The Relations between Core Stability and Tennis-Related Performance Determinants

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ABSTRACT

The purpose of the study was to investigate the relations between core stability and various performance determinants in tennis. Participants were competitive male (n = 14, age = 13.64 ± 1.65 years) and female (n = 15, age = 13.60 ± 1.72 years) junior tennis players. They were tested on core stability (sport-specific core stability test), maximal serve speed (sports-radar), dynamic balance (star excursion balance test), agility (spider run test), upper body strength (forehand and backhand medicine ball throws), and lower body strength (standing long jump test). Pearson’s correlation coefficient indicated no significant correlation between core stability and other variables in both genders. Thus, the study recommended to strength and conditioning coaches engaged with tennis players in these age groups better not to focus primarily on core stability training in order to enhance performances on the aforementioned parameters.

Key Words: Tennis, Core stability, Performance, Strength training
INTRODUCTION

Core stability is defined in athletic settings as the optimum production, transfer and control of force from the center of the body to the limbs, through stabilization of the position and motion of torso (10). It comprises components that rely on coordination, strength, endurance, and power of hip, abdominal, and spine muscles (5). It is assumed in the literature that improvement in these muscles not only have an important role in preventing musculoskeletal problems but also in the enhancement of athletic performance (1). Thus, popularity of core stability training programs among strength and conditioning specialists has massively increased (18, 34).

Earlier studies investigated the association between core stability and performance in different sport branches such as baseball (4, 13), football (18, 31), golf (35), soccer (19), lacrosse (2, 8), hockey (9), kayak (17), various sports (30), and also recreational athletes (20, 26). Findings indicated uncompromised results. Prieske, Muehlbauer, and Granacher (25) systematically reviewed the aforementioned studies and calculated their weighted mean standardized correlation coefficients. The results of the analyses revealed small-sized correlations in both recreational and expert samples.

The importance of core stability was also emphasized for tennis players (12, 21, 22, 23, 29). Particularly, Petersen (21) accentuated the necessity of core stability on effective court movement and injury prevention. On the other hand, there is paucity for information concerning the relations between core stability and factors determining the tennis performance. Therefore, this study attempted to fill this gap through analyzing the relationship between core stability and various tennis-related performance determinants in junior competitive male and female players.

MATERIAL AND METHODS

Subjects

Subjects were competitive male (n = 14) and female (n = 15) junior tennis players participating in both national and international tournaments. Table 1 represents the anthropometric and training characteristics of the subjects. All subjects and parents were informed on the testing procedures and purpose of the study in accordance with ethical guidelines of the local university.
The relations between core stability and tennis-related performance determinants

Table 1

*Anthropometric and training characteristics of the subjects (mean ± standard deviation)*

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>13.64 ± 1.65</td>
<td>13.60 ± 1.72</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163.1 ± 0.13</td>
<td>159.2 ± 0.08</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>52.2 ± 10.57</td>
<td>51.9 ± 10.22</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>19.43 ± 1.68</td>
<td>20.40 ± 3.39</td>
</tr>
<tr>
<td>Experience (year)</td>
<td>4.86 ± 0.95</td>
<td>4.60 ± 0.91</td>
</tr>
<tr>
<td>Tennis practice (h/w)</td>
<td>5.43 ± 1.91</td>
<td>5.60 ± 2.20</td>
</tr>
<tr>
<td>Physical practice (h/w)</td>
<td>2.07 ± 1.14</td>
<td>2.13 ± 0.83</td>
</tr>
<tr>
<td>Total practice (h/w)</td>
<td>7.50 ± 2.95</td>
<td>7.73 ± 2.84</td>
</tr>
</tbody>
</table>

**Measurements**

__Core Stability Test.__ Sport-specific core stability test (SCST) developed by Mackenzie (14) was used to assess the core stability of the subjects. The SCST is a valid and reliable test for measuring core stability in athletes (33). The protocol involves maintaining a prone bridge position during the following stages: 1) holding the basic plank position for 60 s; 2) lifting the right arm off the ground and holding this position for 15 s; 3) returning the right arm to the ground and lifting the left arm off the ground for 15 s; 4) returning the left arm to the ground and lift the right leg off the ground for 15 s; 5) returning the right leg to the ground and lift the left leg off the ground for 15 s; 6) lifting both the left leg and the right arm from the ground and hold for 15 s; 7) returning the left leg and right arm to the ground, and lift both the right leg and the left arm off the ground for 15 s; 8) returning to the basic plank position for 30 s. The test was discarded when the subject was unable to hold the required position. The score is the length of time that the subject maintains the correct position. The test was repeated twice and the best score was recorded for the data analysis.

__Maximal Serve Speed.__ The test was carried out in an indoor tennis court. Subjects were asked to complete a warm up procedure including physical (jogging and stretching) and technical (ground strokes rallies and serve) workouts. A radar
gun (SR3600, Sports-radar, Homosassa, FL, USA) was mounted on a tripod and located behind the subjects. Each subject was encouraged to serve with the highest speed from the deuce court in 30 second intervals. Eight successful serves were recorded and the fastest one was used for the analysis.

**Star Excursion Balance Test (SEBT).** SEBT was administered regarding the protocol reported by previous studies (7, 24). Subjects performed 6 trails on each leg for each reaching direction. They were asked to stand on one leg in the center of a grid, with the most distal aspect of their great toe at the starting line. While maintaining single-limb stance, they were challenged to reach, with their free limb, anterior, posteromedial, and posterolateral directions. The maximal reach distances for each direction were recorded. All reach distances were normalized with the limb length (distance between anterior superior iliac spine and most distal portion of lateral malleolus) to determine the SEBT composite scores calculated by dividing the sum of the 3 reach distances by 3 times limb length then multiplying the score by 100.

**Spider Run Test.** The test was used to assess agility performance of the subjects (11, 28). They were asked to pick up five tennis balls, positioned on a specific location in a regular tennis court, and retrieve them to the rectangle target area behind the center of the baseline. The elapsed time was recorded as soon as the last ball was placed in the rectangle. The test was repeated twice and the best score was recorded.

**Forehand (FH) and Backhand (BH) Medicine Ball Throws.** The FH and BH medicine ball throw tests were administered according to the protocol described in the previous studies (6, 27). The subjects were asked to throw a 2 kg medicine ball behind the designated line through simulating FH and BH strokes. Distance from the line to the point the ball landed was measured. The best of three trials was used for the analysis.

**Standing Long Jump Test.** The measurement was carried out in regard with the studies of Castro-Piñero et al. (3) and Markovic et al. (15). The subjects were asked to stand behind the designated line and jump as far as possible. The distance was measured from the starting line to the landing point where the back of the heel was nearest to the line. The assessment was applied twice and the best score was recorded.

**Procedures**

Subjects were tested on two separate days. On the first testing session, they were tested on sport-specific core stability assessments. A stopwatch was used
to determine the duration times. After completing first session, they were given a resting day. On the second testing session, they were tested on various tennis-related performance determinants. Maximal serve speeds were evaluated using the radar gun. Three tape measures were used to assess reach distances for dynamic balance test. The stopwatch was used to determine the elapsed time for agility test. A steel tape was used to measure the distances for the FH and BH medicine ball throws and standing long jump tests.

**Statistical Analyses**

Descriptive statistics (mean ± SD) were calculated for the variables. The Pearson’s correlation coefficient was used to determine relations between test variables. The statistical significance level was set at p < 0.05. All data were analyzed using SPSS v. 20 for windows.

**RESULTS**

The means and standard deviations for the study variables are presented in Table 2.

| Table 2 | Descriptive statistics (mean ± standard deviation) of male and female players |
|--------------------------|-----------------------------|-----------------------------|
| Gender                   | Male                        | Female                      |
| Core stability (s)       | 140.93 ± 33.61              | 128.87 ± 15.99              |
| Maximal Serve Speed (km·h⁻¹) | 133.43 ± 18.54              | 120.80 ± 14.37              |
| Star Excursion Balance Test - Right (score) | 99.53 ± 6.37              | 101.63 ± 6.57              |
| Star Excursion Balance Test - Left (score) | 101.81 ± 5.87              | 102.01 ± 6.61              |
| Spider Run Test (s)      | 18.78 ± 1.19                | 19.80 ± 1.47                |
| Forehand Medicine Ball Throw (m) | 10.39 ± 2.79              | 8.27 ± 1.03                |
| Backhand Medicine Ball Throw (m) | 10.12 ± 2.65              | 8.01 ± 0.76                |
| Standing Long Jump Test (cm) | 188.2 ± 20.31              | 166.8 ± 17.61              |
The correlations between variables for male and female subjects are presented in Table 3. The results revealed no significant correlation between core stability and other variables in both genders.

### Table 3

Correlations between core stability and other variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p</td>
</tr>
<tr>
<td>Maximal serve speed</td>
<td>– 0.257</td>
<td>0.375</td>
</tr>
<tr>
<td>Star Excursion Balance Test - Right</td>
<td>0.129</td>
<td>0.659</td>
</tr>
<tr>
<td>Star Excursion Balance Test - Left</td>
<td>0.075</td>
<td>0.798</td>
</tr>
<tr>
<td>Spider Run Test</td>
<td>– 0.062</td>
<td>0.833</td>
</tr>
<tr>
<td>Forehand Medicine Ball Throw</td>
<td>– 0.275</td>
<td>0.341</td>
</tr>
<tr>
<td>Backhand Medicine Ball Throw</td>
<td>– 0.325</td>
<td>0.256</td>
</tr>
<tr>
<td>Standing Long Jump Test</td>
<td>– 0.250</td>
<td>0.389</td>
</tr>
</tbody>
</table>

**DISCUSSION**

There is a widespread belief that core stability is an essential factor in peak athletic performance. However, current literature presents limited evidence on the relation between these variables (4, 18, 20). Thus, the purpose of the study was to determine the relationship between core stability and various performance determinants in junior male and female tennis players. As revealed by results none of the parameters were significantly correlated with core stability in both genders. This finding might be explained with the discrepancy between muscle contraction requirements of core and other tests. Since both on-court movements and strokes in tennis depend mainly on eccentric and concentric muscle contraction (27) performance measures were selected accordingly. Conversely, assessment of core stability requires muscular endurance and isometric contraction (20).

The results are either partly or totally in line with the findings of studies that involved tennis players. For instance, Zingaro (36) studied the relation between core stability and serve speed in male and female colligate tennis players. Significant correlation was reported only for female samples. In addition, Spagnuolo and
Romanazzi (32) analyzed the effects of core stability training program on dynamic balance and medicine ball throw in junior tennis players. They found significant development on dynamic balance but not on medicine ball throw performances. Moreover, McCurdy et al. (16) examined the effects of 8-week core stability/strength training on serve speed and core plank time in male and female intermediate levels colligate players. Although they found significant improvement in the core test, the serve speed did not boost. Furthermore, no significant correlation was reported between core stability and serve speed.

Contrasting results were obtained from the previous studies that focused on the association between core stability and performances in other sports. For example, Wells, Elmi, and Thomas (35) found significant correlation between core stability and golf performance (ball speed and distance). Besides, Filipa et al. (7) reported the positive effects of core training on SEBT performance in female soccer players. On the other hand, supportive findings were observed from the earlier studies of Nesser and Lee (19). They dwelled on the relationship between core stability and various strength and power performance variables in female soccer players. Their results showed no correlations between parameters. Moreover, Hoppe et al. (9) found no correlation between core stability and strength, power, speed, and agility in male hockey players. Ambegaonkar et al. (2) stated no correlation between core stability and SEBT in colligate female lacrosse and soccer players. Similarly, Tse, McManus, and Masters (34) examined the effects of core training on core endurance, rowing-specific aerobic capacity, speed, power, and agility performances in rowers. Results demonstrated that the core intervention program did provide progression only on core endurance but not on any performance measures.

CONCLUSION

Despite the increasing popularity of core stability and training in athletic environments, this study suggested that it does not significantly correlate with the tennis-related performance determinants in junior male and female players. Hence, it is recommended to strength and conditioning coaches engaged with tennis players in these age groups better not to concentrate preliminarily on core stability training in order to enhance performances on the aforementioned parameters. Since the generalization of the results is only for junior players further studies are warranted to determine the relationship between core stability and performance variables in professional tennis players.
REFERENCES


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