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Research Article (Araştırma Makalesi)

An Investigation of The Values of Plyometric Training on Anaerobic Performance and Some Physical Performance of Badminton Athletes

Badminton Sporcularına Uygulanan Pliometrik Antrenmanının Anaerobik Performans ve Bazı Fiziksel Performans Üzerine Değerlerinin İncelenmesi

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Abstract: The general aim of the study was to investigate the anaerobic performance and some physical performance values of bedminton athletes participating in plyometric training. Fifteen students (8 boys and 7 girls) between the ages of 12-15 years studying at Siirt sports high school participated in the study. Body weight, 30 m sprint, 10x5 shuttle run agility test, flamingo balance test, standing long jump and shuttle test were measured before and after training. The group participated in plyometric training 3 days a week for 8 weeks. SPSS 22 program was used for data analysis in our study. The data obtained were given as arithmetic mean and standard deviation. The data showed a normal distribution and paired sample t test was used for the comparison of dependent groups. The significance level was determined as $p<0.05$. While there was a significant difference between the pre-post test values of the study group in Standing long jump, 10x5 shuttle run, 30 m sprint, balance and shuttle values ($p<0.05$), there was no significant difference in 10x5 m Shuttle Run Agility Test value ($p>0.05$). It was determined that plyometric training applied to badminton athletes had a positive effect on some physical performance values. We think that the inclusion of plyometric training in the annual training plans of coaches and athletes will contribute positively to performance development in sports branches that are important in the lower and upper extremities and in branches that require explosive power.

Keywords: Plyometric training, Anaerobic, Balance, Agility, Speed.

Özet: Çalışmanın genel amacı pliometrik antrenman uygulamasına katılan bedminton sporcularının anaerobik performans ve bazı fiziksel performans üzerine değerlerinin incelenmesidir. Çalışma Siirt spor lisesinde öğrenim gören 12-15 yaş aralığında 15 (8 erkek ve 7 kız) öğrenci katılmıştır. Antrenman öncesi ve sonrası vücut ağırlığı, 30 m sürat, 10x5 mekik koşusu çeviklik testi, flamingo denge testi, durarak uzun atlama ve mekik testi ölçümleri alındı. Grup 8 hafta süresince haftada 3 gün pliometrik antrenmanlara katıldı. Çalışmamızda verilerin analizi için SPSS 22 programı kullanılmıştır. Elde edilen veriler aritmetik ortalama ve standart sapma olarak verildi. Verilerin normal bir dağılım gösterdiği ve bağımlı grupların karşılaştırmasında paired sample t test kullanıldı. Anlamlılık düzeyi $p<0.05$ olarak belirlendi. Çalışma grubunun ön-son test değerleri arasında Durarak uzun atlama, 10x5 mekik koşusu, 30 m sürat, denge ve mekik değerlerinde anlamlı fark bulunurken ($p<0.05$), 10x5 m mekik koşusu çeviklik testi değerinde anlamlı fark görülmemiştir ($p>0.05$). Badminton sporcularına uygulanan pliometrik antrenmanın bazı fiziksel performans değerleri üzerine olumlu etkisinin olduğu belirlendi. Antrenör ve sporcuların yıllık antrenman planlarında pliometrik antrenmana yer vermesi alt ve üst ekstremitede önemli olan spor branşlarında ve patlayıcı güç gerektiren branşlarda performans gelişimine olumlu katkı sağlayacağı söylenebilir.

Anahtar Kelimeler: Pliometrik antrenman, Anaerobik, Denge, Çeviklik, Sürat.

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1.Introduction

Today, sport has become an important part of our life whether as entertainment and hobby or as competition form. Being away from sports will affect the physical, psychological (Bayrakdaroğlu et al., 2021) and sociological developments of children and the young negatively (Çam, 2016). One of the sports branches that children and the young turn to in order to ensure their growth is badminton. It can be played by many people in closed or open courts for entertainment or competition (Arslan, 2019). Badminton is an entertaining racket sport that is played by one or two people to pass the ball to the opposite field over a net. Badminton is played with a shuttlecock, and it should be played in the air without touching the ground differs badminton from other racket sports. The game is played very fast, and the speed of the shuttlecock can reach at 250 km/s (Arslan, 2019). In a game played fast, the attack of the player to the ball occurs in seconds. Therefore, the player should cerebrate quickly and make the right decision swiftly (Turgut et al., 2017). In addition to making the snap decision, it is also necessary to have good motor skills to continue the game for a long time (Yüksel, 2017). When the literature on badminton is reviewed, it is observed that the exercises have positive effects on physical, physiological and anthropometric parameters (Alcock and Cable, 2009), their effects on strength have been analyzed and the degree of their effect on strength level has been examined (Aygül, 2010). While Salman et al have analyzed the effects of badminton

exercises on hits that will ensure to win the game in matches (Salman and Salman, 2009), Hensley and Paup have studied acute and chronic sport injuries in badminton games (Hensley and Paup, 1979). One of the training programs used for performance improvement is plyometric training. Plyometric training ensures muscles to produce maximum strength in a short time (Pancar et al., 2018). In order to increase and maintain the existing performance of athletes, muscle strength and endurance levels must be at a high level. Many coaches and trainers apply many training methods to improve the performance of the athlete. Plyometric training attracts the attention of many athletes and is constantly used in sports branches. Plyometric training is one of the important training methods used in jumping, throwing, skipping and maximal strength training (Villarreal et al., 2009). It is thought that plyometric training is economical in terms of time during exercises requiring high intensity (Köse and Atlı, 2020).

Many different definitions have been made for plyometric training. Among these definitions, it has been emphasised that it is especially effective in exercises that require explosive power and that it is a category of resistance exercises using body weight (Booth and Orr, 2016). Markovic and Mikulic explained that plyometric training is one of the physical conditioning exercises used for some disease states (Marcovic and Mikulic, 2010). De Villarreal et al stated that plyometric training is one of the trainings used to improve nerve-muscle adaptation and performance of the athlete. Coaches and athletes should consider many different characteristics when applying plyometric training. When planning the study, necessary plans should be made by taking into account the age, gender, sports branch, training content and physical fitness levels of individuals (De Villarreal et al., 2009). It is an endurance exercise that stimulates muscle contraction in a short time and contributes muscles to produce more strength. The effect of plyometric exercises on muscle contraction is actually to ensure the strengthening of muscle fibers, connective tissue and flexibility features. During jumping from a high platform to the ground, muscle fibers are affected by the contraction of agonists, and this provides stretch reflex to be triggered. Also, the stimulation levels of the passive muscle fibers increase gradually (Yüksel et al., 2016). Indeed, plyometric training enables athletes to implement strength very fast in a very short time through eccentric – concentric contraction. Plyometric training is a positive-negative strength workout and contributes to athletes' explosive jumping power. Athletes who will do plyometric training should have basic strength level at sufficient degree. Children do not need much strength since their body weight is not high. They need strength to prevent injuries that might occur in muscles during exercise (Acar, 2016).

The general purpose of our study is to analyze the effects of the 8-week plyometric training applied to badminton players between the age range of 12 and 15 on the anaerobic performance and certain physical performance values.

2.Method

Research Design: The study was organised as a single group. Two measurements were taken before and after the study. After eight weeks of training, the same measurements were taken again. In our study, the group was formed by random sampling method. The general purpose of choosing this method was to increase the reliability of the study by reaching much more reliable and rich data (Flick, 2014).

Research Group: A total of 15 female (n: 7) and male (n: 8) student athletes between the age range of 12 and 15 who studied at a sports high school in Siirt province participated in the study. Before the study, necessary measurements were taken. Then, the participants participated in the determined plyometric training three days a week for 8 weeks together with the badminton training.

Data Collection Tools:

Height Measurement: A stadiometer was used to measure the height of the subjects.

Body Weight Measurement: An electronic scale with a 0.1 degree of precision was used to measure the body weights of the subjects. The subjects stood straight while hands were at both sides and the weight was distributed to both feet equally and the values were recorded as kg.

Standing Long Jump Test: Students leaped forward from a designated spot with adjacent feet. The test was applied 3 times and the highest score was recorded (Bostancı et al., 2019).

Shuttle: Athletes waited readily lying on supine position with knees bent and hands on the nape. Then they were asked to lift their bodies up and touch the knees with the elbows for 30 seconds. The repetitions that did not follow the rules were not accounted for. Crunches performed correctly for 30 seconds were recorded (Mackenzie, 2005).

30-Meter Sprint Test: The 30-meter sprint times of the athletes at the designated field were measured by a photocell, three measurements were taken, and the best result was recorded (Rakovic et al., 2018).

10x5 m Shuttle Run Agility Test: The test is conducted to measure the running speed of an individual. Cones or lines are prepared with 5-meter intervals. The subject gets prepared behind the scratch line. With the start instruction, the subject runs as fast as possible as both feet pass the line, passes the opposite line and returns to the start point. The test was repeated 10 times until the participants completed a total of 50 meters and the running time was recorded (Özer, 2013).

Flamingo Balance Test: Students tried to keep balance on the beam for 1 minute. The balanced foot was on the beam and the other foot was held by hand towards the hip. When students lose their balance or fall off the beam, the time was stopped. Total balance time obtained in 1 minute was recorded as the score (Jakobsen et al., 2011). The plyometric training method was applied to our

study group 3 days a week for 8 weeks together with weekly badminton training. The training programme is given in the table below.

Table 1. Plyometric Training Program

Name of the movement	Repeat / Set / Rest	Name of the movement	Repeat / Set / Rest
Vertical jump with knees pulled up	10 / 3 / 1:1	Jump rope	10 / 3 / 1:1
Sideways wrist jump	10 / 3 / 1:2	Jumping forwards by pulling the knees	10 / 3 / 1:2
Forward jump with kangaroo motion	10 / 3 / 1:1	Sideways jump over obstacle	10 / 3 / 1:1
Jumping movement down the staircase	10 / 3 / 1:1	Running movement in different directions by jumping over obstacles	12 / 3 / 1:1
Stair jumping with one foot forward	10 / 3 / 1:2	Squat jumping movement	12 / 3 / 1:1
Squat jump on the stairs	10 / 3 / 1:1	Jumping over the obstacle to the side area	10 / 3 / 1:2
Double foot leap forwards with double foot	10 / 3 / 1:1	Zig zag dril work	10 / 3 / 1:1

Points to Consider During Plyometric Training

- Training sessions should be carried out on soft grounds.
- The athlete should be able to perform plyometric training exercises
- If he/she is not at a level to perform the training, the movement should be stopped
- Training should be planned from easy to difficult
- Before starting plyometric training, perform warm-up exercises and finish the workout with a cool down.
- Ensure optimal implementation of the work for best performance
- 1-2 minutes rest break should be given between series
- Each set should be between 6-8 seconds, not too long
- Full recovery should be ensured between sets
- Care should be taken to apply the correct technique (Blattner and Noble, 1979).

Statistical Analysis: IBM SPSS 22,0 statistical package program was used for the analysis of the data. Normality tests was conducted to determine whether the data had a normal distribution. Skewness and kurtosis values were used for the normality test, and it was determined that the data were distributed normally. Dependent sample t-test was used in the within group evaluations.

Ethics of research: Our study titled 'Investigation of the values of plyometric training applied to badminton athletes on anaerobic performance and some physical performance' was approved by the ethics committee of Siirt University ethics commission dated 14.12.2023 and numbered 94614.

3.Results

Table 2. The comparison of the physical characteristics of badminton players

Variables	N	X ± SS
Age (year)		13,93±0,799
Height (cm)	15	157,33±8,524
Body Weight (kg)		52,17±2,483

When the table was analyzed, it was observed that the average age of the badminton players was 13,93±0,799, height average was 157,33±8,524 and body weight average was 52,17±2,483.

Table 3. The statistical comparison of intergroup measurements

Variable	N	Test	X ± SS	t	p
Agility	15	Pretest	19,59±,656	1,641	0,162
		Posttest	19,40±0,716		
Standing long jump (cm)		Pretest	1,84±,167	-2,851	0,013
		Posttest	1,90±0,180		
30-meter sprint test		Pretest	5,72±0,305	2,343	0,034
		Posttest	5,63±0,362		
Balance		Pretest	5,07±3,127	3,587	0,003
		Posttest	3,40±2,261		
Shuttle		Pretest	24,33±3,288	-3,201	0,006
		Posttest	26,13±4,015		

According to Table 3, a statistically significant difference was determined between the pretest and posttest values of the standing long jump, 30-meter sprint test, balance and shuttle ($p<0.005$). No statistically significant difference was determined in the agility values ($p>.05$).

4.Discussion

As well as being good at technique and tactic, aerobic, anaerobic, agility and speed are also important parameters to succeed in badminton (Savaş and Uğraş, 2004). Plyometric training is effective in sports requiring explosive power. It has a positive contribution particularly to the improvement in the sport branches requiring bounce, rise, leap, run, jump and launch (Gleim, 1997). This study is an investigation of the effect of the plyometric training performed by the students between the age range of 12 and 15 who studied at a sport high school on anaerobic performance and agility. It was observed in our results that the sprint test of the badminton players is statistically significant. It is believed that the fact that plyometric training strengthens lower extremities and increases explosive power was effective on the significance of the values in our study. In the literature, it was found that Turna and Alpay stated that while there was a significant difference in the speed values of the experimental group, control group did not reveal a significant difference (Turna and Alpay, 2020). It was stated that plyometric training applied to basketball players caused a significant increase in the speed values of the athletes (Bavlı, 2012). Similarly, in the study conducted by Myer et al it was stated that plyometric training contributed to the increase in the speed values significantly (Myer et al., 2005). When the results of the research Chelly et al conducted was examined, it was found that there were statistically significant differences in speed values (Chelly et al., 2010). Unlike these studies, Markovic stated that there was no significant difference in speed values after the plyometric training applied to the athletes (Markovic, 2007).

As a result of the study, it was observed that the agility values of the badminton players were not statistically significant. We can state that the reason of this result was because of that during the measurements, the athletes did not exercise due care and did not display the desired performance. Yanci et al stated in their study that plyometric training caused an increase in the agility values of the football player (Yanci et al., 2016). In his similar study, Markovic reported that plyometric training had a positive contribution to agility values (Markovic, 2007). It is stated in similar research that plyometric training had a contribution to the occurrence of statistically significant differences in the agility values of the players playing football in the 3rd league (Vaczi et al., 2013). It was stated that a significant difference was found in the agility values of the handball players as a result of the 8-week plyometric training (Çakır, 2016). Our study differs from the similar studies conducted in this field. It is thought that the reason why these studies revealed significant results different from our study is due to the different condition levels and weekly exercise time.

A statistically significant difference was determined in the balance values according to our results. When plyometric studies are investigated, it is found that there are many studies in this field. Miller et al applied plyometric training twice a week for 6 weeks and found significant differences in the balance values of the plyometric group (Miller et al., 2006). Unlike this study, Çakır stated that there was no significant difference in the balance values of the handball players after plyometric training (Çakır, 2016). She explained that the reason for this was that the handball team had been training for at least two years and that there was an increase in balanced performance values. It was also reported that there were significant increases in the left leg balance of the handball players after the 10-week plyometric training (Karadenizli, 2016). We can state that the increase in the leg strength values of the athletes and applying badminton exercises 3 days a week was effective on the increase in their balance values. According to our results, there was a significant difference in the pretest shuttle values of the badminton players. Ateş and Ateşoğlu reported in their study on football players that the 10-week plyometric training contributed to an increase in the shuttle values of the athletes (Ateş and Ateşoğlu, 2007). It was stated in another study on handball players that the plyometric training applied 3 days a week for 8 weeks did not cause a significant increase on the shuttle values of the athletes (Pancar et al., 2018). A significant increase was reported in the pretest and posttest shuttle values of the taekwondo athletes due to plyometric training (Ibrık, 2019). The reason of that we obtained an increase in the shuttle values of the athletes was that plyometric training enabled to combine the strength values gained with speed. It can be stated that the increase in the strength levels of lower and upper extremities due to plyometric training is effective on the significance of shuttle values.

Our data revealed that there was a significant increase in the values of standing long jump after plyometric training. One of the methods to determine the explosive power of athletes is standing long jump (Castro et al., 2010). It is ensured to strengthen the features such as muscle fibers, connective tissue and flexibility through plyometric training program. During jumping from a high platform to the ground, muscle fibers are affected by the stretching of agonists, and this provides stretch reflex to be triggered. Also, the stimulation levels of the passive muscle fibers increase gradually (Yüksel et al., 2016). It is thought that the reason of the significant difference in standing long jump values is that plyometric training contributed the increase in the explosive power values significantly by enabling especially lower muscles to strengthen in our study. Pancar et al reported that an 8-week plyometric training applied to handball players caused an increase in the standing long jump performance values of the athletes in the experimental group (Pancar et al., 2018). Unlike our study, it was stated in another study that plyometric training created no significant difference in basketball and handball players (Koç et al., 2011). In a study conducted on football players, significant increases were reported in the standing long jump values of the athletes (Baş, 2018).

Conclusion

Consequently, it was determined that plyometric training applied to the badminton players in the age range of 12 and 15 caused significant increase in the standing long jump, 30-meter sprint, balance and shuttle values of the athletes. Including a plyometric training program in the annual training program will minimize the risk of injury while increasing performance. Plyometric training to be applied in both team and individual sport branches in which lower and upper extremities are important will increase the performance of the athletes.

Author Contributions: The conceptualization of this study was carried out by Y.K. and L.F., the methodology, validation, and analysis were conducted by Y.K., the research and resources were managed by Y.K. and L.F., and the writing—original draft preparation, writing—review, and editing were performed by Y.K. and L.F. The authors have read and approved the published version of this manuscript.

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Data Availability Statement: The data is publicly available.

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