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THE EFFECT OF A SIX-WEEK TABATA PROTOCOL ON JUMP PERFORMANCE IN FEMALE VOLLEYBALL PLAYERS

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ABSTRACT

The purpose of this study was to investigate the effects of a 6-week Tabata protocol on jumping performance in female volleyball players. The Ted College Sports Club Women's Volleyball A team, competing in the KFC Women's First League (n:10) and a total of 20 women (n:10) constituted the study group. The Tabata protocol consisted of a total of 8 exercises: high jump, half squat, burpee, mountain climb, reverse crunch, Russian twist, leg raises, and speed skaters. Each exercise consists of 20 seconds of a very high intensity exercise and 10 seconds of rest. Repeat 8 times for a total of 4 minutes. The findings indicate that Tabata training resulted in significant improvements in volleyball players' vertical jump height and overall fitness levels. However, for such training to be effective, it is crucial that it be performed using correct techniques and tailored to individual needs. Furthermore, to reduce the risk of injury, athletes are advised to perform appropriate warm-up and cool-down exercises before beginning any intensive training program. In conclusion, the Tabata protocol can be considered an effective method for improving the jumping abilities of female volleyball players.

Keywords: Volleyball, Jump performance, Tabata protocol

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INTRODUCTION

Volleyball is a dynamic team sport that involves various game types, develops through years of training, and requires specific athletic skill (Koçak, 2019) Making quick decisions, making the right choices at the right time, and the behavior and decision-making processes of coaches are of vital importance for all sports, including fast-paced and mobile sports branches such as volleyball.

Volleyball is an anaerobic sport in which movements requiring sudden power (vertical and horizontal jump) are performed continuously with short rest periods (Sheppard, Newton, & Mcgıan, 2007). Jumping performance is often enhanced through plyometric training techniques. Plyometric training performed using body weight can be carried out in various forms such as multiple hops, jumps, depth jumps, and squat jumps.

The jumping action in a volleyball match is a fundamental group of movements frequently used in both offensive and defensive phases (spike, block, and serve), and it is one of the most significant factors affecting the match outcome. This sport-specific jumping ability is defined as the athlete jumping as far as possible in the horizontal plane or to the highest point in the vertical plane, and it occurs frequently at indeterminate times during matches. It is clear that athletes must have an above-average jumping ability to gain an advantage and achieve success during a match. Therefore, the vital importance of jumping ability is accepted as an absolute necessity by coaches and athletes (Sheppard, Newton, & Mcgıan, 2007).
Athletes are often subjected to intense and high-volume training programs to achieve their desired physiological, metabolic, cardiovascular, and neuromuscular development (Charitonidis, Koutlianos, Anagnostaras, & Anifanti, 2019). Interval training types, which include intense training, have gained more attention in recent years for improving athletic performance. Intermittent training is defined by short-term intense activities requiring effort above 90% of the $VO_{2max.}$ value or seventy-five percent of maximum power, followed by rest periods or low-intensity exercises (Atakan, Li, Koşar, & Turnagöl, 2021).

One of the most frequently used intermittent exercise methods is known as High-Intensity Interval Training (HIIT). HIIT has many different forms, and the most preferred among them. Tabata is a training program consisting of eight movements; each set involves 20 seconds of intense work followed by 10 seconds of rest, lasting a total of 4 minutes. A four-minute Tabata session significantly increases the aerobic endurance and anaerobic power of physically active individuals (Tabata, Nishimura, Kouzaki, & Yamamoto, 1996). Today, HIIT applications are widely preferred across different groups, such as adult endurance athletes, elite athletes (Kilen, Larsson, & Nordsborg, 2014). team sports players, and various individual sports events (Monks, Seo, & Song, 2017). to enhance endurance performance.

The aim of this study is to investigate the effect of a six-week Tabata training on the jumping performance of female volleyball players. The improvements recorded in the active jump and volleyball spike-step jump ability of highly trained volleyball players demonstrate that further development can be achieved with the application of the Tabata protocol, and highlight its necessity (Sheppard, Newton, & Mcgıan, 2007).

Material and Methods

Research Group

The Women's Volleyball A team roster of the Ted Koleji Sports Club, competing in the KFC Women's 1st League, constitutes the research group for this study. The participants consisted of a total of 20 individuals, divided into an Experimental group (n:10) and a Control group (n:10).

Procedure

Before the study, ethical committee approval was obtained from Kırıkkale University's Non-Interventional Ethics Committee with the decision dated 14.11.2024 and numbered 2024.11.13. After obtaining approval, the age, height, weight, squat jump, and counter-movement jump measurements of the experimental and control groups were taken and recorded as the pre-test results. The same tests were repeated after the six-week Tabata Protocol and recorded as the post-test results.

Height and Weight Measurement

The participants' height and weight measurements were taken in accordance with the appropriate measurement techniques using a Seca brand height and weight measuring device with a precision of 0.01.

Tabata Protocol

The Tabata protocol consists of a total of 8 exercises. Each exercise consists of 20 seconds of a very high intensity exercise and 10 seconds of rest. Repeat 8 times for a total of 4 minutes (Table 1.)

Table 1. Tabata protocol

Tabata Exercise	Time	Rest	Repeat	Total
High Jump	20 Seconds	10 Seconds	8 Times	4 Minutes
Half Squat	20 Seconds	10 Seconds	8 Times	4 Minutes
Burpee	20 Seconds	10 Seconds	8 Times	4 Minutes
Mountain Climb	20 Seconds	10 Seconds	8 Times	4 Minutes
Reverse Crunch	20 Seconds	10 Seconds	8 Times	4 Minutes
Russian Twist	20 Seconds	10 Seconds	8 Times	4 Minutes
Leg Raises	20 Seconds	10 Seconds	8 Times	4 Minutes
Speed Skaters	20 Seconds	10 Seconds	8 Times	4 Minutes

Squat Jump (SJ) Test

The participants' Squat Jump (SJ) trials were performed using the Optojump (Microgate-Italy) device. Participants were instructed to adopt a standing posture with their hands kept free. They were then asked to squat down at the highest possible speed, bringing their knees to 90 degrees, and perform a squat jump as forcefully as possible. The test was repeated twice,

with a one-minute rest given between trials, and the volleyball players' best performances were recorded.

Countermovement Jump (CMJ) Test

The participants' CMJ tests were performed using the Optojump (Microgate-Italy) device. Participants were ensured a standing posture with their feet open at hip/pelvis width and their hands kept free. They were then instructed to squat down very quickly to a 90-degree angle from full knee extension and jump with maximum force. The test was administered twice, with a one-minute rest given between trials, and the best performance score was recorded in cm.

Data Analysis

The statistical analyses of the data collected during the study were performed using the IBM SPSS (Statistical Package for the Social Sciences) Windows Version 29.0 software. Numerical variables were presented with mean ± standard deviation values, while categorical variables were expressed as number and percentage. The Shapiro-Wilk test was applied to determine whether the numerical variables conformed to a normal distribution. The paired samples t-test was used to evaluate the differences between the pre-test and post-test.

RESULTS

As a result of this study, which investigated the effect of a 6-week Tabata protocol on the jumping performance of female volleyball players, the descriptive statistical information regarding the athletes' age, height, and weight is presented in Table 2.

Table 2. Participants' descriptive statistical information.

	Groups	N	Min.	Max	Mean	Sd
Age (Years)	Experimental Group Kontrol Group	10 10	19.00 19.00	22.00 21.00	20.00 20.10	± 1.33 ± 0.99
Height (Cm)	Experimental Group Kontrol Group	10 10	160.00 161.00	189.00 195.00	177.50 178.40	± 8.59 ± 8.85
Weight (Kg)	Experimental Group Kontrol Group	10 10	46.60 55.00	80.30 85.40	62.55 65.05	± 8.48 ± 7.99

As shown in Table 2, the arithmetic mean age of the experimental groups was calculated as 19.00 (±1,33) years, their height was calculated as 160.00 (8,59) cm. and their weight was calculated as 46.60 (±8,48) kg, while the age of the control groups was calculated as 19.00 (±0,99)years, their height was calculated as 161.00 (8,85) cm. and their weight was calculated as 55.00 (±7,99) kg.

t-test was used to investigate the differences between the age, height and weight of the experimental and control groups and the results are presented in Table-3.

Table 3. T-test results comparing the age, height, and weight of the experimental and control groups.

t-test for Equality of Means					Equality of Variances			
Std. Er. Differ.	Mean Differ.	Sig. (2-tailed)	df	t	Sig.	F		
,52599	-,10000	,851	18	-,190	,083	3,375	Experimental	Age
,52599	-,10000	,852	16,647	-,190			Control	
3,90000	-,90000	,820	18	-,231	,873	,026	Experimental	Height
3,90000	-,90000	,820	17,985	-,231			Control	
3,68494	-2,50000	,506	18	-,678	,696	,157	Experimental	Weight
3,68494	-2,50000	,506	17,938	-,678			Control	

The result of the t-test investigating the difference between the ages of the experimental and control groups was calculated as F=3.375, Sig=0.083>0.05. The result of the t-test investigating the difference between the heights of the experimental and control groups was calculated as F=0.026, Sig=0.873>0.05. The result of the t-test investigating the difference between the weights of the experimental and control groups was calculated as F=0.175, Sig=0.696>0.05.

T-test results show that there is no significant difference between the age, height, and weight of the experimental and control groups. In other words, there is a homogeneous distribution between the age, height, and weight of both groups.

Descriptive statistical results of the squat jump and counter movement jump tests of the experimental and control groups are presented in Table 4.

Table 4. Descriptive statistics for the Squat Jump and Counter Movement Jump tests of the experimental and control groups.

Counter Movement Jump (CMJ)			Squat Jump (S J)			Groups	SN
Pre and Postttest Differences (Cm)	Posttest (cm)	Pretes t (cm)	Pre and Postttest Differences (Cm)	Posttest (cm)	Pretes t (cm)		
4.	44.3	40.1	3.6	37.4	33.8	Exp.	**1**
3.1	32.8	29.7	3.1	29.3	26.2	Exp.	**2**
3.5	36.4	32.9	3.2	31.0	27.8	Exp.	**3**
4.2	41.8	37.6	3.3	32.4	29.1	Exp.	**4**
4.2	42.4	38.2	3.2	34.7	31.5	Exp.	**5**
5.1	53.1	48	4.1	44.1	40.0	Exp.	**6**
3.8	37.3	33.5	4.4	32.6	28.2	Exp.	**7**
7.7	39.0	31.3	2.9	26.7	23.8	Exp.	**8**
3.1	32.9	29.8	2.6	28.4	25.8	Exp.	**9**
3.9	40.7	36.8	3.4	32.8	29.4	Exp.	**10**
3.3	34.3	31.0	3.2	31.7	28.5	Control	**11**
3.1	31.9	28.8	3.1	30.1	27.0	Control	**12**
3.7	35.5	31.8	2.7	29.3	26.6	Control	**13**
3.3	34.7	31.4	3.1	29.2	26.1	Control	**14**
3.2	32.2	29.0	3.1	30.1	27.0	Control	**15**
2.9	29.2	26.3	2.4	25.5	23.1	Control	**16**
2.9	29.2	26.3	2.5	25.4	22.9	Control	**17**
2.9	29.0	26.1	2.5	25.5	23.0	Control	**18**
2.7	29.4	26.7	2.6	25.8	23.2	Control	**19**
2.0	29.1	27.1	2.6	25.8	23.2	Control	**20**

The experimental group's pre- and post-test squat jump and counter movement jump results, as well as descriptive statistical information regarding the developmental differences between the pre- and post-tests of these two different vertical jump performances, are summarized in Table-5.

Table 5. Descriptive statistics results of the pre- and post-tests of the experimental group.

Sd	Mean	Max	Min.	N	
± 4,64	29,56	40,00	23,80	10	**SJ Pretest (Cm)**
± 4,99	32,94	44,10	26,70	10	**SJ Posttest (Cm)**
± 5,62	35,79	48,00	29,70	10	**CMJ Pretest (Cm)**
± 5,99	40,07	53,10	32,80	10	**CMJ Posttest (Cm)**
± ,53	3,38	4,40	2,60	10	**SJ Test Pre and Posttest Differences**
± 1,33	4,28	7,70	3,10	10	**CMJ Test Pre and Posttest Differences**

The arithmetic mean of the Squat Jump pre-test in the experimental group was calculated as 29.56 cm, with the highest value being 40.0 cm and the lowest being 23.8 cm. After training, the average SJ value increased to 32.94 cm, with the highest value being 44.1 cm and the

lowest being 26.7 cm. The average SJ increase was 3.38 cm, with the highest increase being 4.4 cm and the lowest being 2.6 cm.
The arithmetic mean of the Counter Movement Jump pre-test of the experimental group was calculated as 35.79 cm, while the highest value was measured as 48.0 cm and the lowest value was 29.7 cm. After training, the average CMJ value increased to 40.07 cm; the highest value was 53.1 cm and the lowest value was 32.8 cm. The mean SJ increase (pre-post test difference) was 3.38 cm, with the highest increase being 4.4 and the lowest increase being 2.6. On the other hand, the mean CMJ increase (pre-post test difference) was 4.28 cm, with the highest increase being 7.7 and the lowest increase being 3.1.
Pre and post test results of the squat jump and counter movement jump of the experimental group and the descriptive statistical information regarding the development differences between the first and last tests of these two different vertical jump performances are summarized in Table-6.

Table 6. Descriptive statistics results of the control group.

Sd	Mean	Max	Min.	N	
± 2,17	25,06	28,50	22,90	10	SJ Pretest (Cm)
± 2,45	27,84	31,70	25,40	10	SJ Posttest (Cm)
± 2,27	28,45	31,80	26,10	10	CMJ Pretest (Cm)
± 2,61	31,45	35,50	29,00	10	CMJ Posttest (Cm)
± ,30	2,78	3,20	2,40	10	SJ Test Pre and Posttest Differences
± ,45	3,00	3,70	2,00	10	CMJ Test Pre and Posttest Differences

The arithmetic mean of the Squat Jump pre-test in the control group was calculated as 25.06 cm, with the highest value being 28.5 cm and the lowest being 22.9 cm. After training, the average SJ value increased to 27.84 cm, with the highest value being 31.7 cm and the lowest being 25.4 cm. The mean SJ increase (pre-post-test difference) was 2.78 cm, with the highest increase being 3.2 cm and the lowest being 2.4 cm.
The arithmetic mean of the Counter Movement Jump pre-test in the control group was calculated as 28.45 cm, while the highest value was measured as 31.8 cm and the lowest value was 26.1 cm. After training, the average CMJ value increased to 31.45 cm; the highest value was 35.5 cm and the lowest value was 29.0 cm. The mean SJ increase (pre-post test difference) was 2.78 cm, the highest increase was 3.2 cm, and the least increase was 2.4 cm. On the other hand, the mean CMJ increase (pre-post test difference) was 3.0 cm, the highest increase was 3.7 cm, and the least increase was 2.0 cm.

Table 7. Shapiro-Wilk test results for the Squat Jump (SJ) test

Test of Normality				
Shapiro-Wilk			Group Name	
Sig.	df	Statistic		
.567	10	.941	Experimental	Squat Jump Test (SJ)
.051	10	.845	Control	

In the analysis of the Squat Jump (SJ) test, the normal distribution assumption for both groups (experimental and control) was assessed using the Shapiro-Wilk test (Table-7). It was

observed that the Squat Jump data showed a normal distribution for both groups and the variances were equal (p>0.05).

Table 8. Independent sample t-test results for the Squat Jump (SJ) test

Independent Samples Test					
t-test for Equality of Means					
Std. Error Differ.	Mean Differ.	Significance			
		Two-Sided p	One-Sided p		
.19585	-.60000	0,03	**.007***	Equal variances assumed	(SJ)

***P<0.05**

As a result of the independent sample t-test (Table-8), which was conducted by taking into account the differences between the pre and post test results of the experimental and control groups in the Squat Jump (SJ) test, a statistically significant difference was found between the groups (p <0.007).

In the analysis of the Counter Movement Jump (CMJ) test, the normal distribution assumption for both groups (experimental and control) was assessed using the Shapiro-Wilk test (Table-9). It was observed that the Squat Jump data did not show a normal distribution for both groups and the variances were not equal (p<0.05).

Table 9. Shapiro-Wilk test results for the Counter Movement Jump (CMJ) test.

Test of Normality				
Shapiro-Wilk			Group Name	
Sig.	df	Statistic		
.005*	10	.762	Experimental	Counter Movement Jump (CMJ)
.384	10	.923	Control	

***P<0.05**

In the Counter Movement Jump analysis, the non-parametric Mann-Whitney U test was preferred because the test group did not show a normal distribution (Table-10).

Table 10. Mann-Whitney U Test results for the Counter Movement Jump (CMJ) test.

Test Statistics[a]	
Counter Movement Jump (CMJ)	
10.000	Mann-Whitney U
65.000	Wilcoxon W
-3.039	Z
0.002*	Asymp. Sig. (2-tailed)
0,02*	Exact Sig. [2*(1-tailed Sig.)]

***P<0.05**

The Mann-Whitney U Test, which was conducted by taking into account the differences between the pre- and post-test results of the experimental and control groups in the Counter Movement Jump (CMJ) test, found a significant difference between the groups in this test as well ($p<0.002$). These findings demonstrate the effectiveness of the training program in both SJ and CMJ performance.

DISCUSSION

In this study, the effect of a six-week Tabata training program on vertical jump ability of KFC Women's 1st TED College Sports Club Women's Volleyball A Team players was investigated. The study results showed significant improvements in both SJ and CMJ performance. The experimental group's pre-test Squat Jump average increased from 29.56 cm to 32.94 cm in the post-test, with an average increase of 3.38 cm. Similarly significant improvements were observed in the Counter Movement Jump test. The CMJ value, which was 35.79 cm in the pre-test, reached 40.07 cm in the post-test, with an average increase of 4.28 cm.

The control group's pre-test Squat Jump average was 25.06 cm, while the post-test average increased to 27.84 cm, with an average increase of 2.78 cm. Similarly, significant improvements were observed in the Counter Movement Jump test. The CMJ value, which was 28.45 cm in the pre-test, reached 31.45 cm in the post-test, with an average increase of 3.00 cm.

Statistical analysis findings demonstrate that the improvements achieved were not random and that the implemented training program had significant effects on performance. According to the independent samples t-test findings for the Squat Jump test, a statistically significant difference was found between the experimental and control groups ($p<0.007$). Similarly, due to the non-normal distribution assumption in the Counter Movement Jump analysis, the non-parametric Mann-Whitney U test was used, and the difference between the groups was found to be statistically significant ($p<0.002$). These results clearly demonstrate the effectiveness of high-intensity Tabata-style training on lower body strength and sudden power development.

The findings of this study are consistent with similar research in the literature. Previous research has demonstrated that high-intensity interval training (HIIT) has beneficial effects on muscle strength, anaerobic capacity, and explosive power (Tabata, Nishimura, Kouzaki, & Yamamoto, 1996). The data obtained in this study suggest that short-term, intense exercises can increase athletes' jumping ability. In sports like volleyball, where jumping ability is crucial, such training can contribute to improved performance.

Similar findings have been obtained in previous studies (Tezer, 2019), (Korkmaz, 2017), (Pehlivan, 2017), (Akman, 2020), (Öz, 2018). (Karatan, 2016). Tabata and high-intensity interval training have been reported to increase jumping performance. The results obtained in this study are consistent with the literature.

Research findings indicate that short-term, high-intensity Tabata training sessions have positive effects on athletes' lower extremity strength and explosive power development. Therefore, Tabata training can be considered an effective training technique in sports like volleyball, where jumping ability is crucial.

CONCLUSIONS

A six-week Tabata training program has been shown to significantly improve jumping ability in female volleyball players. Statistically significant increases in performance were observed in the experimental group in both the Squat Jump and Counter Movement Jump tests, demonstrating that Tabata-style high-intensity interval training is an effective method for improving sports performance. Future research is recommended to investigate the long-term effects of Tabata training using larger sample sizes, implementing similar protocols for various durations and across different age groups. Furthermore, by considering factors beyond jumping ability, such as agility, speed, endurance, and muscular strength, the multifaceted effects of this training type can be demonstrated in more detail.

Author Contributions

Conceptualization, M.M.Ü; methodology, M.M.Ü., A.A.D; formal analysis, A.A.D; investigation, M.M.Ü.; data curation, M.M.Ü.; writing–original draft preparation, M.M.Ü., A.A.D.; writing–review and editing, M.M.Ü., A.A.D.

Informed Consent Statement

The research was conducted in line with the Declaration of Helsinki.

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Conflicts of Interest

The authors declare that no conflicts interest.

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