INTERNATIONAL JOURNAL of IJSETS SPORT, EXERCISE & TRAINING SCIENCES

e-ISSN 2149-8229 **Volume** 11, **Issue** 1, 1–8, (2025) ***Research Article***

https://dergipark.org.tr/tr/pub/useeabd

The Effects of Six Weeks of Core Training on Service Speed and Certain Motor Characteristics in Tennis Players

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Abstract

Aim: This study was conducted to determine the effects of six weeks of core training on service speed, vertical jump, 5m,10m, and 20m sprint speeds in young tennis players.

Method: A total of 20 tennis players aged 13-15 years, 10 male and 10 female, voluntarily participated in the study, which employed a pre-test/post-test experimental model with no control group. In addition to the routine tennis training, the participating athletes engaged in core training three days per week for six weeks. Measurements and tests were made to determine the service speed and certain biomotor characteristics of the athletes before and after the training. Statistical analyses of the data were performed using the SPSS program.

Results: The paired samples t-test was used for normally distributed data. According to the study findings, the post-test values were higher for the service speed and vertical jump tests of the young tennis players than the pre-test values ($p<.05$). For the 5m, 10m, and 20m speed tests, the post-test values were significantly lower compared to the pre-test values ($p<.05$).

Conclusion: As a result, the six-week core training program carried out by the young tennis players was found to improve service speed along with motor characteristics pertaining to jumping and speed. Therefore, core training programs may be recommended for improving overall sports performance as they yielded increased service speed in young tennis players within a very brief period of just six weeks.

Key words: *Biomotor Characteristics, Core Training, Service Speed, Tennis.*

Submission Date : 01.12.2024 **Acceptance Date** : 09.03.2025 **Online Publication Date** : 27.03.2025

https://doi.org/10.18826/useeabd.1594321

INTRODUCTION

Nowadays, racquet sports can be enjoyed by almost anyone, both as athletic and leisure activities. They can be learned and played comfortably and easily both indoors and outdoors, regardless of age or gender Arı and Çolakoğlu, 2021). Tennis, one of the most popular sports in the world, is played by over 75 million people (Pluim et al., 2007) and is a competitive sport that attracts millions of fans worldwide (Fernandez-Fernandez et al., 2013). In this sport, since there is no time limit, matches can last less than 1 hour or more than 5 hours (Kilit & Arslan, 2017). Tennis is a racquet sport that contributes to the health of players of all ages while also helping to manage anxiety and stress, improve coordination, support bone health, enhance cardiovascular functions, and strengthen mental and physical development (Groppel & Dinubile, 2009). In tennis, the serve can be considered the most important stroke technique, as it initiates the game, provides an advantage to the player, and is the only stroke unaffected by the opponent (Crespo & Miley, 2009). In tennis, serving the ball requires very complex coordination between the torso and lower extremities in order to strike it during the tossing and subsequent falling of the ball. The speed of the racket during contact in a successful service as well as the speed of the ball following contact are of critical importance (Başköy, 2018). The sport of tennis requires strength in the upper and lower extremities in addition to all-over physical strength (Joseph et al., 2005). The proportional strengths of the lower and upper extremities directly affect performance (Okut, 2023). Motor characteristics play a crucial role in tennis, as they do in other facets of life and all branches of sports. A successful tennis player skillfully combines components such as strength, speed, quickness, and flexibility (Clark, 2007). One of the important parameters in tennis is the serve. During the serve, force is transferred from the ground, starting from the ankle to the knees, then to the legs, followed by the hips, torso, shoulder, arm, wrist, and finally to the racket. In elite tennis players, part of their success is attributed to high accuracy and speed in powerful serves, known as power serves or flat serves (Girard et al., 2005).

The core region is comprised of different muscle groups, including the hips, waist, and abdomen, and encompasses the center of gravity of the human body (Samson, 2005). Core training has been shown to

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yield significant changes in strength, balance, and other performance factors (Myer et al., 2006). The successful execution of sports relies on the effective development of an athlete's physiological and biomotor characteristics. From a physiological perspective, factors such as endurance, cardiovascular health, muscle mass, muscle strength, and energy metabolism play a crucial role. Additionally, biomotor skills, including balance, flexibility, speed, agility, and coordination, significantly impact sports performance (Kızılca, 2023). Therefore, training programs are generally designed to focus on these physiological and biomotor attributes to enhance the overall performance of athletes. Training is comprised of activities carried out with the goal of improving athletic performance by fatiguing the body at specific time intervals, thus creating changes in the organism leading to more efficient movement. The total time allocated to training increases with greater intensity and frequency of training (Kahraman & Arslan, 2023). Tennis involves rapid changes in direction by making sudden decisions, allowing for maximal speed of movement. Tennis players must be in control of their whole body and maintain excellent physical fitness in order to achieve a high level of success. Regularly taking part in varied training programs aimed at improving physical, physiological, and biomotor characteristics has been found to positively affect the performance of tennis players (Türkay & Gökbel, 2020). Hence, lower extremity strength, power, speed, acceleration, and endurance represent critical elements for tennis players. The pace of play can be adjusted according to the age group of the players, allowing people of all ages to participate. In racquet sports, anaerobic energy systems are the most important parameter affecting the performance level, as striking the ball and player posture positions occur within the space of just a few moments (Orsolic et al., 2018).

Core training is mainly employed to improve balance, strength, and anatomical function flexibility. It positively affects muscles, while simultaneously improving neural adaptation and proprioceptive senses, and strengthening muscular recovery and body control (Hibbs et al., 2011). Due to the rapid changes in direction, acceleration, and rotations in tennis, core training supports the development of optimal strength in regard to sports performance (Eren, 2019). Sever et al. (2017) found that core training interventions had a positive effect on accurate service speed in young tennis players. When the current literature is examined, the effect of core training on strength, balance, and other performance factors has been studied in many different sports (Myer et al., 2006). Gür & Ersöz (2017) stated that core training applied to tennis players has a positive effect on body strength and stability in terms of sports performance. They also emphasized that training targeting the core muscles is an important factor that can affect physical fitness and mobility components on the court. This study will provide a new perspective to the literature, as it has been observed that the number of studies in the field of tennis is quite limited (Samson et al., 2007).

The objective of this study was to determine the effect of core training on certain performance parameters in tennis, a very popular sport requiring uptake at an early age to achieve success. Specifically, the impact of the core training program on service speeds, vertical jumping heights, and sprint speeds (for distances of 5m, 10m, and 20m), all of which greatly affect overall performance in tennis, was examined. Core training aims to strengthen the center of the body, enhancing balance and mobility. This study demonstrates how such training can improve the performance of players in a sport like tennis, which requires speed and agility. As a result, it can contribute to the technical and physical development of tennis players and provide the opportunity to optimize training programs. Additionally, it helps us understand how effective core training at an early age can be in increasing athletes' success in the long term. In this context, the study provides valuable insights for both athletes and coaches.

METHOD

Research model

This study was designed using an experimental model, a type of quantitative research method; specifically, a pre-test/post-test design without a control group was employed. In this design, the participants were tested, and measurements were taken in relation to the dependent variables prior to and following implementation of the experimental protocol (Büyüköztürk et al., 2012). In this study, the effect of six weeks of core training applied to tennis players in accordance with the study model on the serve speed of tennis players was examined.

Training Protokol: In addition to routine tennis training, the participating athletes completed core training exercises three days per week for a total of six weeks. Prior to and following the core training, measurements and tests were made of the athletes' service speeds and certain biomotor characteristics. The core training program performed by the athletes is presented in detail in Table 1.

Table 1. Core training program completed by the participating tennis players

Movement	Number of Sets (Weeks 1-2)	Number of Sets (Weeks 3-4)	Number of Sets (Weeks 5-6)	Duration	Rest Between Sets	Rest Between Movements
Plank	2	3	4	25 sec	30 sec	60 sec
Side Plank	2	3	4	25 sec	30 sec	60 sec
Crunch	2	3	4	25 sec	30 sec	60 sec
Reverse Crunch	2	3	4	25 sec	30 sec	60 sec
Superman	2	3	4	25 sec	30 sec	60 sec
Squat	2	3	4	25 sec	30 sec	60 sec

Population and sample

The research group consisted of a total of 20 active tennis players (10 male and 10 female) from the province of Muş, Turkey, aged 13-15 years, with at least one year of experience playing tennis.

Data collection tools

This study was carried out on a voluntary basis. The tennis players participating in the study were provided with general information regarding the study, including the purpose of the research, before proceeding with testing and measurements. Prior to the start of the study, the subjects read and signed voluntary consent forms. In addition, since the subjects were under the age of 18, parental consent forms were also obtained from the families of the subjects.

Personal Information Form: In our study, a questionnaire containing questions on gender, age, and years of tennis experience was used to collect demographic data on the participating athletes.

Vertical Jump Test: The participating tennis players' vertical jump performances were measured using the Fusion brand Smart Jump mat, which takes electronic measurements. After positioning themselves on the mat, the participants were asked to jump as high as they could with their hands on their waists as soon as they were ready. The athletes performed the jump and their heights were recorded upon landing back on the mat. The jump values of the participants were measured in cm and each athlete performed two jumps, with the best value being recorded (Atan, 2019).

5m, 10m, and 20m Speed Tests: The Fusion brand Smart Speed electronic measuring photocell device was placed at the start and end points of the distances to be run. The participants started the sprint 50 cm behind the starting point and the measurements were carried out using the photocell to record the times. Each participant was allowed two attempts and their best time was recorded (Özdemir, 2013).

Measurement of Ball Speed on Serve: To prevent weather conditions from affecting service speed, measurements were taken on an indoor tennis court. Prior to the training, the athletes were given sufficient time to warm up their muscles, thus minimizing the potential for injury. Following the warm-up, the participants waited for their pulse rates to return to their resting state before starting the test. Each participant performed five serves and the best values were recorded. A radar (Sports Radar, Power Madd) device was used to measure the speed of the tennis ball. The radar was placed in the center (net) line service reception area during measurement. Serves were made in accordance with official tennis rules; only balls landing within the service box on the opposite side of the court were considered valid, and the speed of balls that hit the net was not recorded. For actual data analysis, only the fastest of the five serves performed by each athlete, with maximum power at maximum speed (km/h), was recorded (Kaya et al., 2020).

Data analysis

The SPSS (Statistical Package for the Social Sciences) program version 26.0 was employed in the statistical analysis of the data obtained in the study. The normality of the data was established using the Shapiro-Wilk test (Shapiro & Wilk, 1965). According to the normality test findings, it was determined that the data had a normal distribution ($p > .05$). In analyzing the data, the paired samples t-test was

performed to determine the differences between pre-test and post-test values. A value of $p < .05$ was accepted as statistically significant.

RESULTS

Data pertaining to the demographic characteristics of the participating tennis players are presented in Table 2. The results of the statistical analyses on service speed, sprint speed, and vertical jump performance are shown in Tables 3, 4, and 5, respectively.

Table 2. Demographic characteristics of the athletes participating in the study

Variable	Group	n	%
Gender	Male	10	50.0
	Female	10	50.0
Age	13 Years	6	30.0
	14 Years	8	40.0
	15 Years	6	30.0
Number of years playing tennis	1 year	5	25.0
	2 years	9	45.0
	3 years	6	30.0
Total		20	100

As seen in Table 2, there were equal numbers of male and female participants. With regard to age, 40% were 14 years old, 30.0% were 13 and the other 30.0% were 15. A total of nine participants (45.0%) had been playing tennis for two years, 30.0% for three years, and 25.0% had been playing for only one year.

Table 3. Comparison of the participants' pre-test and post-test service speeds

Parameter	n	Tests	$\bar{X}$	S.D.	t	p
Speed of Serve	20	Pre-Test	86.80	6.39	-.518	.000*
		Post-Test	88.30	6.57		

**p<.05*

According to the results given in Table 3, a comparison of the pre-test and post-test service speeds of the athletes participating in the study revealed a significant difference in favor of the post-test values (p<.05).

Table 4. Comparison of the participants' pre-test and post-test 5m, 10m and 20m sprint speeds

Parameter	n	Test	$\bar{X}$	S.D.	t	p
5 m Speed	20	Pre-Test	1.32	.18	1.951	.018*
		Post-Test	1.17	.15		
10 m Speed	20	Pre-Test	2.13	.13	2.266	.035*
		Post-Test	2.09	.11		
20 m Speed	20	Pre-Test	4.14	.37	3.890	.018*
		Post-Test	4.04	.30		

**p<.05*

According to Table 4, a comparison of the pre-test and post-test sprint speeds in the 5m, 10m, and 20m distances showed significant differences in favor of the post-test results (p<.05).

Table 5. Comparison of the participants' pre-test and post-test vertical jump heights

Parameter	t	Test	$\bar{X}$	S.D.	t	p
Vertical Jump	20	Pre-Test	37.14	.43	-4.520	.001*
		Post-Test	39.04	.40		

**p<.05*

Based on the data presented in Table 5 comparing pre-test and post-test vertical jump heights, a significant difference was observed in favor of the latter (p<.05).

DISCUSSION

The present study sought to determine the effects of a six-week program of core training on service speed and certain motor characteristics in tennis players. A review of the literature discovered studies in which athletes in numerous branches of sport, including tennis, engaged in core training. In our study, the six-week core training was found to have increased vertical jump performance. Ütünbaş et al. (2023) found improvements in vertical jump values as a result of the 6-week core exercises applied to young

football players. Arslan & Ergin (2022) examined the effects of an 8-week core training program on agility, strength performance, and tennis skills in tennis players aged 10-14. As a result of the study, improvements were found in jump skills and tennis skills. In their study, Fernandez et al. (2013) applied a 6-week core strength exercise program to 13-year-old tennis players and found improvements in the players' serve speed at the end of the study. Sannicandro et al. (2020) observed significant differences in the jump heights of 42 young basketball players after four weeks of core training. In their study, Aslan & Kahraman (2023) reported that a six-week core training program improved the vertical jump performances of star soccer players. In a study by Behringer et al. (2013), they investigated the effects of different strength exercises on serve speed in 36 tennis players aged 15. After 8 weeks, the experimental group that performed strength exercises showed improvements in tennis speed. Eren (2019) found significant differences in the vertical jump heights of tennis players in favor of the post-test results following eight weeks of core training. In their study involving female tennis players aged 10-14, Kıvrak & Zorlu (2019) observed significant increases in vertical jump heights. Aktaş et al. (2011) observed a significant difference in the vertical jump performances of male tennis players aged 12-14 in favor of the post-test results of the experimental group compared to those of the control group. A study conducted by Demirkan (2016) involving 9-year-old female tennis players found a significant difference between pre-test and post-test vertical jump heights in favor of the latter. A study involving elite tennis players aged 12-14 conducted by Tunç (2018) also reported a significant difference in vertical jump heights in favor of the post-test values. The results of these studies are consistent with the findings obtained in the present study.

In this study, implementation of the six-week core training program resulted in increased service speed. Eren (2019), examining the effects of eight weeks of core training on groundstroke speed and selected motor characteristics in tennis players aged 12-14, found significant differences in the service speeds in favor of the post-test results. In a study by Sever et al. (2017), the service speeds of the core training group were determined to have increased by 6.6% at the end of the study. Fernandez et al. (2013) conducted a study incorporating core training on a total of 30 male athletes with an average age of 13, observing significant differences in the service speeds measured at the end of six weeks. Begringer et al. (2013), researching the effects of various eight-week strength training programs on the 15-year-old study participants, found increases in the service speeds of all groups. Ferrauti & Bastiaens (2007), who also studied the acute effects of different types of strength training, reported that service speeds increased as heavier weights used in training were replaced with lighter weights. Overall, the results of these studies on pre- and post-training service speeds are similar to the results obtained in our study.

The findings of the present study indicated that the six-week core training program improved 5m, 10m, and 20m sprint performances. According to Aktaş et al. (2011), there were no significant differences in the 5m and 30m sprint speeds of tennis players following an 8-week strength training program, whereas a significant difference was found for the 10m sprint speeds. Yıldız et al., (2018), examining the relationship between explosive strength and speed in child tennis players, observed significant differences for 5m, 10m, and 20m sprint speeds, consistent with our findings. Kramer et al. (2017) also reported significant differences in the 5m and 10m sprint performances of child tennis players. In a study with female tennis players aged 10-14, Kıvrak & Zorlu (2019) noted significant improvement in their 20m sprints. The results of these studies are thus in line with our findings.

CONCLUSION

In this study, conducted to determine the effect of six weeks of core training on service speed and certain motor characteristics in tennis players, core training was found to improve service speed, vertical jump performance, and 5m, 10m, and 20m sprint speeds. Additionally, core training was observed to contribute positively to overall movement efficiency by enhancing balance, stability, and muscle activation, which are fundamental components of athletic performance. These findings highlight the importance of core training in sports like tennis, which require a high level of coordination and explosive strength. In this context, incorporating core exercises into a portion of individual training programs and annual training planning, in addition to routine tennis training programs, can significantly enhance athlete performance.

SUGGESTIONS

- Core training should be included in training programs to improve service speed, vertical jump performance, and sprint speeds in tennis players. Core strengthening can significantly enhance performance in sports like tennis, which require explosive movements.
- Since six weeks of core training resulted in improvements in these motor characteristics, extending the training period could lead to more lasting improvements. Training programs can be planned for a longer duration to increase physical endurance in tennis players.
- It should be emphasized that core training should aim not only to improve service speed but also motor characteristics such as speed and jumping ability. The training can be enriched with exercises specifically targeting these attributes.
- Personalized core training programs should be designed based on the physical levels and needs of tennis players. This could make training more effective for each player to achieve the best results.
- More research should be conducted to understand how core training affects different athletes and age groups. Additionally, studies on the long-term effects of such training will increase its applicability in tennis and similar sports.

Etical Approval and Permission Information

Ethics Committee: Muş Alparslan University, Scientific Research and Publication Ethics Board
Protocol/Number 73

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