Ball Speed during the Tennis Serve in Relation to Skill Level and Body Height

Mustafa Söğüt¹

¹Kırıkkale University, Faculty of Sport Sciences, Kırıkkale, Turkey

msogut@kku.edu.tr

Abstract

The purpose of this study was to determine the possible relations between serve speed and tennis skill level, and body height. Participants were male (n= 16, age= 13.81 ± 1.11 years) and female (n= 17, age= 13.35 ± 1.37 years) junior tennis players. Serve speed was evaluated through using a sports radar gun. Tennis skill level was assessed by means of International Tennis Number (ITN) on-court assessment protocol. Pearson’s correlation coefficient indicated significant and positive relationships between serve speed and ITN in both male (r= 0.678) and female (r= 0.490) participants. Results also revealed significant and positive correlation between serve speed and body height in male (r= 0.733) and female (r= 0.504) players. Thus, study highlighted the positive association between serve speed and skill level, and body height in junior male and female tennis players.

Keywords: Tennis, serve speed, skill level, body height
INTRODUCTION

Improvement in physical fitness of tennis players and production of larger headed rackets are the main factors that triggered the increment in the pace of modern tennis (Cross and Bower, 2006). These progressions also stimulated coaches and tennis players in all competitive levels to focus more on power and velocity of the ball (Abrams et al., 2011). Producing high velocity, especially during the serve, plays an important role in successful play (Martin et al., 2013). For instance, it causes ineffective return via reducing the time for preparation (Vaverka and Cernosek, 2016).

Previous studies reported that the ball speed during the serve is influenced by skill level (Bartlett et al., 1995; Girard et al., 2005; Martin et al., 2014; Ulbricht et al., 2015). Girard et al. (2005) compared the serve speed of male tennis players (age= 21.5 ± 3.8) divided into three sub-groups (beginner, intermediate, and elite) according to their rankings. Results indicated that serve speed was higher in elite level than in beginner and also intermediate levels. Martin et al. (2014) also found significantly faster serve speed in professional players when compared to their advanced counterparts. According to Bahamonde (2000) it is very difficult to gain expertise in serve, since it requires complex coordination of both upper and lower limbs. It also involves precise use of major muscles (Knudson et al., 2004).

On the other hand, several studies emphasized the relations between serve speed and anthropometric characteristics of professional tennis players (Bonato et al., 2015; Vaverka and Cernosek, 2013; Vaverka and Cernosek, 2016; Wong et al., 2014). Sánchez-Muñoz et al. (2007) stated that determining the anthropometric traits of elite players may raise valuable information about the relationship between body structure and sports performance. According to Vaverka and Cernosek (2013) an effective serve is strongly influenced by the relation between serve speed and body height. When the ball is hit at a higher contact point, there will be a larger available serve box area for the ball to land (Brody, 2006). Bonato et al. (2015) also asserted that body height is the main anthropometric factor in serve speed in high level tennis players.

Vast majority of the earlier studies correlating serve speed and other aforementioned parameters mostly focused on professional players. Therefore, there is a paucity of information about the relationships between serve speed and other parameters in junior male and female tennis players. This study attempted to fill this gap through analyzing relations between serve speed and skill level, and body height. It was hypothesized that skill level and
body height of junior male and female players would be positively related to the serve speed. Results of the study may raise information for players, coaches, and other tennis staff in better understanding the association between ball speed during the serve and tennis playing level, and body height.

**METHODS**

**Subjects**

Participants were male (n= 16) and female (n= 17) junior (age= 13.58 ± 1.25) tennis players. Regarding the International Tennis Number (ITN) on-court assessment protocol (Crespo et al., 2003), tennis skill levels of both male and female players were ITN 5. Age, anthropometric values, tennis playing experience, and weekly training characteristics of the participants are presented in Table 1. Participants were informed on the purpose of the study and the testing procedures. Informed consent was signed by the parents of the participants.

**Table 1. Anthropometric and training characteristics of the subjects**

<table>
<thead>
<tr>
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<th>Male (N= 16)</th>
<th>Female (N= 17)</th>
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<tbody>
<tr>
<td>Age (year)</td>
<td>13.81 ± 1.11</td>
<td>13.35 ± 1.37</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163.3 ± 11.42</td>
<td>159.5 ± 0.08</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>51.6 ± 9.48</td>
<td>48.2 ± 6.97</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>19.20 ± 1.72</td>
<td>18.85 ± 1.70</td>
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<tr>
<td>Experience (year)</td>
<td>4.94 ± 0.85</td>
<td>4.82 ± 0.95</td>
</tr>
<tr>
<td>Tennis practice (h/w)</td>
<td>5.81 ± 2.34</td>
<td>5.65 ± 1.41</td>
</tr>
<tr>
<td>Physical practice (h/w)</td>
<td>2.13 ± 1.15</td>
<td>2.24 ± 1.09</td>
</tr>
<tr>
<td>Total practice (h/w)</td>
<td>7.94 ± 3.30</td>
<td>7.88 ± 2.42</td>
</tr>
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**Data Collection Instruments**

A radar gun (SR3600; Sports-radar, Homosassa, FL, USA) was used to determine the serve speeds of the participants. Tennis skill level was evaluated by means of ITN developed by International Tennis Federation. ITN represents a player’s general level of play which classified players from ITN 1 (high level players) to ITN 10 (recreational players) (Crespo et al., 2003). Body height was measured with a portable stadiometer (Seca 213, Hamburg,
Germany) to the nearest 0.1 cm. Body weight (to the nearest 0.1 kg) was measured with a digital weighing scale.

Data Collection

All tests were carried out in an indoor tennis court. Subjects were asked to complete a warm up procedure including physical and technical workouts. The radar gun was mounted on a tripod and located behind the participants. Each participant was encouraged to serve with the highest speed from the deuce court with 30 seconds intervals. Eight successful serves were recorded and the fastest one was used for the analysis. ITN was administered according to manual (Crespo et al., 2003). It measures the consistency, accuracy and power of main tennis strokes (forehand, backhand, volley, and serve) as well as mobility. The assessment was applied twice and the best score was recorded. Anthropometric measurements were performed according to the reference manual (Lohman et al., 1988). Body height and weight values were used to determine body mass index (BMI).

Data Analysis

Descriptive statistics (mean ±SD) were calculated for the variables. The Pearson’s correlation coefficient was conducted to analyze relations between ball speed during the tennis serve and skill level, and body height in both genders. Statistical significance level was set at p < 0.05.

RESULTS

Mean (± SD)values for the serve speed and ITN performances of male and female players are given in Table 2.

Table 2. Serve speed and tennis skill level performances of junior tennis players

<table>
<thead>
<tr>
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<th>Male</th>
<th>Female</th>
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<tbody>
<tr>
<td>Serve speed (km·h⁻¹)</td>
<td>136.50 ± 16.57</td>
<td>121.94 ± 11.64</td>
</tr>
<tr>
<td>ITN</td>
<td>246.31 ± 30.70</td>
<td>229.76 ± 31.15</td>
</tr>
</tbody>
</table>

The correlations between serve speed and tennis skill level, and body height are presented in Table 3. Results indicated significant and positive relationships between serve speed and other variables in both genders.
Table 3. Correlation coefficient between serve speed and other variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male</th>
<th>Female</th>
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<tbody>
<tr>
<td></td>
<td>$r$</td>
<td>$p$</td>
</tr>
<tr>
<td>ITN</td>
<td>0.678</td>
<td>0.001</td>
</tr>
<tr>
<td>Body Height</td>
<td>0.733</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**DISCUSSION**

The purpose of this study was to determine the possible relations between serve speed and tennis skill level, and body height. It was hypothesized that skill level and body height of junior male and female players would be positively related to the serve speed. Results of the study confirmed the hypothesis and revealed significant and positive relations between parameters in both genders.

Although earlier studies showed serve speed discrepancy among players from different skill levels, there has been very limited evidence so far about the relation between serve speed and skill level. Nevertheless, similar findings were observed from the study of Ulbricht et al. (2015). They investigated the relations between fitness characteristics and competitive levels of male ($n= 546$, age= 13.14 ± 1.39 years) and female ($n= 366$, age= 13.06 ± 1.29 years) junior tennis players. Their testing battery included; grip strength, counter movement jump, 10 m and 20 m sprint, tennis-specific sprint, overhead, forehand and backhand medicine ball throws, serve speed and tennis-specific endurance test. Results indicated that serve speed were the most correlated variable with the tennis performance level in both male and female players.

Results also indicated significant and positive correlation between serve speed and body height which contrasts with the findings of Wong et al. (2014). They studied the effects of anthropometric characteristics on serve speed in elite male players. Although they found a positive correlation between serve speed and body height, the findings were not significant. They explained these results with the small sample size ($n=12$). On the other hand, the result of the current study is in accord with the findings of the Vaverka and Cernosek (2013). They examined the relations between serve speed and body height in professional male and female tennis players (participated in Grand Slam tournaments in 2008). They found significant correlation between body height and serve speed in both male and female players. Supportive findings were also observed from the study of Bonato et al. (2015). They investigated the association between anthropometric parameters and maximal serve speed in male professional
tennis players and found positive and significant relations between body height and both first and second serve. They claimed that since the importance of first serve in modern tennis is increasing, body height may be the one of the key factors in talent identification.

In conclusion, the study highlighted the positive association between serve speed and skill level, and body height in junior male and female tennis players. Serve speed might be an important factor in predicting the tennis skill level at this age group. Besides, serve speed and body height might be considered as valuable determinants in determining the future success in tennis. Further studies that will focus on the relation between serve speed and actual rankings of both junior and professional players are recommended.

References


