

Investigation of the Effect of Core Exercises Applied According to Tabata Protocol on Body Composition and Anaerobic Performance Parameters of Young Basketball and Handball Players

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DOI: 10.47750/pnr.2022.13.S08.276

Abstract

Our study was carried out to determine the effect of core exercises applied according to Tabata protocol on body composition and anaerobic performance parameters of basketball and handball players actively participating in competitions. The basketball players group (n=12, mean age: 16.7±1.91) and the handball players group (n=12, mean age: 16.2±1.72) participated in our study on a voluntary basis. In the study, attention was paid to the validity of the results obtained by ensuring that the sample groups and mean ages were similar. Core exercises designed according to Tabata protocol were applied to both sample groups 3 days a week for a period of 10 weeks. Body weight (BW), body mass index (BMI), body muscle ratio (BMR), body fat ratio (BFR) 10, 20, 30-meter sprint, vertical jump and Wingate anaerobic test (peak, mean, lowest value) tests were applied to the groups as pretest and posttest and the results obtained were evaluated in the SPSS 22 software. In our study, normality analysis was determined at the level of -1.5-1.5 and it was decided to use a parametric test and the paired samples t-test was used. The statistical significance level was determined between p<0.00-0.05, the results obtained were evaluated within the sample group and the comparison between the groups was not made statistically. In the measurements between tests of core exercises applied according to Tabata protocol, it was found that there was a significant difference in BMR, 10-meter sprint, vertical jump and peak power values of basketball players, and in BFR, 10-meter sprint, vertical jump and peak power values of handball players (p<0.05). As a result, it was found that core exercises applied according to Tabata protocol provided a significant change in some body composition and anaerobic performance values of basketball and handball players and could contribute to their athletic performances.

Keywords: Tabata Protocol, Core Training, Anaerobic Performance.

INTRODUCTION

The science of training is the whole of the activities carried out to maximize the efficiency in sports activities and to ensure the continuation of the achieved level. Bompa and Haff (2001) defines the hierarchy of training types as conditioning training, technical and tactical training, and psychological and mental training (Muratlı et al., 2011). Nowadays, the training programming applied in sports branches is based on the following principles;

1. Improvement
2. Continuity
3. Diversity
4. Principle of nonlinearity

5. Loading and recovery (Derval and Ganneau, 2019).

The core region is defined as a section where 29 different muscle groups are formed, containing the rib cage, spine, pelvis and shoulder girdle region (Willarsoon, 2018). Core training and exercises are planned in two main groups. The first is to increase performance in individual or team sports, and the second is to look healthy and fit. Health-related applications are also used in the treatment processes of chronic diseases caused by different reasons (Coulombe et al., 2017). In team sports, athletes should maximize their performance level and it is important for success to maintain this high level of performance throughout the competition period (Williams and Rollo, 2015). Tabata exercises: The training method of high-intensity interval training (HITT) was first tried by Peter Coe in the 1970s and developed by Japanese Doctor Izumi Tabata in 1996 (Hattersley, 2014). Tabata exercise protocol: The exercises performed in the form of 20 seconds of application and 10 seconds of rest are performed in 8 sets and take approximately 4 minutes (Olson, 2013). Although it is widely used in this training method, which has various applications, it also carries the risk of injury (Tibana and De Sousa, 2018).

Our current study was carried out with the aim of determining the effect of core exercises applied according to Tabata protocol on body composition and performance parameters in female basketball players and handball players.

Method

Population and Sample Group

The research population consists of female basketball and handball players in the 16-18 age group in Kayseri. The sample group, on the other hand, consists of Kolej Spor women's basketball team which consists of 12 persons with at least 5 years of sports background, and the individuals in the handball sports club of a private college. Before the study, the athletes and their parents were informed and the necessary permissions were obtained in writing.

Data Collection Tools

During the preparation period, core exercises applied according to Tabata protocol were applied to the participants 3 days a week. In the study, the necessary elements for the application of the test protocols were provided and the tests were started.

Applied Measurements and Tests

Height, Body Weight Measurements and Body Composition Analysis

The height measurements of the participants were carried out with a stadiometer fixed to the wall with a standard error of ± 0.1 cm. The body weight, body fat and muscle ratios of the participants were obtained using the TANITA BC6001 device.

10-20-30 Meter Sprint Tests

GAMA branded photocell device with scoreboard feature was used on parquet and flat ground in the measurements of the participants. Participants were given the right to make two attempts and the best score was recorded in seconds.

Vertical Jump Test

Before the test, the participants were given 10 minutes of warm-up time. When the athletes came to the jump mark on a flat ground, two attempts were made with TTK branded digital vertical jump measuring device, and the highest value was recorded in centimeters.

Wingate Anaerobic Power Test

Monark Ergonomic 894 E branded bicycle stopwatch was used in our study. After the weight of the athlete was determined, plates equivalent to 7.5% of the athlete's weight (Kilogram $\times 0.075$) were placed in the test basket (Nummela et al., 1996). After

the warm-up phase was completed, it was applied for 30 seconds with the command. This phase is evaluated in 6 stages in a time period of 4 to 5 seconds. During this time period, the participants' highest, mean and lowest test scores were recorded.

Maximum Anaerobic Power: The highest mechanical power achieved in any five-second time period generated during the test (MAP=Maximum Anaerobic Power).

$$\text{MAP} = (\text{Rmax in the first 5 sec}) \times \text{D/r} \times \text{F} = \text{kgm-5sec, kgm} \times 2 = \text{watts}$$

Maximum Anaerobic Capacity: The mean power generated during the test (MAC=Maximum Anaerobic Capacity).

$$\text{MAC} = (\text{R in 30 sec}) \times \text{D/r} \times \text{F} = \text{kgm-30sec, kgm-30sec} / 3 = \text{watt}$$

Minimum Power: The lowest mechanical power achieved in any five-second time period generated during the test (MinP = Minimum Power) (Özkan et al., 2011).

Training Protocol

Week	Time (sec)	Sets	Rest between movements (sec)	Rest between sets
1	20	2	10	2 minutes
2	20	2	10	2 minutes
3	20	2	10	2 minutes
4	20	2	10	2 minutes
5	25	4	10	2 minutes
6	25	4	10	2 minutes
7	25	4	10	2 minutes
8	25	4	10	2 minutes
9	30	6	10	2 minutes
10	30	6	10	2 minutes

A medicine ball weighing 1 kilogram was used in our study. In the study, overhead split squat, underhand throw, countermovement underhand throw, pullover pass, rotational throw, walking with rotation and seated twist drills were preferred among the core exercises and the program was applied with the help of expert trainers.

Statistical Analysis

IBM SPSS 22.0 software was used in the statistical evaluation of the results obtained in our study. Arithmetic mean (\bar{x}), percent (%) and standard deviation (sd) values were used in descriptive statistics. In the evaluation of the data in the normality test, it was found that the data showed normal distribution with the Kolmogorov-Smirnov test, and it was decided to use the paired samples t-test (Eymen, 2007) to compare the means of the same group.

Results

Table 1 Descriptive Characteristics of the Participants

Variable	Basketball (\bar{x})	Handball (\bar{x})
Age(years)	16.7±1.91	16.2±1.72
Height(cm)	169.2±8.31	159.1±9.29
Body weight(kg)	69.5±7.3	61±13.4
Age of starting sports	11.8±2.4	10.7±3.0

The results in Table 1 were determined as age=16.7±1.91 years, height=169.2±8.31cm, body weight=69.5±7.3kg and age of starting sports=11.8±2.4 in basketball players, and age=16.2±1.72 years, height=159.1±9.29cm, body weight=61±13.4kg and age of starting sports=10.7±3.0 in handball players.

Table 2 Body Composition Analysis of the Participants

Parameter	Group	Pretest	Posttest	t	p
		\bar{x} ±sd	\bar{x} ±sd		
BW (kg)	Basketball	69.5±7.3	68.1±7.35	-4.98	.061
	Handball	61±13.4	60.9±6.87	7.15	.524
BMI (kg/m ²)	Basketball	24.16±4.98	24.04±3.15	2.45	.850
	Handball	24.13±2.85	24.01±3.48	1.73	.241
BMR (%)	Basketball	27.9±2.89	29.9±12	6.91	.042*
	Handball	28.1±1.98	29.5±2.14	9.82	.157
BFR (%)	Basketball	20.2±3.59	20.7±4.97	4.45	.112
	Handball	22.1±4.84	21.9±2.41	3.52	.037*

BW=Body Weight, BMI=Body Mass Index, BMR=Body Muscle Ratio, BFR=Body Fat Ratio (Significance Level p=0.00-0.05*)

When the results in Table 2 were examined, it was found that there was a decrease in the mean BW and BMI values of the participants, and an increase in the BMR and BFR values as a percentage (%). It was found that there was a significant difference in BMR values of basketball players and in BFR values of handball players (p<0.05).

Table 3 Results of 10, 20, 30 Meter Sprint and Vertical Jump Tests of Participants

Group	Measurement	\bar{x} ±sd	t	p	
Basketball	10m	1	1.7 ±.05	-4.251	.041*
		2	1.7±.02		
	20m	1	2.3±.07	-1.159	.359
		2	2.2±.04		
	30m	1	3.5±.03	1.254	.124
		2	3.5±.02		
Handball	10m	1	1.6±.01	5.231	.035*
		2	1.5±.08		
	20m	1	2.1±.07	7.215	.412
		2	2.1±0.3		
	30m	1	3.2±.01	5.365	.298
		2	3.1±.02		
Vertical Jump	Measurement	\bar{x}±sd	t	p	
Basketball	Pretest	32.7±7.68	1.753	.005*	
	Posttest	34.1±6.89			
Handball	Pretest	28.5±7.3	2.961	.007*	
	Posttest	31.7±8.5			

(\bar{x} = Mean, sd= Standard Deviation, Significance Level p=0.00-0.05*)

When Table 3 was examined, it was found that there was a statistically significant positive correlation between basketball (n=12) and handball players (n=12) who participated in the study in 10-meter sprint and vertical jump tests (p<0.05). No significant difference was found in the 20- and 30-meter sprint tests (p<0.05).

Table 4 Mean Values of Wingate Anaerobic Power Test Participants

Parameter	Group	n	Pretest	Posttest	t	p
			$\bar{x} \pm sd$	$\bar{x} \pm sd$		
Peak Power (watts)	Basketball	12	476.33±45.61	481.12±52.67	1.85	.026*
	Handball	12	347.19±71.62	351.92±66.95	7.28	.015*
Mean Power (watts)	Basketball	12	268.90±81.24	272.61±84.10	-5.14	.375
	Handball	12	246.18±52.23	261.95±72.39	9.95	.085
Lowest Power (watts)	Basketball	12	153.21±41.85	157.51±32.71	4.56	.298
	Handball	12	152.51±36.27	152.68±42.18	-3.58	.159

(\bar{x} = Mean, sd= Standard Deviation, Significance Level $p=0.00-0.05^*$)

When Table 4 was examined, it was found that the mean power values of the participants were ($t=-5.14$; $p>0.05$) in basketball players and ($t=9.95$; $p>0.05$) in handball players, while the lowest power values were ($t=4.36$; $p>0.05$), ($t=-3.58$; $p>0.05$) in basketball players, and although there was improvement, they were not found to be statistically significant. The peak power values of the participants were determined as ($t=3.21$; $p<0.05$) in basketball players and ($t=2.51$; $p<0.05$) in handball players and they were found to be statistically significant.

Discussion, Conclusion and Recommendations

In our study, core exercises applied according to the 10-week Tabata protocol were applied with the aim of determining their effect on body composition and some performance parameters in basketball and handball players, and the literature was reviewed and discussed appropriately.

In our study, the changes between the body composition of the participants before and after the training program were examined, and it was found that there was a positive difference ($p<0.05$) in the BMR values of basketball players and BFR values of handball players (Table 2). No significant difference was found in the mean BW, BMI and BFR values of basketball players, and in mean BW, BMI and BMR values of handball players ($p>0.05$). In a similar study by Murawska et al. (2020), it was determined that there was a significant difference in the mean BW, BFR and BMR values of the participants. In their study, Domaradzki et al. (2020) determined a significant difference in mean BW values, but no difference was found in mean BFR values. In a similar study by Kester (2017), it was found that the exercises applied according to Tabata protocol caused a significant difference in the BMI and BFR values of the participants. Based on these results, it is observed that there are different results similar to our study. It is thought that factors such as demographic structure of the sample group, nutrition, performance level of the participants, and sports background are effective in these differences.

In the study, it was found that there was a statistically positive difference ($p<0.05$) in the 10-meter sprint and vertical jump measurements of basketball and handball players at the end of 10 weeks (Table 3). It was found that there was no significant difference ($p>0.05$) in the 20- and 30-meter sprint tests. Bradshaw et al. (2007) stated in their study that HIIT exercises have a positive effect on the performance of athletes. In their study, Ishøi et al. (2018) found that interval training with high intensity provided a positive improvement in the sprint performance values of athletes ($p<0.05$). In their study, Arede et al. (2019) found that the combined training program provided a positive improvement in the sprint and vertical jump performances of young basketball players ($p<0.05$). In the study conducted by Ronnestad et al. (2019) with the participation of football players, it was found that there was a significant difference in sprint and vertical jump performances ($p<0.05$). Aksovic et al. (2017) it was founded positive relations 20-meter sprint test score ($p<0.05$). Based on these results, it is explained in various studies that HIIT training programs planned have a positive effect on athletes or sedentary individuals.

Basketball and handball are sports branches that require a high level of performance, in which explosive power is at the forefront. Anaerobic power and capacity are an important element for correct and successful application of movements (Stolen et al., 2005). In our study, it was found that there was a significant difference ($p<0.05$) in the peak power performance values of the participants according to the results of the Wingate anaerobic power test, while no significant difference was found in the mean and lowest value measurements ($p<0.05$) (Table 4). According to Zupan et al. (2009) was founded anaerobic training protocol effect performance not only male but also female players. It is observed that the core exercises applied have a positive effect on the performance averages of the participants.

When the literature is reviewed, it is observed that core exercises have a positive effect on anaerobic performance parameters in athletes. In a similar study conducted with volleyball and basketball players, it was found that the performance averages of the participants were significantly different in favor of the posttest (Luebbbers et al., 2003). However, in the study of Grgic (2020), it was determined that there was no significant difference in the peak and mean power results of the participants after the nutrient-supported training protocol and a different result was obtained. In the study of Orhan (2013), it was found that there was a significant difference at the end of the performance tests of basketball players.

Based on these results, it is observed that there are studies that have determined that core exercises have a positive effect on the performance averages of basketball and handball players, and those that have not. It is thought that the differences and the same content of the training program contribute to the performance improvement of the athletes. It is thought that the age, gender and situations such as the league in which athletes participate may be effective in this performance differentiation.

In conclusion, it was found that core exercises designed according to Tabata protocol have a positive effect on body composition and anaerobic performance values in basketball and handball players. However, it was determined that there was no statistically significant difference in some parameters. It is thought that this differentiation may be due to differences such as gender, metabolic differences, training level and season phase of the participants. Moreover, the validity and reliability of the methods used in the calculation of body composition may have affected the measurement results (Duz et al., 2009). As a conclusion, it is stated that for similar studies to be carried out in the future, an increase in the sample group will make the results obtained from studies in professional or semi-professional groups more generalizable. It is also thought that similar exercises performed throughout the year may be effective in the improvement and continuity of performance.

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