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**EFFECT OF 12 WEEKS BASIC TENNIS TRAINING ON TENNIS SKILL,
STRENGTH AND SIMPLE REACTION TIME IN CHILDREN**

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ABSTRACT

The aim of this study was to determine the effect of 12 weeks of basic tennis training on tennis skill, strength parameters and simple reaction time characteristics. A total of 24 boys aged 12 years participated in the study voluntarily. Volunteers were divided into two groups as control and experimental groups. The experimental group received a 12-week tennis training program that included basic tennis techniques. The control group did not receive any training program during this period. Data were obtained from subjects one day before and after the 12-weeks. Handgrip strength, back and leg strength, squat strength tests on the wall; ITN forehand and backhand batting and service tests for tennis skill; Visual and auditory simple reaction time tests were used for reaction time parameters. For the data analysis, dependent and independent t tests were used in SPSS 22.0 program. There was a significant difference between the pre-post tests in all measured characteristics of the experimental group ($p < 0.05$). No statistically significant difference was observed in the control group ($p > 0.05$). When the experimental and control groups were compared, there was a difference in favor of the experimental group ($p < 0.05$). In conclusion, it can be said that 12 weeks of basic tennis training has positive effects on strength, reaction and basic tennis skills.

Keywords: Tennis, Training, Strength, Reaction, Skill

1. INTRODUCTION

The best way to be successful in sports is through the correct planning of branch and athlete-specific training as well as the application of scientific methods and regular monitoring of the performances of the athletes. Today's scientific research examines all the components of exercise and reveals all of the physical (Dogan, Yilmaz, Kabadayi, Bostanci & Mayda, 2019; Yilmaz, Kabadayi, Bostanci, Ozdal & Mayda, 2019) and psychological effects including respiratory (Vural, Ozdal & Pancar, 2019), biochemical (Cinar, Akbulut, Pancar & Kilic, 2019; Pancar, Ozdal, & Vural, 2018; Pancar, Ozdal, Sarikaya & Cinar, 2018; Ozdal, Bicer, & Pancar, 2019), psychological adaptations (Tahhan, Ozdal Vural & Pancar, 2019; Tahhan, Ozdal, Vural & Mayda, 2019) that affect performance. It is an indisputable fact that following the results by the coaches will play an important role in the selection and success of the players before the competition. Tennis is a sports branch which has many different motor features in the technical aspect. In order to achieve the highest level of success in this branch, players must have the necessary motor skills. It is also important for the tennis branch in itself (Elliott, Marsh & Overheu, 1987).

In the latest researches, the conditional characteristics that a tennis player should have been listed as follows (Blimkie, 1992); 15% strength, 15% speed, 25% strength, 35% coordination, and 10% flexibility. Tennis sport requires different skills due to its game structure. During learning, it is usually appropriate to study closed skills, and at the middle and upper levels, more open skills are required. Tennis is a sport with more coordinated features. Therefore, the transfer of previously acquired knowledge and skills to the newly acquired skill is more important during the acquisition of tennis-related skills (Olcucu, 2011).

In this research, the effect of basic tennis training, which we think will be high in the development of tennis skills, on strength and simple reaction time characteristics needed in tennis is wondered. Our study is important in this respect. The aim of this study was to determine the effect of 12 weeks of basic tennis training on tennis skills, strength parameters and simple reaction time characteristics.

2. MATERIAL METHOD

2.1. Experimental Design and Participant

The study designed randomize controlled pre and posttest design. Healthy male students aged 12 years participated in the study voluntarily. In choosing individuals, care was taken to ensure that they were close to each other in terms of age, height, and body weight. A total of 24 students were identified as a research group. The study group was randomly divided into two groups as 12 experimental and 12 control groups.

Table 1. Descriptive Characteristics of the Participants

	Groups	Min.	Max.	Mean.	Std. D.
Weight (kg)	Experiment	32.00	46.00	35.92	4.36
	Control	31.00	66.00	37.50	10.10
Height (m)	Experiment	1.26	1.63	1.50	0.10
	Control	1.36	1.64	1.50	0.08
BMI (kg/m ²)	Experiment	12.82	20.16	16.21	2.42
	Control	12.50	24.54	16.63	3.40

Table 1 shows the descriptive characteristics of the participants. According to the table 1, the mean of the weight of the participant was determined as 32.00±4.36 (experiment), 31.00±10.10 kg (control), height was 1.26±0.10 (experiment), 1.36±0.08 (control), and BMI was 12.82±2.42 (experiment), 12.50±3.40 kg/m² (control).

2.2. Training Protocol

The experimental group was included in a training program designed to teach basic skills to a new learning group for 12 weeks and 3 days a week. Regular tennis exercises were applied to the experimental group for 90 minutes in each training session. The first 10-15 minutes of each training was warm-up, the last 5-10 minutes were cooled and the remaining 70 minutes were applied to basic tennis skills.

In the basic tennis skills training, basic posture exercises, racket grip and swings, rotations, stepping, forehand stroke techniques, backhand stroke techniques and service stroke techniques were studied. While performing this training, the studies included that including in the ITN test.

2.3. Back and Leg Strength Measurement

Back strength measurement was performed with Takei back and leg dynamometer. The participants 5 minutes after warming, knees stretched position dynamometer stand on the legs after placing the arms stretched, back straight and body slightly forward with the hands of the dynamometer bar grasped with the vertical pull up to the maximum rate. This measurement was repeated three times and the highest value was recorded (Bompa, 1998; Marques, 2005).

2.4. Squat Test on the Wall

During the pre-test and post-test, squat measurement on the wall was done to the subjects with the greatest possible accuracy. Measurements were made to ensure that the ankles and knee joints of the subjects were inclined 90 degrees and that the head touched the wall. Then, while one foot was fixed, it was meticulously observed and measured whether the other foot was lifted in the appropriate position. This measurement was repeated 3 times for each subject and was recorded taking into account the highest values (Lubans et al, 2011).

2.5. Handgrip Strength Measurement

The hand-grip force measurements were performed with precision and the measurements were carried out with Takei brand hand dynamometer. Measurements were made for 4-5 minutes before the warm-up was done after the volunteer standing in a smooth and anatomical position without bending the arm

and the body to the arm at a 45-degree angle dynamometer was used 3 times for handgrip strength and the highest value was recorded (Tamer, 1995).

2.6. Skinfold Measurement

Holtain brand skinfold clamp type calibrator which applied 10 g / sqm pressure was used for the measurement. Measurements were carried out 3 times for each region to ensure that subcutaneous fat was not separated from muscle tissue. The data obtained from the measurements were calculated according to the "Yuhasz du formula and revealed the percentage of body fat (Lohman and Pollock, 1981).

2.7. Measurement of Visual and Auditory Reaction Times

Computerized response time tests were used to determine the visual and auditory reaction times of the subjects. Subjects' reaction to visual and audible stimulation by pressing the relevant button on the keyboard or mouse reaction time was recorded in milliseconds (Niemi and Näätänen, 1981).

2.8. INT Measurement

First, a total of 10 balls were thrown from a backhand to a forehand with a row in the section that measures the depth and strength of the basic stroke. Subjects earned points based on where the spinning ball hit the field. the maximum score in this section was 90 (Marques, 2005).

2.9. Statistical Analysis

SPSS 20 program was used for statistical analysis. Values are presented as mean and standard deviation, and the significance level is examined as 0.05. Shapiro-Wilk test was performed to check the normal distribution before proceeding to statistical procedures. Paired Samples T test was used for significance between the pre-test and post-tests of the groups. Independent Samples T test was performed to compare the two groups.

3. RESULT

Table 2. Analysis of the Pre-test and Post-tests of the Experimental Group

		Mean	S.D.	t	p
Left Handgrip Strength (kg)	Pre-test	20.96	3.12	-9.078	.000
	Post-test	22.05	3.03		
Right Handgrip Strength (kg)	Pre-test	21.96	4.06	-3.274	.007
	Post-test	23.50	3.50		
Leg Strength (kg)	Pre-test	40.64	9.46	-2.572	.032
	Post-test	44.25	7.33		
Back Strength (kg)	Pre-test	46.25	11.34	-2.726	.024
	Post-test	49.90	8.85		
Squat Test on the Wall Right (sec)	Pre-test	6.75	2.76	-6.139	.000
	Post-test	8.37	2.51		
Squat Test on the Wall Left (sec)	Pre-test	7.88	5.07	-7.403	.000
	Post-test	9.47	4.82		
Body Fat Percentage (%)	Pre-test	12.66	4.75	7.875	.000
	Post-test	12.02	4.55		
ITN Forehand Test (point)	Pre-test	0.50	0.90	-19.282	.000
	Post-test	4.83	1.02		
ITN Backhand Test (point)	Pre-test	0.50	0.90	-6.665	.000
	Post-test	4.33	1.66		
ITN Service Test (point)	Pre-test	0.00	0.00	-10.457	.000
	Post-test	4.33	1.43		
Visual Reaction Time (sec)	Pre-test	587.55	67.97	5.237	.000
	Post-test	514.50	72.16		
Auditory Reaction Time (sec)	Pre-test	564.58	91.89	6.695	.000
	Post-test	478.42	93.81		

Table 2 shows that analysis of the pre-test and post-tests of the experimental group. After the training program 12-week of the experimental group which includes of basic tennis skills, significant differences were found in left and right hand grip strength, leg and back strength, left and right leg squat test, body fat percentage, ITN forehand, backhand and service tests, visual and auditory reaction time ($p < 0.05$).

Table 3. Analysis of the Pre-test and Post-tests of the Control Group

		Mean	S.D.	t	p
Left Handgrip Strength (kg)	Pre-test	18.45	2.10	.924	.375
	Post-test	18.28	2.33		
Right Handgrip Strength (kg)	Pre-test	19.13	3.13	.976	.350
	Post-test	18.66	3.04		
Leg Strength (kg)	Pre-test	30.52	7.27	.947	.102
	Post-test	29.26	7.19		
Back Strength (kg)	Pre-test	42.77	11.02	.566	.126
	Post-test	41.38	10.71		
Squat Test on the Wall Right (sec)	Pre-test	3.23	1.01	.222	.829
	Post-test	3.19	1.18		
Squat Test on the Wall Left (sec)	Pre-test	2.85	1.07	.839	.419
	Post-test	2.62	1.02		
Body Fat Percentage (%)	Pre-test	11.72	5.11	-1.860	.072
	Post-test	12.36	5.16		
ITN Forehand Test (point)	Pre-test	0.17	0.57	-1.483	.166
	Post-test	0.50	0.90		
ITN Backhand Test (point)	Pre-test	0.33	0.77	.561	.586
	Post-test	0.17	0.57		
ITN Service Test (point)	Pre-test	0.17	0.57	.000	1.000
	Post-test	0.17	0.57		
Visual Reaction Time (sec)	Pre-test	540.58	63.59	-1.821	.096
	Post-test	573.75	77.54		
Auditory Reaction Time (sec)	Pre-test	606.25	75.83	-1.101	.081
	Post-test	634.83	92.77		

Table 3 shows that analysis of the pre-test and post-tests of the control group. After the training program 12-week of the control group, there were no significant differences in left and right hand grip strength, leg and back force characteristics, squat test on left and right leg wall, body fat percentage, ITN forehand, backhand and service tests, and visual and auditory reaction time ($p > 0.05$).

Table 4. Comparison of Pre-post test Percentage Differences of Experimental and Control Group

	Groups	Mean. (%)	S.D.	t	p
Left Handgrip Strength (kg)	Experiment	5,40	2,53	5,256	,001
	Control	-1,67	3,90		
Right Handgrip Strength (kg)	Experiment	8,02	8,93	2,880	,009
	Control	-2,66	9,23		
Leg Strength (kg)	Experiment	2,79	8,26	2,799	,010
	Control	-4,86	4,62		
Back Strength (kg)	Experiment	2,46	5,34	4,321	,001
	Control	-5,07	2,83		
Squat Test on the Wall Right (sec)	Experiment	31,92	2,76	3,275	,003
	Control	-1,34	2,26		
Squat Test on the Wall Left (sec)	Experiment	33,43	4,35	2,235	,036
	Control	0,04	170		
Body Fat Percentage (%)	Experiment	-5,54	1,78	-15,964	,001
	Control	5,98	1,75		
ITN Forehand Test (point)	Experiment	408,33	99,62	10,275	,001
	Control	33,33	7,84		
ITN Backhand Test (point)	Experiment	383,33	85,04	6,665	,001
	Control	0,00	1,85		

Table 4. Comparison of Pre-post test Percentage Differences of Experimental and Control Group (*cont.*)

	Groups	Mean. (%)	S.D.	t	p
ITN Service Test (point)	Experiment	433,33	43,54	9,297	,001
	Control	8,33	1,85		
Visual Reaction Time (sec)	Experiment	-13,11	4,80	-4,350	,001
	Control	6,45	2,85		
Auditory Reaction Time (sec)	Experiment	-16,18	7,75	-7,884	,001
	Control	4,56	4,79		

Table 4 shows the comparison of pre-posttest percentage differences in the experimental and control group. A significant percentage difference was found between experimental and control groups in favour of the experimental group in all parameters ($p < 0.05$).

4. DISCUSSION

In this study, 24 healthy male students voluntarily participated in our study group. 12 of these volunteers were in the experimental group and 12 were in the control group. The mean bodyweight of the experiment group was 35.92 ± 4.36 kg, the length was 1.50 ± 0.10 m, and the body mass index was 16.21 ± 2.42 kg / m²; the mean bodyweight of the control group was 37.50 ± 10.10 kg, the height was 1.50 ± 0.08 m, and the body mass index was 16.63 ± 3.40 kg / m². In terms of the descriptive characteristics examined, the experimental and control groups included in the study were found suitable for the implementation of the tennis training program.

There was a significant increase in right and left hand grip strength, dynamometer, back and leg strength and squat strength in right and left leg wall after 12 weeks of tennis training ($p < 0.05$). In the control group without tennis training, no significant change was observed in any of the strength parameters ($p > 0.05$). At the same time, there was a significant difference in favor of the experimental group ($p < 0.05$).

These results showed that the strength parameters were not affected by time factor as seen in the control group and that tennis training had positive effects on the strength parameters as seen in the experimental group. Previous studies show that tennis training has positive effect widely on strength parameter in athletes and sedentary individuals (Coleman, 2009; De Renne, Ho & Murphy, 2001; Ravé, Micallet & Girard, 2008; Roetert, Kovacs, Knudson & Groppe, 2009; Szymanski, 2007; Vural, M., Ozdal, M., & Oztutuncu, 2017).

ITN forehand, backhand hit and service tests which measured the tennis skills of the experimental group showed a significant increase after 12 weeks of tennis training ($p < 0.05$). In the control group without tennis training, no significant change was observed in any of the tennis skill test parameters ($p > 0.05$). At the same time, there was a significant difference in favor of the experimental group ($p < 0.05$).

These results showed that tennis skill was not affected by learning factors and time factors as shown in the control group, and as shown in the experimental group, tennis training had positive effects on the strength parameters. The latest studies emerged that basic tennis training has a positive effect on tennis skills and tennis stroke techniques (DeRenne, Buxton, Hetzler & Ho, 1994; DeRenne, Buxton, Hetzler & Ho, 1995).

In our study, it is possible to explain the increase in basic skills both with increasing strength parameters (Wulf, McConnel, Gärtner & Schwarz, 2002) and with the learning effect developed by continuing training (Fortun, Davies, Giandariia & Romkyn, 1997; Oztutuncu, Ozdal & Vural, 2018). Parallel to the increasing strength in the literature, both the performance of the throw and throw-throws mentioned that the performance increased (Rotella and Bunker, 1978). Therefore, it is thought that the increase in the basic skill level of tennis obtained in our study can be explained by both the positive effect of the 12-week training program on the (physical) strength and the learning effect stemming from the modelling of the skill skills applied (psychometrically).

Visual and auditory reaction time test results of the experimental group showed a significant decrease in the reaction performance after 12 weeks of tennis training ($p < 0.05$). In the control group without tennis training, no significant change was observed in any of the reaction time parameters ($p > 0.05$). At the same time, there was a significant difference in favor of the experimental group ($p < 0.05$).

These results showed that the reaction time was not affected by learning factors and time and tests, as shown in the control group, and that tennis training had positive effects on simple visual and auditory

reaction time parameters as seen in the experimental group. In the previous studies showed that the training programs have a positive effect on reactions time on tennis players (Collet, 1999; Takeuchi, 1993; Häkkinen and Komi, 1983; Ihara and Nakayama, 1986; Salonikidis and Zafeiridis, 2008; Wojtys, Huston, Taylor & Bastian, 1996). The speed of the reaction which known as apart of the motion speed; is known as the time it takes to initiate the conscious action when a signal is given to the time and is related to neurophysiological properties (Acak, Karademir, Taşmektepligil & Caliskan, 2012; Ozaslan, Bicer, Ozdal, Vural & San, 2017).

In the present study, it is thought that the reaction time improvement in the experimental group obtained from our study is due to neuromuscular adaptation. Stretch reflex, neuromuscular adaptations gained by training, musculotendinous system and Golgi tendon elasticity (Chu, 1992; Salonikidis and Zafeiridis, 2008) and experience effect providing increased learning and cross-transfer adaptation can be shown as the mechanisms of improvement in reaction time

As a result, it could be said that the training program, which includes basic tennis skills for 12 weeks on boys in the 12-year age group, have positive effects on the auditory and visual simple reaction time, forehand batting, backhand batting, serving shot skill, right and left handgrip strength, back strength, leg strength, right and left leg wall squat strength.

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