İlkiliroğlu Ersin
Demirci Nevzat

THE EFFECTS OF SHADOW WARM-UP ON TENNIS GROUNDSTROKE ACCURACY AND DEPTH POWER

UČINKI OGREVANJA BREZ LOPARJA NA NATANČNOST UDARCA GROUNDSTROKE IN GLOBINSKO MOČ

ABSTRACT

The purpose of this study was to determine whether shadow warm-up has an effect on tennis backhand (Bh) and forehand (Fh) Groundstroke Accuracy and Depth Power. The study group consisted of 28 subjects divided into 2 groups: (n=14) control group performing traditional warming and (n=14) experimental group performing shadow warming in addition to traditional warming. After 2 weeks from the pre-test measurement, the results of the Groundstroke Accuracy and the Depth Power test measurements of both groups were determined by the ITN test. The Independent Samples T-Test was carried out to compare the intergroup scores. Paired Samples T Test was used to determine intra-group scores. Additionally, Pearson Correlation Test was applied to determine the relationship between the parameters. According to intra-group research findings; when pre test – post test results of both groups were evaluated with ITN results, there was a significant increase in Ground stroke Depth Power (GSDP) and Groundstroke Accuracy Power (GSAP) ($p<0.05$). In the intergroup analyzes, the experimental group achieved a higher significant difference Groundstroke Accuracy Power result compared to control group ($p<0.05$). Again for the experimental group it was detected that there is a positive relation between the Fh-accuracy (GSAP-Post Test-Fh) (R:0.80; $p<0.001$) and Bh-accuracy (GSAP-PostTest-Bh) results (R:0.89; $p<0.001$) which feature the GSAP- Post-test results and where this relation has been found slightly higher in favor of the GSAP-Post Test-Bh. In conclusion, this study showed positive results of shadow-warm-ups on Fh and Bh GSAP parameters of individuals tennis performances ($p<0.05$) but no effect on their GSDP ($p>0.05$).

Keywords: Tennis, Tennis Groundstroke Accuracy-Depth Power, Shadow Warm-Up.

Mersin University
Corresponding Author:
Dr. Ersin İlkiliroğlu
Mersin University; School of Physical Education Sports,
Department of Coaching Education,
Çiftlikköy Kampusu, 33343,
Yenişehir Mersin Mersin
mersinilk@gmail.com

IZVLEČEK

Namen te raziskave je bil ugotoviti, ali ima ogrevanje brez loparja učinek na natančnost udarca groundstroke pri backhandu (Bh) in forehandu (Fh) ter na globinsko moč. V raziskavi je sodelovalo 28 merjencev, ki so bili razdeljeni v dve skupini: kontrolna skupina (n = 14) je izvajala običajno ogrevanje, testna skupina (n = 14) pa je poleg običajnega ogrevanja izvedla še ogrevanje brez loparja. Po dveh tednih od meritev pred testiranjem smo rezultate testiranja natančnosti udarca groundstroke in globinsko moč pri obeh skupinah določili s testom ITN. S t-testom za neodvisne vzorce smo primerjali rezultate med skupinama. S t-testom za parne vzorce smo opredelili rezultate znotraj skupine. Poleg tega smo izvedli tudi Pearsonov korelacijski test, s katerim smo ugotavljali odnose med parametri.

Glede na izsledke raziskave znotraj skupine smo ugotovili, da smo pri ocenjevanju rezultatov pred testom in po njem s pomočjo rezultatov ITN pri obeh skupinah ugotovili značilno povečanje globinske moči udarca groundstroke (GSDP) in natančnosti udarca groundstroke (GSAP) ($p < 0,05$). V analizah rezultatov med skupinami je testna skupina dosegla višje značilne vrednosti moči udarca groundstroke v primerjavi s kontrolno skupino ($p < 0,05$). V testni skupini je bila ugotovljena pozitivna povezava med rezultati natančnosti Fh (GSAP-Post Test-Fh) (R: 0,80; $p < 0,001$) in rezultati natančnosti Bh (GSAP-PostTest-Bh) (R: 0,89; $p < 0,001$), ki vsebujejo rezultate GSAP-Post-test in kjer je bila ta vrednost nekoliko višja v prid GSAP-Post Test-Bh. Zaključili smo, da je raziskava pokazala pozitivne rezultate ogrevanja brez loparja pri parametrih Fh in Bh GSAP za uspešnost posameznih teniških igralcev ($p < 0,05$), ni pa bilo učinkov na njihov GSDP ($p > 0,05$).

Ključne besede: tenis, natančnost udarca groundstroke in globinska moč, ogrevanje brez loparja

INTRODUCTION

The success in tennis sport as well as in all branches of sports is based on the fact that the athletes should develop all elements of basic motor skills to show maximum performance. With respect to motor skills, coordination, agility, speed and especially strength development are the most important elements that tennis players should pay attention during the training process (Gelen et al., 2007). The success in tennis depends on near-perfect technical skill, physical preparation and protection, correct psychological approach and the court tactic to be made according to the opponent. To win in today's modern tennis requires using these elements in the right place and time (Smekal et al., 2000; Vergauwen et al.,1998). Furthermore, the speed of the ball and accuracy are two of the most important components in faster scoring in the modern game tempo (Signorile et al., 2005).

Some researchers have emphasized that physical abilities are important for tennis performance (Fernandez et al., 2006; Ferrauti et al., 2001; Kovacs, 2007; Reid and Schneiker, 2008). The physical abilities in tennis consist of upper and lower body, strength, speed and agility (Kovacs, 2007). In addition to training methods that are used to increase the performance of athletes, warm-up exercises also gain importance for the protection of existing performances. Any activity that increases body temperature by several degrees is called warm-up (Gogte et al., 2017). To follow the physiological changes that may affect the performance of athletes during games especially in the branches of sports like tennis and to do studies aimed at minimizing the negative effects of these changes will affect the success. After the competition, the physical and physiological changes in the muscles should be revealed the nervous system activation should be examined and brought to a point close to resting (Keskin et al., 2016). One of the methods used to develop this skill is Shadow tennis exercises. Shadow exercises, which are also known as Shadow practice or Shadow play, are defined as a repetitive action that mimics a certain skill used in a particular sport (Letts, 2007). The most important feature that distinguishes the shadow warm-up from the actual stroke is the failure of stroke (Ivancevic et al., 2011). The performance of the athletes can be increased as a result of the improvement in forehand (Fh) and backhand (Bh) tennis stroke techniques that can be properly exercised with shadow tennis exercises.

In our study, it was planned to investigate the effects of Shadow warm-ups to perform Fh - Bh strokes techniques of complex motor skills that have an important place in tennis game with the best performance in training or tournaments with the methods that allow structuring of proper warm-up exercise by taking into account the general character of tennis sport, the score times in the game, number of strokes, the stroke techniques used, and the resting periods. Therefore, Shadow warm-up that we consider as the study design to increase the speed and stroke of the ball is important. The purpose of this study was to examine whether Shadow warm-up had an effect on tennis Groundstroke Accuracy Power (GSAP) and Groundstroke Depth Power (GSDP).

MATERIAL AND METHOD

Research Model

The experimental design, Pre-test-Post-test Control Group Test Design was used in this study. In accordance with all the data obtained, the participants were selectively assigned to the experimental and control groups to ensure equivalence. All participants continued similar training

programs 3 days in a week for 2 weeks after the pre-test. Within 2 weeks after the pre-test, the control group performed traditional warming before their training, and the process of teaching Shadow warm-ups after traditional warming was applied to the experimental group. After two weeks, Groundstroke Accuracy and Depth Power post-test measurements were obtained by ITN test. Before the test, the control group performed traditional warming and TTF in-court stroke warm-ups, and the experimental group performed Shadow warm-ups and TTF in-court stroke warm-ups in addition to traditional warming.

Participants

Women and men competitor athletes in the 12-15 age group who were living in Mersin and had tennis player license for at least 2 years were included in this study. The study was composed of a total of 28 athletes including 20 women and 8 men in the Experimental Group (n=14) and Control Group (n=14). Before the study, all of the subjects were given detailed information about the study, and the Informed Consent Form that includes the risks and disorders that may be encountered and indicates that they voluntarily participated in the study was signed. This study was approved by Mersin University Science Research Ethics Committee (2016/7). The study was conducted in accordance with the Helsinki declaration WMADH (2000).

Data collection

The data collected from the athletes participating in the study and the measurements were gender and age, height (Durandt, 2009), body weight (Zorba and Saygın, 2009), Body Mass Index determination (Mackenzie, 2005), then ITN groundstroke depth power test and ITN groundstroke accuracy power test for the measurement of tennis performance, respectively.

Testing procedure

Warming Instruction

All athletes were allowed to perform traditional warming for 10 minutes (low tempo running for 5 minutes, static stretching for 5 minutes) before the ITN tests and Shadow warm-ups, and then, all athletes were allowed to apply pre-test and post-test warming instruction.

Pretest Warming Process and ITN

1. Traditional Warming 10 minutes

2. TTF in-court stroke warm-up 5 minutes

3. ITN Pre-test measurement

After pre-test measurements, the athletes were divided into two groups, and the Experimental group was made practice Shadow warm-ups for 4 times in total, twice a week within 2 weeks so that they would learn Shadow warming. At the end of two weeks, ITN tests were repeated for post-test measurements of all athletes. Data were recorded as GSDP - GSAP Pre-Test. No athlete was provided with the information on Shadow Warming before pre-test measurements.

Shadow Warming Designs

Three different Shadow Warming designs were created. Each design was composed of a set consisting of 10 strokes and three sets that would repeat with 20-second resting between the sets.

Players performed 10 strokes (20sec) in 1 set, three sets in a study design and 90 strokes in total. The resting time was 20 sec between the sets and 90 sec between three different study designs. Total Shadow warm-ups lasted for 8 minutes.

Shadow Warming Design Application I

The athletes in the Experimental Group stand in basic tennis position behind the balls with a vertical distance of 1 m between two balls standing 3 m horizontally away.

1st SET starting position	**2nd SET** starting position	**3rd SET** starting position
10 Shadow Strokes (20sec)	10 Shadow Strokes (20sec)	10 Shadow Strokes (20sec)
20sec resting	20sec resting	90 sec resting

A total of 30 strokes in Shadow Warming Design I last about 60sec. The resting time is 20sec between the sets and 90sec at the end of the 3rd set. After resting, Design II is initiated (Picture I)

Shadow Warming Design Application II

The athletes in the Experimental Group stand in basic tennis position behind the balls with a vertical distance of 1 m to the ball which is more behind on the forehand side between two balls standing 3m horizontally and 2m vertically away (cross).

1st SET starting position	**2nd SET** starting position	**3rd SET** starting position
10 Shadow Strokes (20sec)	10 Shadow Strokes (20sec)	10 Shadow Strokes (20sec)
20 sec resting	20 sec resting	90 sec resting

(Picture II)

Shadow Warming Design Application III

The athletes in the Experimental Group stand in basic tennis position behind the balls with a vertical distance of 1 m to the ball which is more behind on the backhand side between two balls standing 3m horizontally and 2m vertically away (cross).

1st SET starting position	**2nd SET** starting position	**3rd SET** starting position
10 Shadow Strokes (20sec)	10 Shadow Strokes (20sec)	10 Shadow Strokes (20sec)
20 sec resting	20 sec resting	Study is finished.

(Picture III)

Post Test Warming Instruction

2 weeks after the pre-test measurements, the ITN Post-test of the Experiment and Control group was performed. In the ITN post-test, Control and Experimental Groups were made apply different warming methods before GSAP– GSDP measurements.

Control Group Post Test Warming Process and ITN

1. Traditional Warming 10 minutes

2. TTF in-court stroke warm-up 5 minutes

3. ITN Post Test measurement

Experimental Group PostTest Warming Process and ITN

1. Traditional Warming 10 minutes

2. Shadow Warm-ups 8 minutes

3. TTF in-court stroke warm-up 5 minutes

4. ITN Post Test measurement

Statistical analysis

Statistical studies of this study were performed using the SPSS 18 statistical program. The statistical results were evaluated according to the significance level of (p=0.05). Mean and standard deviation were used as descriptive values. The Kolmogorov Simirnov test was used to test the normal distribution in the statistical analyses, and when the groups were analyzed separately, it was observed that all groups were distributed normally (p>0.05). The Independent Samples T-Test was used to compare two independent groups, the Paired Samples T-Test was used in the analysis of the same group, and the Pearson Correlation test was used to determine the relationship between variables.

RESULTS

It was observed that all variables showed normal distribution in participants. Whether there was a significant difference between the averages of age and physical data of the athletes in the Experimental and Control Groups is presented in Table 1.

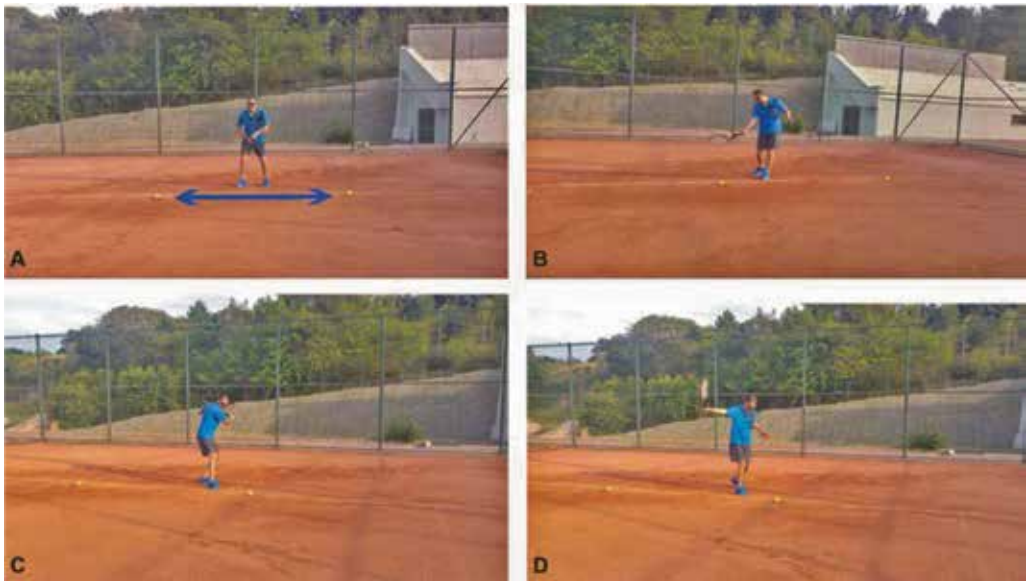
When Table 1 was examined, no significant difference was found between the baseline values of both groups participating in the study (p>.05). These values indicate that groups initially had similar characteristics (Table 1).

Table 1. Between Groups Age and Physical Properties Comparison of Athletes

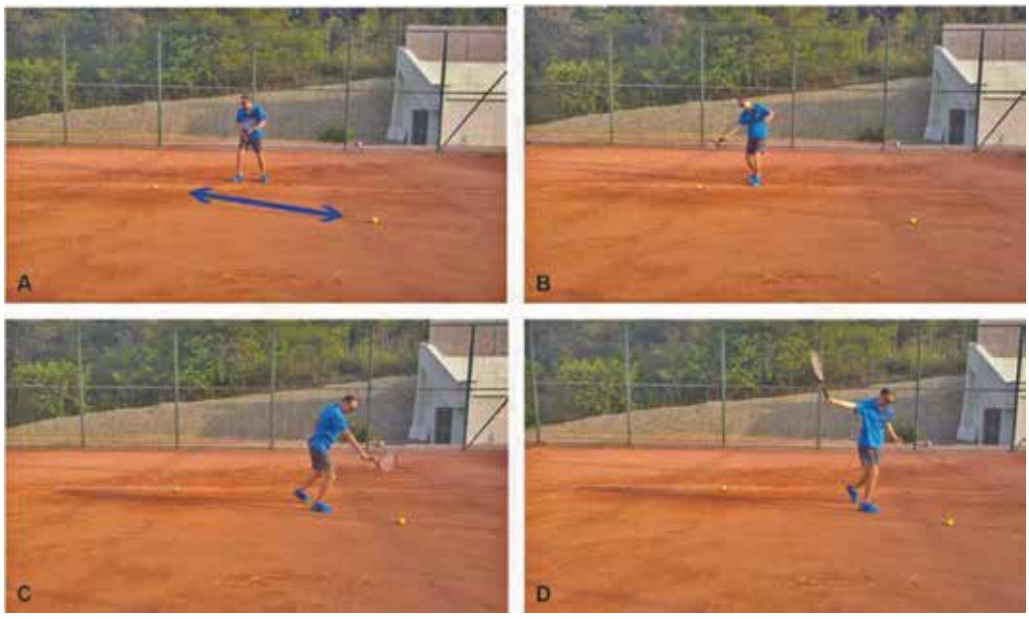
	Groups	N	$\bar{x}$	sd	p
Age	Control	14	13,21	,975	,089
	Experimental	14	13,86	,949	,089
Weight	Control	14	56,64	8,01	,666
	Experimental	14	58,54	10,11	,665
Height	Control	14	1,65	,057	,923
	Experimental	14	1,66	,093	,923
BMI	Control	14	20,45	2,38	,702
	Experimental	14	20,90	3,62	,702

p>0,05 BMI (Body Mass Index), $\bar{x}$ (Median), sd(Standart Deviation)

A statistically significant difference was found between GSDP-Pre-Test (42.53±14.61) and GSDP-Post-Test (48.64±12.86) of the Control group (p:0.032). A statistically significant difference was found between GSDP-Pre-Test (44.35±6.61) and GSDP- Post-Test (55.7±19.17) of the experimental



Picture 1. Shadow Warming Design I



Picture 2. Shadow Warming Design II

Picture 3. Shadow Warming Design III

group (p:0.000). It was determined that GSDP values of the Experimental group were higher than the values of the Control group (Fig1).

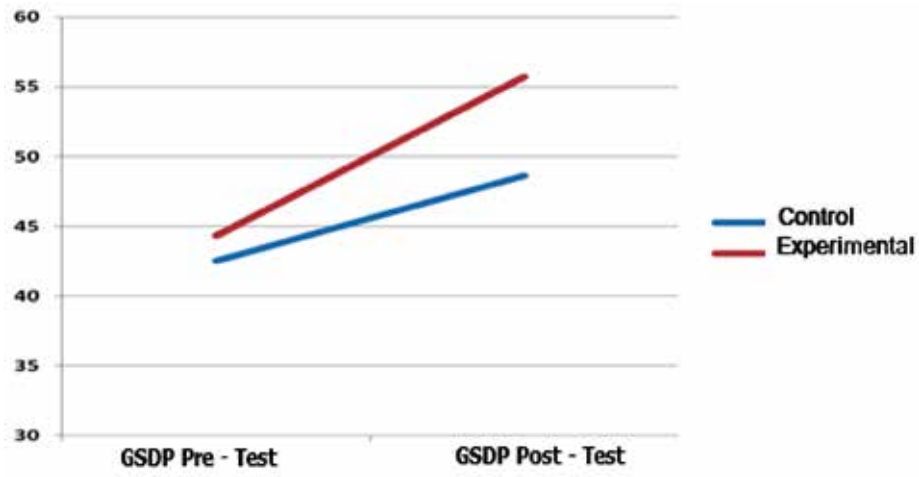


Fig 1. Comparison of GSDP Pre-Test and Post-Test Values within the Group.

p<0.05, GSDP (Groundstroke Deep Power)

A statistically significant difference was found between GSAP-Pre-Test (45.85±11.99) and GSAP-Post-Test (51.14±14.04) of the Control group (p:0.002). A statistically significant difference was also found between GSAP-Pre-Test (44.32±10.04) and GSAP-Post-Test (63.07±10.68) of the Experimental group (p:0.000). It was determined that the values of the experimental group were higher than the values of the control group (Fig 2)

Fig 2. Comparison of GSAP Pre-Test and Post-Test Values within the Group.

p<0.05, GSAP (Groundstroke Accuracy Power)

GSDP Pre-test and Post-test values of both groups were examined and the mean differences were compared. In the groups that were initially equivalent, it was found that GSDP Post-test Measurement of the Control Group was (=48.64±12.86) and GSDP Post-test Measurement of the Experimental Group was (=55.71±9.17). In conclusion, although there was an increase in favor of the Experimental Group, it was observed that this difference was not significant as a result of the analyses (p>0.05) (Fig 3).

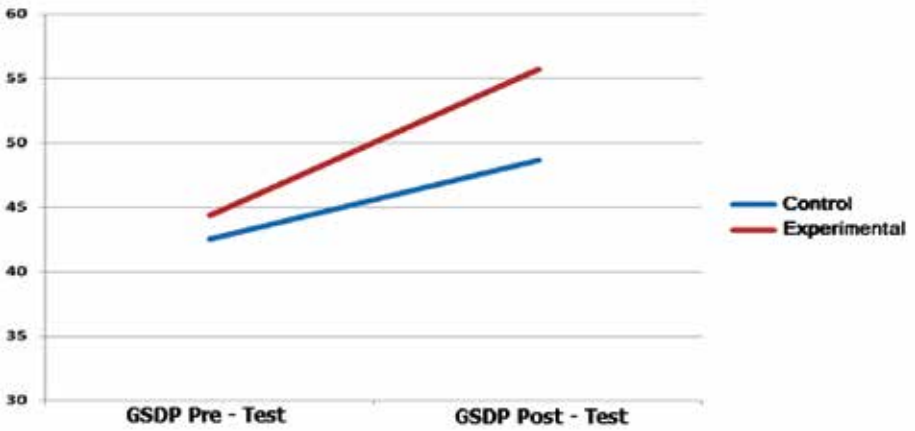


Fig 3. Comparison of GSDP Pre-Test and Post-Test Values between the Groups.

p>0.05, GSDP (Groundstroke Deep Power)

When GSAP-Pre-Test and GSAP- Post-Test values of the Control and Experimental groups were compared according to whether shadow warming was performed, it was observed that the difference found based on the GSAP- Post-Test result was significant in favor of the experimental group (Fig 4).

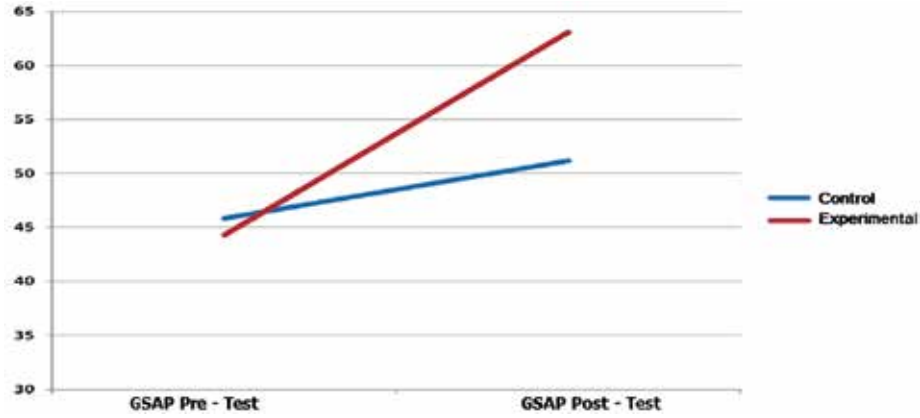


Fig 4. Comparison of GSAP Pre-Test and Post-Test Values between the Groups.

p<0.05, GSAP (Groundstroke Accuracy Power)

With respect to shadow warm-ups, it was found that there was a highly positive relationship between GSAP- Post-test and GSAP-Post Test-Fh and GSAP-Post Test-Bh in the Experimental Group (Fh; p:0.001- R:0.805; Bh; p:0.001 – R:0.897). This result was determined to be higher in favor of GSAP-Post Test-Bh (Table 2).

Table 2. The Pearson Coralation coefficients between GSAP- Post-Test with GSAP-PostTest-Fh and GSAP-Post Test-Bh Values in the Experimental Group.

GSAP – Post Test			
Experimental Group	N	R	p
GSAP Post Test-Fh	14	,805**	,001
GSAP Post Test-Bh	14	,897**	,000

DISCUSSION AND CONCLUSION

In this study which was carried out to analyze whether shadow warm-ups had effects on groundstroke accuracy and depth power, when intra-group GSDP-Pre-test and GSDP- Post-test ITN values of the Control and Experimental groups were compared, statistically significant differences were determined in both groups. When intergroup GSDP-Pre-test and GSDP- Post-test ITN values of the Control and Experimental groups were compared, it was observed that the intra-group difference found as a result of the analyses in both groups was not statistically significant in the comparison between the groups. However, it was also determined that the values of the Experimental group were higher than the values of the Control group. It can be thought that this improvement of the equivalent Control - Experimental groups that we formed at the beginning of our study is due to the similar training programs of 2 weeks and the transfer of the experience they gained after 2 times trials of the ITN pre-test application to the ITN Post test. In a study, Hodges (1989) mentioned the importance of physical training in table tennis in the trainer manual and also stated that Shadow play is a wonderful training method for technical development in table tennis players.

In the study carried out by Yüksel (2015), it was concluded that Shadow badminton trainings applied could have positive effects on the physical performance parameters of the individuals aged 8-10 years and that the frequency and duration of application could be considered sufficient. This result of the study in the literature is not compatible with GSDP results in our research. On the other hand, the improvement in GSAP results of the experimental group supports the above literature results.

Ken Chertow, a gold medalist Olympic wrestler, used the Shadow practice for a long time to improve his speed and condition and to improve the permanence of wrestling techniques (Chertow, 2008). Based on this information, we can say that the proper use of Shadow warming in different branches of sports and ages can provide an increase in performance.

In a study conducted by professional tennis players, the average number of times during a service rally in the backstage players over 15 seconds while the players who play the attack in the first quarter the volley players are seen in an average of less than 5 seconds (Bernardi, De Vito, Falvo, Marino, Montellanico, 1998). Acceleration, deceleration, sudden changes in direction, agility and explosive behavior are required to work continuously in training, as the players can perform specific movements to the tennis, which consist of repeated movements throughout the match. Studies have shown that a decrease in strokes percentages of up to 81% is observed at the moment when fatigue starts. (Davey, Thorpe, Williams, 2002; 2003). In addition, the rallies in women's matches last longer than men. The rally times of professional players and amateur players vary according to the physical and technical capacities of the players (Reid and Schneiker, 2008)

In the study carried out, when GSAP results were evaluated, intra-group ITN pre and Post-test measurements of the Control and Experimental groups showed a significant improvement. As a result of the intergroup analyses of ITN results, it was determined that GSAP results of the Experimental group showed a significant improvement compared to the Control group. As a result of the data analyses, it is thought that the improvement of GSAP in the Control group was due to the 2-week training program and the transfer of the experience they gained after 2 times trials of the ITN pre-test application to the ITN post test. On the other hand, the fact that the experimental group, which was initially equivalent, showed a different improvement than the Control group indicates that this difference occurred based on the effect of Shadow warm-ups.

In their study in (2007), Florendo and Bercades investigated the effects of Shadow practice in learning forehand technique, and a total of thirty-two subjects (N=32) were randomly divided into experimental (n=16) and control (n=16) groups. The Experimental group performed the Shadow practice before training with multiple balls, and the Control Group trained with a single ball while waiting for their turn for each pair. Pre-test and Post-test were performed to test the consistency and accuracy skills of participants, and according to the results of data analysis, it was revealed that there was a significant change in post-test scores of both groups compared to their pre-test scores. However, only the experimental group was able to get the targeted scores in the holding skill test. Similarly, in (1999) Navy mentioned that Shadow play could be helpful in the formation of feelings related to how the racket and the stance in the right position should be in table tennis. Along with the contribution of the literature, it can be said that Shadow warming that we made practice in our study is the accurate and adequate warming method for athletes to get racket and accurate stroke positions and to increase GSAP performance as a result of the development of their feelings.

In a similar study; Flores et al., (2010), in the study of the effect of the shadow practice in learning backhand stroke in table tennis according to the control group performing multi-ball stroke study after the shadow study in the experimental group engaged in the study of multi-ball stroke performance of the transfer performance of the next test was significantly different. Shadow tennis study was found to be a successful method in the teaching of skills and its use in different sportive skill trainings was proposed.

In a study carried out by Abdoli et al. (2017) the effects of observational combination, Shadow play and physical practice on dart throwing skills were investigated in 72 university students. The study consisted of 6 groups and each group included 12 participants: Group 1 (Observational), Group 2 shadow (Shadow play), Group 3 (physical), Group 4 (observational and physical), Group 5 combination (observational, physical and Shadow play), Group 6 (control). Each group performed 60 dart trials based on special instructions during the application. When the repeated measurements were compared, it was determined that the combination group and the Shadow play groups had the most significant result. In the informal interview conducted with a table tennis team in Metro Manila University, Büyük reported that the strokes of university players were improved after the Shadow practice and included the Shadow play in his training since then (Flores et al., 2010). This result is compatible with the GSAP results of our study and can be used as an effective method in the development of accuracy.

Warming is a widely accepted practice before almost every athletic event. However, although warming is necessary for optimum performance by many trainers and athletes, there are surprisingly few scientific studies supporting its effectiveness (Bishop and Middleton 2013; Akşit 2012). When it is considered in terms of ITN test results although the physiological parameters are not examined as a result of Shadow play, we can say that it is a warming method that does not make a difference in GSDP performances of athletes but is an effective warming method for GSAP. Some researchers have emphasized the importance of physical abilities for tennis performance (Fernandez et al., 2006; Ferrauti et al., 2003; Kovacs, 2007; Reid and Schneiker, 2008). Therefore, it can be argued that the completion of a warm-up may improve the next performance before joining the competition for many different branches of sports. Warm-up practices performed before the actual performance should cover not only the physiological but also the psychological preparation of the athletes.

The human movement consists of four bases; stopping, relocating, changing level, pushing, pulling and rotation (Cook et al., 2010). Shadow warm-ups consist of the combination of these four bases. Furthermore, function can be defined as the fulfillment of the criteria required for a person to perform a task. Functional movement is a movement or movements performed to fulfill the requirements of a job or task (Boyle, 2004). For this reason, Fh-Bh movements used in tennis can be defined as functional movements. In this sense, the shadow warm-ups that we applied can also be considered as functional practice. It can be said that the increase in GSAP depends on the improvement in functional movement components.

According to research findings, Shadow warm-ups were not included in the study since they had no significant effect on GSDP in the experimental group, and based on the result that Shadow warm-ups caused a significant difference in the GSAP Post-test results of the experimental group, it was aimed to examine its relationship with the groundstroke accuracy power Post-test forehand stroke (GSAP-Post Test-Fh) and groundstroke accuracy power Post-test backhand stroke (GSAP-Post Test-Bh) values, two sub-variables that make up this result. Analyses indicate a highly positive relationship between GSAP- Post-test and GSAP-Post Test-Fh and GSAP-Post Test-Bh.

It was determined that this relationship was slightly higher in favor of GSAP-Post Test-Bh. The performance of the athletes can be increased as a result of the improvement in Fh and Bh tennis stroke techniques that can be properly exercised with Shadow warming. It is thought that Shadow warming may be effective for tennis to automatically perform Fh-Bh strokes in tennis within a short time. In Gallewey's famous book (The Inner Game of Tennis), it is suggested that the best performance will be achieved allowing the engine control system by promoting smooth movements in which there is no conscious intervention, that is obtained in the automatic process (Flores et al., 2010). Shadow warm-ups designed in our research involve the most repeated Fh-Bh stroke combinations in tennis. The fact that the athletes made an improvement in the ITN test GSAP measurement after focusing on accurate methods by Shadow warm-ups indicates that our designs are correct and good work to improve the techniques of tennis players.

For the most effective completion of the coordination component, the same muscles should be used as the target activity during the movement and the same contraction time should be maintained (Bompa, 2000; Boyle, 2004; Brown, 2007; Cook, 2003; Muratlı, 2010; Muratlı et al., 2007). The ITN test that we used in our research is used as a means of estimating how strong the ball is stroke as well as allowing us to evaluate Fh-Bh skill in terms of accuracy and depth. We think that not only accuracy but also the strong strike of the ball made contributions to the increases in GSAP determined as a result of the analyses. As a result of these, Shadow warm-ups is a method that can be also used when Fh-Bh strokes are intended to be stronger.

In conclusion;

The success in tennis can be achieved by near-perfect technical skills, physical - psychological preparation and the approaches to protect them. Furthermore, the speed of the ball and accuracy continue to be the two most important determining components in scoring. In our study, the effects of Shadow warm-ups on Fh-Bh depth and accuracy power, which are tennis groundstrokes, were investigated, although there was an improvement in GSDP, it was not found to be significant, and a significant improvement was determined in GSAP. It was determined that there was a highly positive relationship between GSAP- Post Test and GSAP-Post Test-Fh and GSAP-Post Test-Bh in the experimental group performing shadow warm-ups, and that this relationship was slightly higher in favor of GSAP-Post Test-Bh. The fact that the shadow warm-ups we designed were similar with the ground, space and environment components where we performed the ITN tests of the athletes may have also contributed to the significant improvement in GSAP, however, the fact that the Control group could not show as much performance as the experimental group by entering the tests with the same gain suggests that the significant difference was due to Shadow warming.

As a result of the discussion, we recommend to apply them in addition to traditional warming for an increase in groundstroke accuracy power in tennis branch. Furthermore, we think that the use of Shadow warm-ups with sports-specific designs in different branches and ages will contribute positively to the performances of the athletes. Therefore, it was concluded that Shadow warm-ups applied in the study had positive effects on forehand and backhand groundstroke accuracy power, which are the physical performance parameters of tennis athletes. In this context, it can be concluded that the Shadow Warming application is an effective technique which is used in remembering or learning the correct form by using a skill again and again.

REFERENCES

Abdoli N, Parsaie N, Rohbanfard H. The Effect of Combining Observational, Shadow and Physical Practice on Learning Dart Throwing Skill. Motor Behavior. Fall 2017; 9 (29): 149-68. (In Persian).

Akşit T. (2012). Tennis Pysiology and Performance. Turkey Clinics J Sports Sci;4(2):81-91

Bernardi M, De Vito G, Falvo ME, Marino S, Montellanico F. (1998). Cardiorespiratory adjustment in middle-level tennis players: Are long term cardiovascular adjustments possible? In: Lees A, Maynard I, Hughes M, Reilly T, eds. Science and Racket Sports II. 2nd ed. London: E & FN Spon; p.20-6.

Bishop D., & Middleton G. (2013). Effects of static stretching following a dynamic warm-up on speed, agility and power. J Human Sport Exercise; 8(2);391–400

Bompa TO. (2000). Theory & metholodology of training. 2nd. ed. Bağırgan Publisher, Ankara.

Boyle M. (2004). Functional Trainıng for Sports. USA: Human Kinetics.

Brown E.L. (2007). Strength Training. USA: Human Kinetics.

Chertow K. (2008). May 2008, from Shadow Wrestling. Retrieved http://www.kenchertow.com/training_tips/training_exercises/te_shadow_wrestling.html

Cook G., Burton L., Kiesel K., Rose G. & Bryant M.F. (2010). Movement: Functional Movement Systems - Screening, Assessment, Corrective Strategies. USA: On Target

Davey PR, Thorpe RD, Williams C. (2003). Simulated tennis matchplay in a controlled environment. J Sports Sci ;21(6):459-67.

Durandt J. (2009). Fitness testing and the physical profiling of players. Boksmart Sport Science Institute of South Africa, 7.

Fernandez J., Mendez-Villanueva A., Pluim BM. (2006). Intensity of tennis match play. Br J Sports Med; 40(5):387-91.

Ferrauti A., Bergeron M. F., Pluim B.M., & Weber K. (2001). Physiological responses in tennis and running with similar oxygen uptake. European Journal Of Applied Physiology, 85(1/2).

Ferrauti A., Pluim BM., Busch T., & Weber K. (2003). Blood glucose responses and incidence of hypoglycaemia in elite tennis under practice and tournament conditions. J Sci Medicine Sport ;6(1):28-39.

Florendo F., & Bercades D. (2007). The effectiveness of shadow practice in learning the standard forehand drive. 10th Anniversary ITTF Sports Science Congress Proceedings Book. University of Zagreb, Faculty of Kinesiology; Croatian Table Tennis Association; International Table Tennis Federation. May 18-20, 2007.

Flores M.A., Bercades P.D., & Florendo F. (2010). Effectiveness of Shadow Practice in Learning the Standard Table Tennis Backhand Drive, 6(6), 105–110.

Gelen E., Mengütay S., & Kermen O. (2007). The effect of two different training methods on forehand groundstroke performance in tennis. International Journal of Human Sciences,4(2).

Gogte K., Srivastav P., & Miyaru G.B. (2017). Effect of Passive, Active and Combined Warm up on Lower Limb Muscle Performance and Dynamic Stability in Recreational Sports Players. Journal of Clinical and Diagnostic Research: JCDR, 11(3), YC05–YC08.

Hodges L. (1989). Instructor's Guide to Table Tennis. Retrieved May 2008 from www.usatt.org/organization/instructors_guide.pdf

Ivancevic T.T., Jovanovic B., Jovanovic S., Djukic M., Djukic N., & Lukman A. (2011). The Law of Neuromotor Control. Paradigm Shift for Future Tennis (11th ed.). Berlin: Springer. http://doi.org/10.1007/978-3-642-17095-9

Keskin B., Ateş O., & Kiper K . (2016). The Impact of Special Training Program on ITN Grades of Tennis Performance Athletes. İstanbul University Journal of Sport Sciences, 6 (3), 79-93.

Kovacs MS. (2007).Tennis physiology: training the competitive athlete. Sports Med;37(3): 189-98.

Letts G. (2007). August 2007, from Table Tennis/Ping Pong. Retrieved http://tabletennis.about.com/od/glossary/g/shadowplay.htm

Mackenzie B. (2005). 101 Performance Evaluation Tests. Electric Word plc. London:96.

Muratlı S., Kalyoncu O., & Şahin G. (2007). Training and Competition (2. ed.). Istanbul: Ladin Publishing.

Muratlı S. (2010). Design of Strength Training Programs. In N. Mazıcıoğlu (Ed.),Personel Fitness Trainer (pp. 315-339). Türkiye: Scala Pub.

Navy R. (1999). 2008 from www.teachpe.com/gcse/Table Tennis.pdf Table Tennis.

Reid M., & Schneiker K. (2008). Strength and conditioning in tennis: Current research and practice. Journal of Science and Medicine in Sport, 11(3), 248–256

Signorile J.F., Sandler D.J., Smith W.N., Stoutenberg M., & Perry A.C. (2005). Correlation analyses and regression modeling between isokinetic testing and on-court performance in competitive adolescent tennis players. Journal of Strength and Conditioning Research / National Strength & Conditioning Association, 19(3), 519–526

Smekal G., Pokan R., von Duvillard S.P., Baron R., Tschan H., & Bachl N. (2000). Comparison of laboratory and "oncourt" endurance testing in tennis Int J Sports Med;21(4):242-9.

Vergauwen L., Spaepen AJ., Lefevre J., & HespelP. (1998). Evaluation of stroke performance in tennis. Med Sci Sports Exec ;30(8):1281-8.

Yüksel M. (2015). *A Research On The Impacts Of Shadow Badmınton Traınıngs On The Performance Of 8-10 Age Group Of Badmınton Players.* Ph. D. Thesis, Gazi Unıversity Instıtute Of Health Scıences

Zorba E., & Saygın Ö. (2009). Design of Strength Training Programs. 2nd.Ed. İstanbul: İnceler Pub, 205-217.

WMADH. (2000). World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. Journal of the American Medical Association. 284. pp. 3043- 3045.