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FUTBOLCULARA UYGULANAN SEKİZ HAFTALIK CORE ANTRENMANIN BAZI FİZİKSEL VE FİZYOLOJİK PARAMETRELER ÜZERİNE ETKİSİ

ÖZET

Omurgayı dengede tutan core antrenmanı gövdenin antrene edilmesinde kullanılmaktadır. Bu çalışmada, 8 haftalık core antrenmanın futbolcuların fiziksel ve fizyolojik parametreleri üzerine etkisi araştırıldı. Çalışmaya 18-30 yaş arasında; 22 çalışma grubu (ÇG), 22 kontrol grubu (KG) olmak üzere toplam 44 futbolcu dahil edildi. ÇG'na 8 hafta antrenmanlarına ek olarak core antrenman programı uygulanırken, kontrol grubunun ise sadece normal antrenmanlarına devamı sağlandı. Grupların vücut kompozisyonu, bacak kuvveti, sırt kuvveti, esneklik, dikey sıçrama, 20 m. sürat ölçümleri ile VO2max (maksimal oksijen tüketim kapasitesi) ölçümleri alındı. İkili grupların karşılaştırılmasında ön test ve son test farkı alınarak bağımsız t-testi uygulandı. Her grubun ön test ve son testlerinin karşılaştırılmasında bağımlı t-testi kullanıldı. ÇG'nun ön test ve son test değerleri karşılaştırıldığında tüm parametrelerde anlamlı bir iyileşme gözlendi. KG'nun ön test ve son test değerleri karşılaştırıldığında; BKİ, vücut ağırlığı, dikey sıçrama, bacak ve sırt kuvveti değerlerinde anlamlı bir iyileşme gözlendi. Gruplar arası farklarda; ağırlık, BKİ, esneklik, bacak ve sırt kuvveti, 20 m. sürat ve VO2max değerlerinde ÇG lehine $p<0.05$ düzeyinde anlamlılık saptandı. Sonuç olarak core kuvvet antrenmanlarının bazı fiziksel ve fizyolojik parametreler üzerine olumlu etkileri olduğu söylenebilir.

Anahtar Kelimeler: Core antrenman, futbolcu, fiziksel ve fizyolojik özellikler

THE EFFECTS OF EIGHT-WEEK CORE TRAINING ON SOME PHYSICAL AND PHYSIOLOGICAL PARAMETERS OF FOOTBALL PLAYERS

ABSTRACT

In this study, we investigated the effect of eight-week core training on physical and physiological parameters of football players. 44 football players, 22 experimental group (EG) and 22 control group (CG), between 18-30 years of age were included in the study. While eight-week core trainings were applied to EG, normal trainings were continued in CG. Body composition, leg strength, back strength, flexibility, vertical jump, 20-m speed and VO_{2max} (maximal oxygen consumption capacity) measurements of the groups were taken. Independent t-test for paired comparison of the groups and dependent t-test for the comparison of pre- and post-tests of the groups were used. Significant improvement was observed in all parameters of EG. A significant improvement was seen in BMI (Body Mass Index), weight, vertical jump and leg and back strength values of CG. In the differences of the groups, the significance at $p<0.05$ level was detected in weight, BMI, flexibility, leg and back strength, 20-m speed and VO_{2max} values in favor of EG. All in all, it can be concluded that there are some positive effects of core strength training on physical and physiological parameters.

Keywords: Core training, football, strength, performance.

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INTRODUCTION

The training is composed of efforts to improve performance componentsin a particular system to achieve sporting performance. One of important components of the training is the strength. Skeletal muscle moves or ensures the stability of the joint or the joint group connected by it as a result of nerve impulses coming to them and a number of biochemical events caused by these impulses (Günay and Yüce, 2001).Core strength training is often used in training of many of body muscles holding the spine and hip in balance (Savaş, 2013). Body structures containing core regions in terms of musculoskeletal system forming the body are spine, pelvis, hip, proximal lower limbs and abdominal muscles. The structures called core muscles contains the body muscles and the muscles located around pelvis which are important in most of the major sporting events, provide the spine and pelvis balance and ensure resistance occurring to be distributed from large muscle groups to small muscle groups in a balanced way (Baechle et al., 2000; Putnam, 1993). It is emphasized in the studies conducted that the core training is based in the preservation of athletic performance (Jim et al., 2013) and also the protection from injury (Mc Gill, 2010). Core training exercises are among the most widely applied activities in the training program of many sport branches and in the fitness rooms in recent years. Core trainings are also recommended for the healthy individuals in order to increase the functional capacity and improve the athletic abilities (Willardso's, 2008).

The purpose of this study is to investigate the effects of the core training method, which is effective in the acquisition and protection of the strength, on some physical and physiological parameters. The knowledge of the effects of the purpose-oriented core trainings on physical and physiological properties of athletes is considered to be guidance to both athletes and coaches.

MATERIALS and METHODS

Data of 44 football players between 18-30 years of age (22 EG and 22 CG) from 48 male football players studying in School of Physical Education and Sports, Gaziantep University was evaluated for the study.

All subjects were informed about the work plan and purpose and written consent forms showing their participation voluntarily to the study were taken.

For the study, 15 exercise movements selected according to their own body weights were applied as three sets for 90 minutes two days a week (Tuesday-Thursday) for 8 weeks to the subjects located in EG group in addition to football training, after the demographic data of all subjects were obtained. Each movement was applied for 30 seconds with 30 seconds rest between movements and complete rest between sets. The subjects located in CG were asked to continue their normal training and any additional program was not applied. The effects of core strength trainings applied to the football players on physical and physiological parameters were investigated with this study.

As physical and physiological parameters of the subjects in both of the groups, age, sport age, height, body weight, body composition, leg strength, back strength, flexibility, vertical jump, 20-m speed and VO_{2max} (maximal oxygen consumption capacity) measurements were taken.

Measurements were performed twice, including before and after trainings.

Applied movements

Elbow plank, plank jump-ins, push-ups, jump-inside the lines, push-ups, plank jump-ins, bicycle crunches with pause, feet hard assisted superman exercies, one arm/leg plank balance, windshield wipers, spiderman push up+side crunches, throw downs-assisted, raised leg circles, side plank, triangle crunches, bird dogs, leg raises.

Data collection

Age and sport age detection

The ages, years of birth and sport ages of the subjects were asked to them and determined as years.

Height and body weight measurement

The heights of the subjects were measured by the stadiometer (SECA, Germany) having 0.01 m degree of precision. Body weight measurements were performed by electronic scales (SECA, Germany) having 0.1 kg degree of precision according to standard techniques when the subjects were with sportswear (shorts, T-shirts) and without the shoes (Zorba and Ziyagil, 1995).

Body fat percentage measurement (%)

Yuhasz formula was used to determine the body fat percentage by measuring subcutaneous fat thickness of 4 regions (triceps, suprailiac, abdominal and subscapula) (Zorba and Ziyagil, 1995). Skinfold caliper (Holtain, UK) was used for measuring the body fat percentage.

Yuhazs formula:

Fat % = 5.783+0.153 (Triceps + Subscapula + Abdominal + Suprailiac)

Leg strength measurement(kg)

Measurements were performed using leg dynamometer with Takei brand. For these measurements, the subjects were asked to pull the dynamometer bar grasped by their hands upwards vertically at maximum rate by using their legs when the subjects' arms were stretched, backs were straight and bodies were bent slightly forward after the subjects bent their knees and placed their feet on the dynamometer table after warming for about five minutes.This pulling was repeated twice and the best value was saved (Özer, 2001; Harrison et al., 1998).

Back strength measurement (kg)

Measurements were performed using leg dynamometer with Takei brand. For these measurements, the subjects were asked to pull the dynamometer bar grasped by their hands upwards vertically at maximum rate by using back muscles when the subjects' arms were stretched, backs were straight and bodies were bent slightly forward after the subjects stretched their knees and placed their feet on the dynamometer table after warming for about five minutes. This pulling was repeated twice and the best value was saved (Özer, 2001; Harrison et al., 1998).

Flexibility measurement (cm)

Flexibility measurements of the subjects were performed by sit-and-reach test on the flexibility stand. The subjects were applied to this test after warming. When the subjects rested their naked soles of feet on the test stand while sitting on the ground, they pushed forward ruler on the table extending forward without bending the knees and the stretching distance was recorded by standing 2 sec at the farthest point to extend (Özer, 2001; Harrison et al., 1998).

Vertical jump (cm)

Vertical jump test measures the ability to jump quickly in a vertical direction. Vertical jump test The subjects try to jump with double feet to the highest level as possible in front of the platform hanging on the wall in vertical jump test. Before the test, normal arm lengths of the subjects were determined in front of the platform which tests would be performed. As a result of the test, the difference

between jump distances and arm lengths of the subjects were determined and vertical jump distance was recorded in cm. The test was applied to the participants of the study twice and the best result was recorded(Günayet al., 2006; Tamer,1995).

20-meter speed measurement (sn)

The subjects were waited in ready state after warming a meter behind the starting photocell and ran 20-m with maximum speed together with start command in the test. Measurements were performed with photocells placed at the beginning and end of 20-m running distance. The test was performed twice and the best measure was recorded (Hindistanet al., 1999).

VO_{2max}measurement(ml/kg/min)

20-m shuttle run test was used to determine the maximum VO_2 values of the subjects. It was a test at which running speed started as 8.5 km/hour and increased 0.5 $km.s^{-1}$at each one minute, and 20-m distance was run as a round-trip. In accordance with the protocol, 20-m shuttle run test tape was used to determine the running speed. The test was terminated when the subject didn't catch up two successive signals or left the test. VO_{2max} values of the subjects were recorded in ml/kg/min according to the results obtained(Tamer, 2000).

RESULTS

Table 1: Descriptive features of the subjects participating to the study

Variable	Group	N	Mean	Std. Dev.	t	p
Aeg (years)	Experimental	22	21.52	1.54	-0.695	0.491
	Control	22	21.90	1.92		
Sport Age (years)	Experimental	22	7.19	2.27	-1.868	0.071
	Control	22	8.85	3.30		
Height (cm)	Experimental	22	1.78	0.06	0.557	0.581
	Control	22	1.77	0.04		

When pre-test and post-test descriptive features of the groups participating in the study were investigated, statistically significance was not detected for age, sport age and height parameters ($p>0.05$).

Table 2: Pre-test and post-test analysis of the physical and physiological parameters of the experimental group

Variable	Group	N	Mean	Std. Dev.	t	p
Body Weight (kg)	Pre-test	22	71.29	4.83	**4.176**	**0.001***
	Post-test	22	70.58	4.96		
BMI (kg/m^2)	Pre-test	22	22.65	1.73	**4.024**	**0.001***
	Post-test	22	22.41	1.75		
BFP (%)	Pre-test	22	11.77	1.41	**7.168**	**0.001***
	Post-test	22	10.52	1.14		
Flexibility (cm)	Pre-test	22	9.18	8.18	**-5.375**	**0.001***
	Post-test	22	13.35	6.63		
Vertical Jump (cm)	Pre-test	22	47.33	5.46	**-4.870**	**0.001***
	Post-test	22	50.19	4.86		
Leg Strength (kg)	Pre-test	22	112.47	16.32	**-4.962**	**0.001***
	Post-test	22	126.86	14.34		
Back Strength (kg)	Pre-test	22	116.16	15.08	**-8.981**	**0.001***
	Post-test	22	130.79	14.84		
20-m Speed (sec)	Pre-test	22	3.00	0.19	**5.014**	**0.001***
	Post-test	22	2.80	0.14		
VO_2max (ml/kg/min)	Pre-test	22	47.24	4.50	**-4.857**	**0.001***
	Post-test	22	49.48	4.75		

***p<0.05**

When pre-test and post-test physical and physiological parameters of the experimental group participating in the study were analyzed, statistically significance was observed in all parameters ($p<0.05$).

Table3: Pre-test and post-test analysis of the physical and physiological parameters of the control group

Variable	Group	N	Mean	Std. Dev.	t	p
Body Weight (kg)	Pre-test	22	69.65	5.54	**-2.179**	**0.042***
	Post-test	22	69.85	5.59		
BMI (kg/m^2)	Pre-test	22	22.32	1.53	**-2.177**	**0.042***
	Post-test	22	22.38	1.57		
BFP (%)	Pre-test	22	11.11	1.58	1.335	0.198
	Post-test	22	10.93	1.59		
Flexibility (cm)	Pre-test	22	7.48	7.07	0.542	0.594
	Post-test	22	7.10	5.63		
Vertical Jump (cm)	Pre-test	22	48.25	6.96	**-2.118**	**0.048***
	Post-test	22	50.15	6.79		
Leg Strength (kg)	Pre-test	22	118.03	22.20	**-2.260**	**0.036***
	Post-test	22	124.83	22.62		
Back Strength (kg)	Pre-test	22	120.35	23.33	**-2.705**	**0.014***
	Post-test	22	127.00	23.45		
20-m Speed (sec)	Pre-test	22	2.90	0.19	1.707	0.104
	Post-test	22	2.84	0.19		
VO_2max (ml/kg/min)	Pre-test	22	46.94	4.03	0.426	0.675
	Post-test	22	46.65	4.27		

***p<0.05**

When pre-test and post-test physical and physiological parameters of the control group participating in the study were analyzed, statistically significance was detected in body weight, body mass index, vertical jump, leg strength, back strength parameters ($p<0.05$) but was not detected in other parameters ($p>0.05$).

Table4: Comparison of the physical and physiological parameters of the experimental and control groups

Variable	Group	N	Mean Difference	Std. Dev.	t	p
Body Weight (kg)	Experimental	22	-0.71	0.78	**-4.711**	**0.001***
	Control	22	0.20	0.41		
BMI (kg/m^2)	Experimental	22	-0.23	0.26	**-4.520**	**0.001***
	Control	22	0.07	0.14		
BFP (%)	Experimental	22	-1.24	0.79	**-4.819**	**0.001***
	Control	22	-0.18	0.60		
Flexibility (cm)	Experimental	22	4.17	3.56	**4.358**	**0.001***
	Control	22	-0.38	3.09		
Vertical Jump (cm)	Experimental	22	2.86	2.69	**0.901**	**0.373**
	Control	22	1.90	4.01		
Leg Strength (kg)	Experimental	22	14.38	3.28	**2.615**	**0.016***
	Control	22	6.80	3.46		
Back Strength (kg)	Experimental	22	14.62	3.46	**2.728**	**0.010***
	Control	22	6.65	3.99		
20-m Speed (sec)	Experimental	22	-0.20	0.180	**-2.549**	**0.015***
	Control	22	-0.06	0.16		
VO_2max (ml/kg/min)	Experimental	22	2.23	2.11	**3.099**	**0.004***
	Control	22	-0.29	3.04		

***p<0.05**

When pre-test and post-test physical and physiological parameters of the experimental and control groups participating in the study were analyzed, statistically significance was detected in all parameters, except vertical jump parameter, in favor of the experimental group ($p<0.05$).

DISCUSSION

In this study, the effects of 8-week core strength training on some physical and physiological parameters in football players were investigated.

Age, sport age, height, body weight, body composition, leg strength, back strength, flexibility, vertical jump, 20-meter speed measurements, and 20-meter shuttle run (VO_{2max}) test and measurement were applied to the volunteers participating to the study.

Of the subjects in the study, mean ages were 21.52 ± 1.54 years in the experimental group and 21.90 ± 1.92 years in the control group; sport age means were 7.19 ± 2.27 years in the experimental group, 8.85 ± 3.30 years in the control group;height means were 1.78± 0.06 m in the experimental group, 1.77 ± 0.04 min the control group.The fact that the mean age was measured according to the subjects composed of the individuals not completing the development period could be considered as the reason of non-significance of these parameters.

Body weight values were found to decrease in both experimental and control groups after 8-week core training program applied in our study. This difference was expressed statistically significant at the level of $p<0.05$ (Table 2). Significant decreases in pre-test and post-test measurements of weight loss were

reported in similar or different studies (Akcan, 2013; Günay et al., 1994; Çeker, 1996). However, it was specified in the study named as the effects of 8-week core training on balance and functional performance in young football players that there wasn't any significance in pre-test and post-test body weight parameters of both the experimental and control groups(Aslan, 2014). Significant decrease of body weight observed in our study shows similarity with some studies in the literature, but don't do with some others. Body fat percentage decreases as a result of burning of a high amount of calories with the trainings(Stamford,1983). The significant decrease in body weight can be said to be associated with the decrease in body fat percentage

A significant decrease was observed in the body mass index values of both the experimental and control groups after 8-week core training program applied in our study. When this difference was statistically evaluated according to pre-tests and post-tests within the group, a significant decrease was seen at the level of $p<0.05$ in the experimental and control groups.

Similar results were obtained in pre-test and post-test measurements in the studies related with different strength exercises (Harbili, 1999; Çeker, 1996;Pulur, 1995).

Body mass index is calculated dividing the weight by the height's square in terms of meters. A significant decrease in body mass index obtained in our study is in line with similar studies in the literature. While strength exercises increase lean body mass with anabolic action, they also cause alterations on the body composition by reducing fat body percentage (Harbili, 1999). The significant decrease in body mass index can be said to be related to this condition.

When pre-tests and post-tests within the group were evaluated after core strength training program, the flexibility values of the subjects changed significantly at the level of $p<0.05$ in the experimental group while there was no significant difference in the flexibility values of the control group.

The flexibility values of the experimental group were found to change significantly in the study investigating of handball-specific strength training on certain performance parameters (Eler and Sevim, 2002). Şahin emphasized in the study named as the effects of two different strength training programs on some physical, physiological and technical features that there was a significant increase in the flexibility values of the group of quick strength and continuity in strength among the groups participating to the study($p<0.05$) (Şahin, 2008). Similarly, a significance at the level of $p<0.05$ was found in the flexibility values of the experimental group's athletes of two different strength training programs applied to the male athletes (Akcan, 2013). Some certain characteristics of the individuals, such as age, height and weight, have been known to affect flexibility rates for a long time (Bompa, 1998; Astrand, 1997). Ergun and Baltacı observed a negative correlation between the flexibility and body weight in their study named as the association between static strength levels and the physical properties of elite athletes according to age and gender (Ergun and Baltacı, 1992). Accordingly, flexibility is increased with decreasing body weight. The significance obtained in our study is considered to associate with this.

A significance at the level of $p<0.05$ was found in vertical jump values of the experimental and control groups.

Strength trainings applied to the male subjects between 18-24 years of age

(Polat et al., 2002) were expressed to cause significant increase in anaerobic strength values of two different strength training methods(Günay and Onay, 1999). Also, it was stated in a similar study that strength trainings increased significantly the vertical jump values of young football players with respect to pre-test and post-test measurements (Gorostiaga et al., 2004).

Significance in the vertical jump values of our study shows parallelism with the literature. As a result of performing strength trainings correctly, improvement in the vertical jump, horizontal jump and maximal half squat values should be seen (Erdogan and Pulur, 2000). Significance observed in the vertical jump values in our study should be attributable to the situation.

When pre-test and post-test within the groups were statistically evaluated after 8-week core strength training program applied in our study, leg and back strength values of the athletes were observed to change significantly at the level of $p<0.05$ in the experimental and control groups.

Core strength training was emphasized to benefit lower extremity strength balance in young football players in the case of application in addition to the basic training(DeloLucano et al., 2015). In a similar study, 9-week core exercises applied additionally to the trainings was informed to contribute positively to 10-20-meter sprint performance(Prieske et al., 2015). It was reported that 12-week core trainings applied to 16-age group football players on 20-m speed parameter (Afyon, 2014), 12-week combined strength and power trainings of U-14 young football players on 10-m and 30-m sprint times (Wong et al., 2010) and 6-week static core exercises on 20-m sprint performance (Kelly et al., 2011) made a positive contribution. On the other hand, Balaji and Murugavel declared in their study investigating the effects of core strength trainings on motor skills of handball players that speed, agility, explosive leg strength and upper body strength of them increased significantly (Balaji and Murugavel, 2013). It was observed in a study performed on young basketball players between 14-15 years of age that the difference between back and leg strength values of the experimental and control groups before and after training was statistically significant (Kavak, 2002). Meanwhile, it was foundin a similar study conducted by Polat that quick strength applications didn't provided a significant difference between pre-tests and post-tests of the groups in terms of relative back strength however 8-week quick strength and sprint trainings provided minor improvements in relative back strength (Polat, 2000).

The strengths of many large and small muscle groups were increased with core trainin gby improving body control and balance(Aşçı, 2011).Significant change obtained in data of the experimental group in our study is considered to be related with this situation. However, observation of a significant increase in the leg and back strengths in our study can be associated to training quality, individual differences and hereditary factorsof the control group.

While a significant change in 20-m speed test values in our study was found in the experimental group, there was no significance in the control group.

In the literature, it was reported that quick strength trainings generally affect the sprint time positively (Sevimet al., 1996; Polat, 2000; Çimen and Günay, 1996).

When similar studies in the literature are evaluated, significant change in the values of 20-m speed test in our study is seen to be consistent with other

studies. In this case, the strength trainings could be said to contribute positively to sprint time.

Upon evaluation of core strength trainings forming the basis of our study with respect to pre-test and post-test values within groups, a significant change in VO_{2max}values was observed in the experimental group but the control group values didn't show any significance.

In the studies performed about the subject,Park house et al expressed in their study investigating the effect of static core exercises on performance against dynamic exercise that there were improvements in core region muscles in terms of endurance and strength(Parkhouse and Ball, 2011) while Clayton et al informed in their study analyzing the association of isokinetic core trainings with the performance of baseball players that core trainings contributed to the strength rather than the endurance (Clayton et al., 2011). Evrim detected that 8-week strength continuity trainings provided positive improvements to aerobic strength values of the experimental group in table tennis players between 16-18 years of age (Evrim, 2006).On the other hand, it was reported that two different strength training programs applied to elite male hockey players on grass between 17-19 years of age (Şahin, 2008)and maximal strength trainings in volunteer male athletes in the age group of 20(Günay and Onay, 1999) didn't cause any significant change in aerobic values of the subjects.

In similar studies in the literature, significant decrease in VO_{2max}values in our study was also observed in some studies, but not in some others. The increase in VO_{2max} values as a result of 8-week core strength trainings applied to the experimental group can be explained by the compliance of the respiratory system to the training. Heart and respiratory system endurance is also referred to aerobic efficiency which the organism provides oxygen and energy to the muscles (Sevim et al., 1996). It is specified in the literature that respiratory capacity increases, breathing muscles become stronger and harmony is provided together with endurance trainings (Açıkada and Ergen, 1990).

As a result, it can be concluded that 8-week core strength trainings have positive effects on the parameters like strength, flexibility, aerobic capacity, anaerobic power, body mass index, which are the conditional characteristics of athletes, and the application of especially core trainings covering the exercises performed with own body weight to the individual and team athletes and the inclusion of these trainings into their training plans can be beneficial.

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