speeds of efficient and non-efficient serves may differ, future studies on the speeds of efficient and non-efficient serves according to position, serve type, and gender should be performed.

It was seen that females' serve type preference was JF serve instead of SS. In future studies, the characteristics of female volleyball should be investigated in detail. Comparison of male and female volleyball players revealed differences in serve speeds when players were classified according to in-game role. In terms of position, male opposites and female middle blockers showed the highest serve speeds. Trainers should note that female volleyball players' serve preference has changed to jump float instead of standing serve. Female opposites should be trained for JF and JT serves because of lower serve speeds than those of other female players. It was an expected result that gender has an effect on serve speeds of players according to in-game role, however male setters have similar serve speed when compared with female setters. Male setters should train to increase their serve speed.

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