



10-14 Yaş Arası Kadın Voleybolcularda 6 Haftalık Pliometrik Antrenmanın Bazı Seçilmiş Motorik Özelliklere Etkisi

The Effects of 6-Week Plyometric Training on Some Selected Motoric Characteristics in Women Volleyball Players Between 10-14 Years of Age

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Abstract: This research is conducted to determine how plyometric training, like standing long jump, vertical jump, 30-second sit-ups, 30-second push-ups, 30-meter sprint, handgrip strength, leg (back) strength and measure of flexibility affects female volleyball players between the ages of 10-14. The participants were included in the study according to the volunteerism principle. Thirty-six middle school volleyball players participated in this research conducted in Elazığ / Turkey. Measurements of thirty-six students in this sampling group are calculated as 52.067 ± 11.574 kg on weight-average, 157.11 ± 9.164 on height average, 13.06 ± 1.162 on age average. Besides their regular exercise program, a plyometric training program is applied 3 times per week to the participants through 6 weeks span. Paired Samples t-Test is used after conducting the normality test to analyze the data. The result of the research showed that after the end of the research in standing long jump, vertical jump, 30-second sit-ups, 30-second push-ups, 30-meter sprint, handgrip strength (right) and flexibility measurements differed drastically ($p < 0.05$). The plyometric training program had an effect of development in motor skills while it did not have an effect on the handgrip strength (right) and leg (back) strength. Within the scope of these results, it was suggested that athletes, coaches and sports managers could contribute to the development of athletes who play volleyball by including plyometric training programs in their training programs. Furthermore, it is believed that future studies can contribute to the literature on the subject by forming the population and the sample of the study in extensive and various ways and evaluating plyometric training programs in terms of the athletes of other sports branches.

Structured Abstract: Sampling group of this research is gathered from Gazi middle school (12 female students), Hilalkent middle school (12 female students) and Kovancılar Eti Holding middle school (12 female students) in Elazığ/Turkey. These were thirty-six female students between the ages of 10-14 who participated in regular volleyball exercises before. Before starting the research, students signed Volunteer participation certificates and their parents signed informed parent approval certificates. The necessary warm-up movements were performed before the start of the measurements and tests. Athlete students' measurements were taken the day before the first training and one day after the last training. The plyometric training

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program was planned to be 40-50 minutes 3 days a week for 6 weeks. Athletes measurements of height, weight, standing long jump, vertical jump, 30-second sit-ups, 30-second push-ups, 30-meter sprint, handgrip strength, leg (back) strength and flexibility are applied on pre-test and post-test of the athletes.

It has been identified that the average age of the sampling group was 13.06 years, average height was 157.11 cm and the average body weight was 52.6 kg.

Statistically significant differences were found in standing long jump (cm), vertical jump (cm), flexibility (cm), 30-second sit-up, 30-second push-up, 30-meter sprint and handgrip (right hand) measurements ($p < 0.05$). Leg back strength and handgrip (left hand) tests ($p > 0.05$) showed no significant difference.

This study was conducted on 36 volleyball athletes at the secondary school level and the effects of a 6-week plyometric training on selected force parameters were investigated. Accordingly, no change was observed as a result of the height and age values of the athletes participating in the study

In the study there was a significant difference in the long jump test in favor of the final test ($p < 0.05$). In the 8 week study of 25 boys aged 12-14 made by Kızılet et al. (2010) significant differences in long jump values were found it can be said that this significant difference is due to fact that the jumps in plyometric training, splashes are made as explosives in a very short period and consequently both explosive power and explosive properties are developed (Chu, 1984; Kubo, 2007).

Plyometric training is generally used to strengthen the lower extremity muscles, rapid strength, nerve-muscle activity, muscle-tendon complex, and vertical jump height (Kotzamanidis, 2006). Consequently, a significant difference was observed in the vertical jump test we made ($p < 0.05$). In another study, it was found that there was a significant and maximal force of force training in young football players aged 12-15 (Ataberk et al., 2010).

In the research, it was found that the average results of flexibility (cm) pre and post-test were statistically significant ($p < 0.05$). Plyometric training has been shown to increase the coordination between muscles and flexibility that develops accordingly. Another study of athletes between the ages of 14-16 found significant differences in flexibility test values (Pense & Harbili, 2001).

In this study, a significant difference was in the 30-second sit-ups test in favor of the final test. 17 volunteer students ($p > 0.05$). Including 15 boys and 2 girls between the ages of 12-14, conducted a study to examine the effects of judo on the physical parameters of visually impaired individuals, the first and final test significant differences were found at p.001 level (Yılmaz et al., 2003). In this context, we can say that additional plyometric training sparring with girls engaged in volleyball sports regularly improves the muscles.

In the study, it was found that there were significant improvements in test values fo 30-second push-up performance ($p < 0.05$). The push-up station in the training program said that it will be effective in the development of dynamic forces in the upper extremity.

30 m. Sprint (seconds) pre and post-test average results statistically showed a significant difference ($p < 0.05$). Different force training protocols also stated that there were significant decreases in 30m sprint times and it is reported that there is a positive relationship between muscle strength increase and speed characteristics (Eler & Sevim, 2002; Topuz, 2008).

There was no statistically significant difference in leg-back strength in favor of the final test ($p > 0.05$). Since leg-back strength develops more difficult than other muscle groups, it is thought that the 6-week plyometric training program is insufficient in muscle development.

A statistically significant difference was found in the right handgrip test ($p < 0.05$). In the left handgrip test, there was no significant difference, although there was a difference between the preliminary test 23.95 ± 6.45 and the last test 24.82 ± 6.37 ($p > 0.05$). In the study to determine the handgrip force values of children who do sports and do not 11 years of age, it was determined that children who exercised were more likely to have a higher handgrip than those who did not (Ziyagil, 1998). Given the direct relationship of grip strength, it is thought that the grip strength in sports branches such as volleyball, basketball, handball, where more grip power is used, is higher than in individuals who do not play sports.

Consequently, it was concluded that the 6-week plyometric training program for girls between the ages of 10-14 positively affects the selected force parameters except for left handgrip and waist-leg strength.

Keywords: Sportsmen, Volleyball, Exercise, Plyometric Exercise, Motor Skills.

Öz: Bu araştırma, pliometrik antrenmanın 10-14 yaş arası kadın voleybolcularda; durarak uzun atlama, dikey sıçrama, 30 saniye mekik, 30 saniye şınav, 30 metre sprint, el kavrama kuvveti, bacak (sırt) kuvveti ve esneklik ölçümü gibi motorik özelliklere etkisini belirlemek amacıyla yapılmıştır. Araştırmaya Türkiye’de (Elazığ ili) düzenli olarak voleybol branşında spor yapan toplam 36 ortaokul öğrencisi katılmıştır. Katılımcılar gönüllülük esasına uygun şekilde araştırmaya dahil edilmiştir. Bu örneklem grubundaki 36 öğrencinin ortalama kiloları 52.067 ± 11.574 kg, boy uzunlukları 157.11 ± 9.164 cm, yaşları ise 13.06 ± 1.162 belirlenmiştir. Bu sporculara düzenli voleybol antrenmanlarının dışında 6 hafta boyunca haftada 3 kez pliometrik antrenman programı uygulanmıştır. Verilerin analizi için normallik testi yapıldıktan sonra Paired Samples t testi kullanılmıştır. Araştırmanın sonunda, durarak uzun atlama, dikey sıçrama, 30 saniye mekik, 30 saniye şınav, 30 metre sprint, el kavrama kuvveti(sağ) ve esneklik değerlerinde anlamlı bir farklılık olduğu görülmüştür ($p < 0.05$). Pliometrik antrenmanın voleybolcularda bazı motorik özellikleri geliştirdiği, el kavrama (sol) ve bacak (sırt) kuvvetlerini etkilemediği belirlenmiştir. Bu sonuçlar çerçevesinde, sporcular, antrenörler ve spor yöneticileri pliometrik antrenman programlarını voleybol antrenman programlarına dahil ederek voleybol sporcularının gelişimlerine katkıda bulunabileceği öne sürülmüştür. Ayrıca, gelecekte araştırmaların araştırma evrenini ve örneklemi daha geniş ve çeşitli açılardan oluştup, inceleyerek ve plyometric anterman programlarının etkisini diğer spor branşlarının sporcuları açısından değerlendirerek bu konudaki literatüre katkıda bulunacağı düşünülmektedir.

Anahtar Kelimeler: Sporcular, Voleybol, Antrenman, Pliometrik Antrenman, Motorik Özellikler

Introduction

An exercise is an activity to increase performance in grounds of physiological, mental, technique and tactical abilities. Among these plyometric exercises is one of the programs developed with the intention of peak performance in sportive activities. In literature plyometric exercises are defined as exercises in which muscles exert maximum force in short intervals of time. In general, it is conducted to strengthen the lower extremity muscles, quick force, anaerobic power, nerve-muscle activity, muscle-tendon complex and to increase vertical jump height (Wu et al., 2009; Kotzamanidis, 2006).

It composes the foundation of performance by combining volleyball, technique-tactical, conditional and mental abilities with psychological aspects. Volleyball is a sport consisting of consecutive short-term exercises and resting periods. Moves like block, dunk and net movements in Volleyball's basic technique require sudden explosive force (Ergun et al., 1994).

Development of psychomotor skills is a life-long process and it is an accumulation of coordinated muscle activities induced by conscious mental activity which occurs by physical movement. Psycho-motor skills are divided into attention, force, balance, response speed, coordination and flexibility. It has been reported by many researchers that strength training is effective on "development of child strength" and constructive during "transition from childhood to adolescence" (Boyacı & Tutar, 2018; Suman et al., 2001). According to the Gallahue (1982) pyramid model, children between the ages of 10 and 14 take part in the period of sports movements, leaving behind the period of reflex movements, the period of primitive movements and the period of basic movements. Considering these first in this study, the effect of 6-week plyometric training performed regularly during normal training period on some selected motoric characteristics of 10-14 age volleyball players was tried to be determined.

Method

Sampling group of this research is gathered from Gazi middle school (12 female students), Hilalkent middle school (12 female students) and Kovancilar Eti Holding middle school (12 female students) in Elazığ/Turkey. These were thirty-six female students between the ages of 10-14 who participated in regular volleyball exercises before. Before starting the research, students signed Volunteer participation certificates and their parents signed informed parent approval certificates. The necessary warm-up movements were performed before the start of the measurements and tests. Athlete students' measurements were taken the day before the first training and one day after the last training. The plyometric training program was planned to be 40-50 minutes 3 days a week for 6 weeks. Athletes measurements of height, weight, standing long jump, vertical jump, 30-second sit-ups, 30-second push-ups, 30-meter sprint, handgrip strength, leg (back) strength and flexibility are applied on pre-test and post-test of the athletes. The following measurements were included in the sample group and the process was as follows (Kılınç, 2008; Mackenzie, 2005; Özer, 2001; Tamer, 2000; Zorba, 2000).

- *Measurement of height and body weight*; the heights of the athletes were measured with a tape measure with their feet bare, body upright and head forward. Body weights were measured with a digital scale, branded Simbo, with a sensitivity of 0.1 kg with their feet bare and dressed in a sports outfit. These measurements were made only during the pre-test process.
- *Standing long jump*; the tips of two toes of the athletes are placed on the line previously designated for the jump. Then the knees are bent at 45 degrees, arms at the back and feet spaced at shoulder width. With their knees bent, they are asked to quickly jump into the sandbox using their arms and legs. The jump distance of the athletes is measured by targeting the heels between the starting line and the point where they fell into the sandbox. The test was repeated twice and the best scores of the athletes were recorded in centimeters.
- *Vertical jump test*; athletes were made to jump vertically with their feet widely spaced and knees bent, with one hand in the air. They are made to touch the tape measure that was previously fixed to the wall with their fingertips while their hands in the air. The test was repeated twice and the best scores of the athletes were recorded in centimeters.
- *30-second sit-ups*; athletes are asked to use all their power for 30-seconds when they were ready, to touch the ground with their shoulders, touching the ground with their backs and complete the movement. scores are recorded in units.
- *30-second push-ups*; the movement of the athletes on the cushion in the straight front position with arms at the width of the shoulders, elbows in full extension, arms in the flexion position with the chest touching the ground and rising again (elbows in full extension) is counted as complete. Measurement results were recorded in units.
- *30-meter sprint*; athletes were asked to complete the measurement with high output and maximal force in a designated 30 m area. the test is conducted twice on each athlete and the best score measured and recorded with stopwatch using seconds as the measure.
- *Handgrip strength test*; athletes were warmed up before the test. TAKEI brand dynamometer was used in the measurement. The handgrip strength of the subjects is measured on feet. The subjects' arms were at an angle of 10-15 degrees from the shoulder, starting from the right hand, the maximum handgrip strength measurements are taken while the subjects were resting. after two attempts best measures for both hands were recorded as right and left handgrip forces.
- *Leg strength measurement*; measurements were made with TTK 5402 Digital Brand back leg dynamometer. The athletes were warmed up. They were then asked to place their feet on the dynamometer stand with the knees bent at 130–140 degrees, with the arms, stretched, their backs straight and the body slightly tilted forward, with the hands grasping the dynamometer bar

vertically using their legs at the maximum capacity to pull it upwards. Each athlete has given two attempts and the best results were recorded.

- *Flexibility measurement*; the flexibility measurements of the athletes were performed with the sit-and-lay test. The participant sits on the floor, extending her legs, resting her soles on the front of the table, extending her arms as far as possible on the metric panel on the top surface of the table and waiting for a few seconds at the last point where the fingertips touch. The last contacted point in the metric panel was determined and recorded. If the participant's legs were bent and the participant's contact with the ground is ceased before or during the waiting period, the measurement is repeated and counted as invalid. The athletes were given two attempts and their best scores were recorded in centimeters.

Table 1: Designated 6-week plyometric training program for the sample group

Week	Monday	Wednesday	Friday
1	Rope skipping 3x20 Double feet jumping from floor to crate 3x10 Long jump with changing directions 3x10	Lateral leap over obstacle 3x15 Push-up 4x4 Knees belly high double foot standing jump 3x10	Rope skipping 3x20 Single foot leap forward 3x10 Lateral leap over obstacle 3x15
2	Rope skipping 3x20 Single foot leap forward 3x10 Double leg vertical jump 3x10	Lateral leap over obstacle 3x15 Depth jump 3x10 Push-up 4x4	Rope skipping 3x20 Double leg vertical jump 3x10 Standing long jump 3x10
3	Rope skipping 3x20 Lateral leap over obstacle 3x15 Standing long jump 3x10	Double feet jumping from floor to crate 3x10 Long jump with changing directions 3x10 Push-up 4x4	Rope skipping 3x20 Pushing the body upwards by changing feet positions (commando dance) 3x10 Long jump with changing directions 3x10
4	Rope skipping 3x20 Standing long jump 3x10 Pushing the body upwards by changing feet positions (commando dance) 3x10	Double feet leap forward from funnels 3x10 Kangaroo jump 3x10 Push-up 4x4	Rope skipping 3x20 Standing long jump 3x10 Long jump with changing directions 3x10
5	Rope skipping 3x20 Long jump with changing directions 3x10 Lateral leap over obstacle 3x15	Knees belly high double foot standing jump 3x10 Depth jump 3x10 Push-up 4x4	Rope skipping 3x20 Double leg vertical jump 3x10 Lateral leap over obstacle 3x15
6	Rope skipping 3x20 Double feet jumping from floor to crate 3x10 Double leg vertical jump 3x10	Depth jump 3x10 Single leg vertical bounce 3x10 Push-up 4x4	Rope skipping 3x20 Single foot leap forward 3x10 Pushing the body upwards by changing feet positions (commando dance) 3x10

The obtained data were loaded into the SPSS Statistics 22 package program. The normality analysis was then performed and "Paired Samples t-Test" was performed to determine the differences between the average values between the pre-test and post-test measurements of the volleyball players. The level of significance was taken as $p < 0.05$.

Findings

The findings obtained for the research are given below.

Table 2: Average of the sample group according to age, height and body weight

Variable	N	Average
Age (year)	36	13.06
Height (cm)	36	157.11
Body Weight (kg)	36	52.06

It has been identified that the average age of the sampling group was 13.06 years, average height was 157.11 cm and the average body weight was 52.6 kg (Table 2).

Table 3: The average scores of some motoric characteristics of the sampling group according to the results of the interdependent sample t-test

Variable	Test	N	Average	Standard Deviation	t	p
Long Jump (cm)	Pre-test	36	185.67	17.95	-4.167	0.003*
	Post-test	36	189.83	15.25		
Vertical jump (cm)	Pre-test	36	225.94	16.29	-6.352	0.001*
	Post-test	36	230.72	16.55		
Flexibility (cm)	Pre-test	36	28.78	4.05	-7.430	0.001*
	Post-test	36	32.11	3.92		
30 s. sit-up (total)	Pre-test	36	20.44	2.00	-9.364	0.001*
	Post-test	36	23.56	2.09		
30 s. push-up (total)	Pre-test	36	3.17	0.95	-6.298	0.001*
	Post-test	36	4.33	0.90		
30 m sprint (sn)	Pre-test	36	5.33	0.35	2.500	0.023*
	Post-test	36	5.33	0.35		
Leg back force	Pre-test	36	58.94	15.67	-1.958	0.067
	Post-test	36	59.39	15.53		
Handgrip (right hand)	Pre-test	36	24.43	7.32	-4.572	0.001*
	Post-test	36	26.47	7.12		
Handgrip (left hand)	Pre-test	36	23.95	6.45	-1.401	0.179
	Post-test	36	24.82	6.37		

*p<0.05

Statistically significant differences were found in standing long jump (cm), vertical jump (cm), flexibility (cm), 30-second sit-up, 30-second push-up, 30-meter sprint and handgrip (right hand) measurements ($p<0.05$). Leg back strength and handgrip (left hand) tests ($p>0.05$) showed no significant difference (Table 2).

Results

This study was conducted on 36 volleyball athletes at the secondary school level and the effects of a 6-week plyometric training on selected force parameters were investigated. Accordingly, no change was observed as a result of the height and age values of the athletes participating in the study.

In the study there was a significant difference in the long jump test in favor of the final test ($p<0.05$). in the 8 week study of 25 boys aged 12-14 made by Kızılet et al. (2010) significant differences in long jump values were found it can be said that this significant difference is due to fact that the jumps in plyometric training, splashes are made as explosives in a very short period and consequently both explosive power and explosive properties are developed (Chu, 1984; Kubo, 2007).

Plyometric training is generally used to strengthen the lower extremity muscles, rapid strength, nerve-muscle activity, muscle-tendon complex, and vertical jump height (Kotzamanidis, 2006). consequently, a significant difference was observed in the vertical jump test we made ($p<0.05$). in another study, it was found that there were significant differences and maximal forces of force training in young football players aged 12-15 (Ataberk et al., 2010).

In the research, it was found that the average results of flexibility (cm) pre and post-test were statistically significant. ($p<0.05$). Plyometric training has been shown to increase the coordination between muscles and flexibility that develops accordingly. Another study of athletes

between the ages of 14-16 found significant differences in flexibility test values (Pense & Harbili, 2001).

In this study, a significant difference was in the 30-second sit-ups test in favor of the final test. 17 volunteer students ($p>0.05$). Including 15 boys and 2 girls between the ages of 12-14, conducted a study to examine the effects of judo on the physical parameters of visually impaired individuals, the first and final test significant differences were found at $p.001$ level (Yılmaz et al., 2003). In this context, we can say that additional plyometric training sparring with girls engaged in volleyball sports regularly improves the muscles.

In the study, it was found that there were significant improvements in test values for 30-second push-up performance ($p<0.05$). The push-up station in the training program said that it will be effective in the development of dynamic forces in the upper extremity.

30 m. Sprint (seconds) pre and post-test average results statistically showed a significant difference ($p<0.05$). Different force training protocols also stated that there were significant decreases in 30m sprint times and it is reported that there is a positive relationship between muscle strength increase and speed characteristics. (Eler & Sevim, 2002; Topuz, 2008).

There was no statistically significant difference in leg-back strength in favor of the final test ($p>0.05$). Since leg-back strength develops more difficult than other muscle groups, it is thought that the 6-week plyometric training program is insufficient in muscle development.

A statistically significant difference was found in the right handgrip test ($p<0.05$). In the left handgrip test, there was no significant difference, although there was a difference between the preliminary test 23.95 ± 6.45 and the last test 24.82 ± 6.37 ($p>0.05$). In the study to determine the handgrip force values of children who do sports and do not 11 years of age, it was determined that children who exercised were more likely to have a higher handgrip than those who did not (Ziyagil, 1998). Given the direct relationship of grip strength, it is thought that the grip strength in sports branches such as volleyball, basketball, handball, where more grip power is used, is higher than in individuals who do not play sports.

Consequently, it was concluded that the 6-week plyometric training program for girls between the ages of 10-14 positively affects the selected force parameters except for left handgrip and waist-leg strength. Within the scope of these results, it was suggested that athletes, coaches and sports managers could contribute to the development of athletes who play volleyball by including plyometric training programs in their training programs. Furthermore, it is believed that future studies can contribute to the literature on the subject by forming the population and the sample of the study in extensive and various ways and evaluating plyometric training programs in terms of the athletes of other sports branches.

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