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Determining Effect of Plyometric Exercises on Various Motoric Characteristics for Woman Volleyball Players

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Abstract

The aim of this study is to investigate the effect of plyometric training on the agility, vertical jump and 20 meter speed tests performance and volleyball performance of female volleyball players. The study was carried out on 14 female athletes from the 13-14 age group of Izmit DSI Sports Club whose sports age was 3.5 ± 0.70 years. Athletes were randomly divided into two groups as experimental (n=7) and control (n=7). Volleyball-specific technical-tactical trainings and plyometric training program were applied to the experimental group for 8 weeks, 3 days a week and 90 minutes in scope. The control group continued only 90 minutes of volleyball training. Prior to plyometric training, both groups were given agility, vertical jump and 20 meter speed tests as pre- and post-tests. First and last test values of the groups were determined and descriptive statistics were made by using SPSS 22.0 statistical package program. Wilcoxon test was used to compare the first and last measurements of the groups, and Mann-Whitney U test was used to compare the data of the control and experimental groups. According to the data obtained, when the experimental group first test and last test were compared, it was found that there was a statistically significant increase in vertical jump and illionis agility test results ($p<0.05$). There was no statistically significant difference between the 20 meter speed test values of the experimental group and all variables of the control group ($p>0.05$). There were statistically significant differences between the two groups in the comparison of the final measurement values of 20 meters speed, vertical jump and illinois agility test between the groups ($p<0.05$). As a result, it can be said that 8-week plyometric training has a positive effect on the speed, agility and vertical jump performance of volleyball players in the 13-14 age group.

Keywords: Volleyball, plyometric, vertical jump, agility.

INTRODUCTION

Today, with a history of more than a century, volleyball is a complex team game that requires multi-faceted sports skills and with constantly changing positions (12). Considering the necessity of playing time, correct and quick play in volleyball, it is necessary to have all the basic motoric features such as general strength, endurance, speed, agility and coordination(18). When examining the structure of this branch, it is necessary to have the ability to perform skills such as rapid and sudden movements, maintaining balance, vertical jumps, changing direction and making quick decisions in a harmonious manner. Therefore, these traits need to be run and developed in relation to each other in training (2,18,27,7).

Improving the height of the jump in training exercises is one of the main goals of most coaches. Therefore, both training scientists and coaches have developed working models that improve the jump height. One of the commonly used training methods in these study models is plyometric training (29). Plyometrics are also training techniques used by athletes to increase power and explosiveness in all sports (10). Since volleyball is an 'interval sport'', in which consecutive application of short-term maximal loading and appropriate rest periods are available (24), coaches and training scientists apply plyometric exercises as a training method to improve the jump level of athletes.

In literature, there are studies showing that plyometric training can contribute to improvements in vertical jump performance, acceleration, muscle strength, leg strength, increased joint awareness and general proprioception (22, 20, 24, 16, 8, 5,28). However, there are also studies that show that it is an effective form of training that develops branch-specific biomotoric properties for sport branches that require force and speed such as sudden running and direction changes (3, 25, 21, 11, 26, 4, 23). It is thought that athletes can not only use plyometric exercises to break the monotony of training, but they can also improve their strength and explosiveness while trying to be more agile (20).

From this point of view; the aim of this study was to determine the effects of plyometric training program on vertical jump, agility and 20 m sprint of volleyball players in women aged 13-14 years.

MATERIAL AND METHOD

The study group consisted of 14 volleyball female volleyball players with a sports age of 3.5 ± 0.70 years in the 13-14 age group playing volleyball in Izmit DSI Sports Club. Athletes were randomly selected and divided into two groups: experiment (n = 7) and control (n = 7). In addition to the technical-tactical trainings specific to volleyball for 90 minutes, 3 minutes a week for 8 weeks, a 20-minute plyometric training program was applied to the experimental group (Table 1). The control group received only 90 minutes of volleyball-specific technical-tactical training.

Table 1. 6 Weeks Plyometric Training Protocol

Week	Training Days	Exercise Number	No of Repeats x Set Number	Rest Between Repeats (s)	Rest Between Sets (min)	Total Jump
1. Week	1.	1, 2, 3, 4, 5, 6	10x1	60		60
	2.	1, 2, 3, 4, 5, 6	10x1	60		60
	3.	1, 2, 7, 8, 10, 11, 12	10x1-5x1	60		60
2. Week	4.	14, 15, 9, 11, 12	10x2-5x2	60	2	70
	5.	14, 15, 9, 11, 12	10x2-5x2	60	2	70
	6.	14, 15, 9, 11, 12	10x2-5x2	60	2	70
3. Week	7.	8, 14, 16, 18, 21, 22	10x2-5x2	60	2	80
	8.	8, 14, 16, 18, 21, 22	10x2-5x2	60	2	80
	9.	8, 14, 16, 18, 21, 22	10x2-5x2	60	2	80
4. Week	10.	8, 15, 16, 21, 18	10x2-5x2	60	2	90
	11.	8, 15, 16, 21, 18	10x2-5x2	60	2	90
	12.	8, 15, 16, 21, 18	10x2-5x2	60	2	90
5. Week	13.	8, 15, 21, 23, 13	10x2-5x2	60	2	90
	14.	8, 15, 21, 23, 13	10x2-5x2	60	2	90
	15.	8, 15, 21, 23, 13	10x2-5x2	60	2	90
6. Week	16.	7, 8, 10, 16, 17, 18, 21	10x2-5x2	60	2	90
	17.	7, 8, 10, 16, 17, 18, 21	10x2-5x2	60	2	90
	18.	7, 8, 10, 16, 17, 18, 21	10x2-5x2	60	2	90
7. Week	19.	14, 15, 21, 13, 16, 17, 18	10x2-5x2	60	2	100
	20.	14, 15, 21, 13, 16, 17, 18	10x2-5x2	60	2	100
	21.	14, 15, 21, 13, 16, 17, 18	10x2-5x2	60	2	100
8. Week	22.	7, 8, 17, 21, 23	10x2	60	2	100
	23.	7, 8, 17, 21, 23	10x2	60	2	100
	24.	7, 8, 17, 21, 23	10x2	60	2	100

The plyometric movements applied to female volleyball players were tabulated as follows (Table 2).

Table 2. Plyometric Exercise Table

1. Double foot forward and backward jump at obstacle
2. Double foot right and left jump at obstacle
3. Jump forward and backward with the right foot in the obstacle
4. Jump forward and backward with the left foot in the obstacle
5. Jump right and left with the right foot in the obstacle
6. Jump right and left with the left foot in the obstacle
7. Squat jump
8. Jump pulling knees to chest
9. Obstacle jump between height with double foot
10. Double foot jump on rings
11. Zig-zag jump right foot
12. Zig-zag jump left foot
13. Obstacle jump and jump into the vault
14. Commando dance
15. Burpee
16. Jump and obstacle jump by changing feet in rings
17. Jump from the vault and jump the obstacle
18. Double leg obstacle jump
19. Right foot obstacle jump
20. Left foot obstacle jump
21. Vault jump
22. Right and left foot jump obstacle from different heights
23. Zig-Zag double feet jump on rings

Before and after the 8-week training program, vertical jump, illionis agility and 20 m sprint tests were applied to both groups as first and last tests. These test protocols are;

Vertical Jump Test: The athlete stretched his hands up on the wall and chalked the wall at the level of the middle finger; and made a marking with chalk on the wall by leaping from the point where it was located. The best results were recorded after 2 trials (6).

Illinois Agility Test: In a 10m long and 5m wide course, 4 cones were used at the beginning, at the finish, and at the turning point of both. The other 4 cones were placed in the middle with 3.3m intervals. The athletes exited the start cone by starting the stopwatch with the start command, and the stopwatch was stopped when the chest sections reached the end cone level. The best results were recorded after 2 trials (20).

20 Meter Speed Test: The speed performance of the subjects was determined by 20 meter speed test. In the 20-meter course, the start command is exited behind the designated area for the start and the stopwatch is started. The stopwatch was stopped when the athlete reached the finish at chest level. The best results were recorded after 2 trials.

Analysis of Data

Using the SPSS 22.0 statistical package program, Wilcoxon test and Mann-Whitney U test were used for the comparison of the first and the last measurements and descriptive statistics. Significance level was set at $p < 0.05$.

FINDINGS

The findings of the research are presented in the tables below, respectively.

Table 4. Analysis Results of First and Last Measurements of Research Group

		Experiment			Control		
Variables	**N**	**X**	**Sd**	**p**	**X**	**Sd**	**p**
Age (year)	7	13.57	0.53		13.43	0.53	
Height (m)	7	1.63	0.04		1.58	0.06	
Weight (kg)	7	53.37	3.52		50.87	4.73	
20 m Sprint (sec) First	7	4.33	0.15	**0.18***	4.51	0.19	0.61
20 m Sprint (sec) Last	7	4.23	0.16		4.49	0.22	
Vertical Jump (cm) First	7	29.71	4.54	**0.02***	27.43	2.7	0.23
Vertical Jump (cm) Last	7	34.71	4.92		28	3.06	
Illinois Agility (sec) First	7	17.78	0.77	**0.02***	18.22	0.5	0.50
Illinois Agility (sec) Last	7	15.79	1.08		18.18	0.46	
*p<0.05							

In the study, when the first and last test values of the experimental group were compared, 20 m sprint test, vertical jump and Illinois agility test were found to be statistically significant ($p<0.05$). There was no significant difference in the control group ($p>0.05$) (Table 4).

Table 5. Experimental and Control Groups Comparison Results of the Last Measurement Values

Variables	Groups	X	Sd	p
20 m Sprint (sec) Last	Experimental	4.23	0.16	**0.03***
	Control	4.49	0.22	
Vertical Jump (cm) Last	Experimental	34.71	4.92	**0.01***
	Control	28	3.06	
Ilinois Agility (sec) Last	Experimental	15.79	1.08	**0.00***
	Control	18.18	0.46	

*p<0.05

In the study, it was found that there was a statistically significant difference between the two groups in the comparison of 20 m speed, vertical jump and Illinois agility test last measurement of the experimental and control groups ($p<0.05$) (Table 5).

DISCUSSION AND CONCLUSION

In this study, the effect of 8-week plyometric exercises on the performance of female volleyball players between the ages of 13-14 was investigated and the results obtained were compared with the other studies in the literature.

Akçınar's (1) study showed that Illinois agility test was used as a post-test (13.30 ± 0.66 sec) in plyometric studies in 11-12 age group athletes twice a week in different directions. control group reported a significant difference in posttest (14.27 ± 0.60 sec) comparison; In addition, it concluded that plyometric studies had a positive effect on training planning in this age group. Bayraktar (5), volleyball players at the end of a 14-week plyometric study experimental group pre-test and post-test values taking 3 steps vertical jump (6.92 ± 6.25 cm) and active jump (6.17 ± 4.72 cm) statistically reported a significant difference ($p<0.05$).

Aykora and Dönmez (3) reported that there was a statistically significant difference in the mean values of vertical and initial test measurements (1.66 ± 0.88 cm) in plyometric exercise according to Tabata protocol in volleyball players aged 16-17 ($p<0.05$). Although the age groups of female volleyball players were different in the literature, it was found that plyometric exercises improved the jump performance of volleyball players. Büyükipekçi (9) in his study, the values obtained in the agility measurements of female volleyball players were compared and accordingly; There was a statistically significant difference between first and second measurements ($p<0.05$). The results obtained in the literature support this study.

Baktaal (4), 16-22 age group female volleyball players in the 6-week season added to the training program plyometric studies, vertical jump values are higher than the initial values added that the added plyometric exercises may have a positive effect on the jump performance.

Miller et al. (20) reported that 6-week plyometric training can be an effective training technique to improve athletes' agility, and improvements in agility may be beneficial for athletes during the final pre-season preparation stage. Pancar et al. (23) reported that the 8-week plyometric training program applied in addition to handball training was significant in favor of the posttest (29.71 ± 3.58 cm) in the vertical jump performance of female handball players in the 12-14 age group ($p<0.05$). Similarly with this study, plyometric training applied to athletes of the same age group, although in different branches in the literature, showed a significant increase on the vertical jump values of athletes.

Harput et al. (15), in their research on the effect of pliometric training on female volleyball players on balance, jump distance and hamstring quadriceps rate, at the end of 6 weeks plyometric training, a significant difference was found in the parameters selected in the experimental group and it was concluded that it could be effective in increasing

sports performance($p<0.05$). Turgut et al. (28), they concluded that the 12-week low-intensity plyometric exercises that they apply to 11.1 years age volleyball players are effective on balance performance ($p<0.05$).

Gül et al. (13), 8-week plyometric training applied to tennis athletes is effective on ITN tennis performance, Gül et al. (14), plyometric training, which they applied to basketball players for 8 weeks, was found to be effective on vertical and horizontal jump, hand grip, sit & stretch flexibility test performance, Öztin et al. (19), they found significant improvements in vertical and horizontal jump, 30 m speed, anaerobic power, 20 m shuttle, body density, body fat percentage and lean body weight($p<0.05$). Bozdoğan and Kızılet (7), in their study on the effect of 8-week plyometric training applied to badminton athletes on agility, coordination, jump performance and biomotor properties, at the end of the training, it was determined that they provided improvement in the parameters determined in the plyometric training group. It was stated that there was a significant difference in the values of multiple and fixed jump, left foot forward jump, standing long jump and yo-yo intermittent recovery test values ($p<0.05$).

Thakur et al. (27), in their research on the effect of plyometric and weight training applied to students of physical education and sports department on the vertical jump performance, It has been reported that the plyometric and weight training of the data obtained as a result of the 6-week training of the students aged 18-21 provided significant improvements. They concluded that plyometric exercises are a viable training method and can be beneficial in the performance of vertical jump in athletes. Özmen and Aydoğmuş (18), in their research that they investigated the effect of plyometric training applied to badminton players on adolescent period on agility and squat jump performance, found that the plyometric group showed more improvement (6%) than the control group and plyometric training improved agility and jump performance in adolescent badminton players ($p<0.05$).

As a result of the study, it was found out that plyometric trainings applied together with volleyball-specific exercises for 8 weeks improved 20-meter speed, agility and vertical jump performance in 13-14 age group volleyball players. In this context, it can be said that plyometric exercises can positively affect the speed, agility and jump performance of female volleyball players.

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