

The Effects of Core Training Applied to Footballers on Anaerobic Power, Speed and Agility Performance

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ABSTRACT This study was conducted to investigate the effects of physiological parameters of core strength training applied to footballers. 15 core exercises were applied to 31 footballers aged 18-30, along 6 weeks. Zigzag test was applied to the footballers to measure agility measurements and Wingate test was applied to measure anaerobic power. Results of repeated measurement ANOVA indicated that there were only significant differences among the weeks in terms of 10 m sprint ($P=0.012$) and 20 m speed ($P=0.000$). It is possible to conclude that the core strength training may contribute to the speed performance. However, it would not be sufficient to consider only core strength training for anaerobic power and agility measurements.

INTRODUCTION

Today's sports require athletes to be in optimum condition physically. This is a process which requires more weight. A well core part is both enable to weigh upon the athletes and ensure the technique movements being performed better (Satiroglu et al. 2013). The core strength training is a commonly used method that we should dwell on for athletic performance (Jim et al. 2013) due to the fact that it trains a lot of trunk muscles which stabilize the spin and glute (Savas 2013).

All these muscles work together to keep the body in balance during the movement. The core training method differs from weight-lifting exercises in practice and it aims to improve muscle strength. At the same time, it builds up the core part which helps transmitting the energy efficiently from lower extremity to upper extremity and also the other way around, it improves the body control, body balance and efficiency between movement transitions (Satiroglu et al. 2013). It was reported that there was a relationship between core strength training and endurance (Clayton et al. 2011), and core strength training provided development in balance ability (Dello et al. 2014; Marković et al. 2015; Yoon et al. 2015; Trampas et al. 2015) and improvement in vertical jumping (Sharma et al. 2012).

Although anaerobic performance is important for all kinds of sports events, the importance increases in certain sports using anaerobic performance predominantly. The core training comes into prominence in football, as in many

team play, sudden and high intensity power formation required in process of breakaway and press defence. Many laboratory and field tests are used for measuring anaerobic power. Although many methods are tried for measuring the individual anaerobic capacity, mostly Wingate Test for Anaerobic Power is used compared to the other tests (Ozkan et al. 2010). It is known that the ability of footballers to achieve high speed movement is important in performance during football matches. Despite the fact that high speed movements are contributing only 11 percent to the total running distance, sprint contributes directly to score a goal and possession of the ball and it becomes one of the most important movement in the match. The superior performance of professional football players in different speed tests were compared to the highest standards of football and general population and it was seen that high speed capability was an advantage for the footballers at the elite level (Little and Williams 2005). Lately "speed, agility, quickness" training method is suggested as an effective way for condition in field games, such as football in particular and sports in general (Karacabey 2013). The recorded sprint distances during the matches indicated the necessity of features both acceleration and maximal velocity.

This study determined that anaerobic power, strength, maximum speed, acceleration and agility features can be seen as independent features in this population and this finding is thought to contribute to the trainers and footballers at elite level.

METHODOLOGY

For this study, 31 of 44 football players' data, aged between 18-30, studying at Gaziantep University department of Higher School of Physical Education and Sports and playing at local or national teams, were evaluated. All subjects were informed about study plan and purpose and they signed the written consent form denoting that they were volunteers.

After getting 31 of 44 football players' demographic information aged between 18-30, 15 chosen isometric and dynamic core exercise movements were performed by their own body weight along 6 weeks, two days a week and one hour a day; in addition to their trainings. Each movement was performed for 30 seconds and after the subjects rested for 30 seconds. They rested between the sets. The effects of the core strength training on physical and physiological parameters which was applied to footballers was examined with this study. After learning age, stature, weight and sports age of subjects, Wingate Anaerobic Power Test, 10 meters sprint and zig-zag test which was done for measuring 20 meters maximum speed and agility measurement, were performed by the subjects. The measurements were taken for four times: before the training, in second week, in fourth week and at the end of the sixth week.

Age and Sport Age Determination

The year of birth and sport age of the subjects were determined as years by asking themselves.

Stature and Body Mass Index Calculation

The statures of the subjects were measured by stadiometer at 0.01 kg degree of precision, their body mass was measured by electronic scale at 0.1 degree of precision (SECA, Germany). The measurements were taken according to standard technics while the subjects were in their sport wears (short, t-shirt) and shoeless (Gribble et al. 2004; Ekizler et al. 2006).

Wingate Anaerobic Strength and Vital Capacity Test

A Monark cycle ergometer with a weigh bridge which was connected to a computer modified for Want and running with a compatible

software, was used. The saddle and handlebar settings were done for each athletes before the test and the weight applied to the athletes as an external resistance was calculated as 75 gr/kg for Monark cycle ergometer. A 5-minute warm-up session was performed by the subjects consisting of 20 percent of the test weights calculated on cycle ergometer at 60-70 cycles / minute pedalling speed, 4-8 second period containing two or three sprints. The subjects wanted to reach the highest pedal speed without resistance and as soon as possible. After being reached at maximum speed (approximately 3-4 seconds later), the test was started by leaving the weight which was calculated as 75gr/kg before. The subjects pedalled for 30 seconds at maximum speed against the resistance. They were verbally encouraged throughout the test. In the recovery period, they pedalled against light-weight resistance for 2-3 minutes and return to normal.

Five seconds, providing maximum power average of the test, was named as "peak power", average power during 30 seconds test was named as "average power" and recorded five seconds, providing minimum power during the test, was named as "minimum power". In addition, a mathematical relation was calculated between fatigue index, peak power and minimum power. $[(PP - MP) / PP \times 100]$ (Aziz and Chuan 2004).

Speed Measurement

10 Meter Sprint Measurement

The subjects kept waiting in ready position after warming up 1 meter behind the starting photo-cells. After the start signal, they ran at maximum speed along 10 meters. Measurement made with photo-cells put 10 meter distance from start and finish points. This run has been repeated twice and the best scores were registered.

20 Meter Maximum Speed Measurement

The subjects kept waiting in ready position after warming up 1 meter behind the starting photo-cells. After the start signal they ran at maximum speed along 20 meters. Measurement made with photo-cells put start and finish points of 20 meter distance. This run has been repeated twice and the best scores were registered.

Agility Test

Agility was tested by using zigzag test comprising four sections which were 5 meters and initiated 100 degrees angle. This test was chosen because athletes needed the control of balance while they were performing acceleration, deceleration and agility. All tests were performed on a synthetic indoor field. 10 m, 20 m and agility tests were completed, respectively. The subjects rested at least 2 minutes between the tests and performed each test twice. The best performances in each test were used for analysis. To minimize the effects of the fatigue on performance, all tests were completed after 48 hour from a heavy physical training or competition (Little and Williams 2005).

Statistical Analysis

SPSS for Windows (Ver. 16) statistical package program was used in analyzing of the data. The repeated measurement variance analysis was used for determination of 10 and 20 m speed, agility, anaerobic power and anaerobic capacity differences according to weeks, and Bonferroni multiple comparison test was used for determining the difference between weeks.

RESULTS

Descriptive statistics on determined features are given in Table 1. It was observed that 10 m speed varied as to weeks ($P=0.012$). When Table 2 was examined, it was observed that 10 m speed after two weeks of performance was significantly higher than after four weeks of performance and at the end of the performance.

Table 1: Descriptive statistics on determined features

Weeks	N		Min	Max
Age (years)	31	21.5± 0.3	18.0	26.0
Sports age (years)	31	7.9± 0.6	2.0	19.0
Weight(kg)	31	72.6± 1.3	64.0	97.0
Stature (cm)	31	1.8± 0.1	1.6	1.9
BMI(kg/m ²)	31	22.8± 0.3	19.3	27.7

It was observed that 20 m speed varied as to weeks ($P=0.000$). When Table 3 was examined, it was observed that the measurement values taken before the performance and fourth weeks of performance were significantly higher than the measurement values of second week and sixth week.

Table 2: Descriptive statistics for 10 m speed and the results of Bonferroni Test

Weeks	N		Min	Max
Before	31	1.4 ± 0.1 ^{ab}	1.2	1.7
Second week	31	1.6 ± 0.1 ^a	1.3	5.5
Fourth week	31	1.4 ± 0.1 ^b	1.2	1.6
Sixth week	31	1.4 ± 0.1 ^b	1.3	1.6

^{a, b} The difference between averages of the weeks indicated by different letters are significant. ($P=0.012$).

Table 3: Descriptive statistics for 20 m speed and the results of Bonferroni Test

Weeks	N		Min	Max
Before	31	27± 0.1 ^a	2.5	2.9
Second week	31	2.6± 0.1 ^b	2.4	2.9
Fourth week	31	2.7± 0.1 ^a	2.4	5.8
Sixth week	31	2.6± 0.02 ^b	2.4	2.7

^{a, b} The difference between averages of the weeks indicated by different letters are significant. ($P=0.000$).

The agility values of the subjects did not differ significantly as to weeks ($P=0.077$) (Table 4).

Table 4: Descriptive statistics as to agility

Weeks	N		Min	Max
Before	31	5.6± 0.1	5.0	6.1
Second week	31	5.7± 0.1	5.0	6.1
Fourth week	31	5.6± 0.1	5.1	6.2
Sixth week	31	5.6± 0.1	5.2	6.1

Anaerobic power did not differ significantly as to weeks according to Table 5 ($P=0.661$).

Table 5: Descriptive statistics for anaerobic power and the results of Bonferroni Test

Weeks	N		Min	Max
Before	31	781.5 ± 19.6	610.5	999.9
Second week	31	788.4 ± 19.2	623.3	988.9
Fourth week	31	761.2 ± 20.5	589.1	945.0
Sixth week	31	771.8 ± 20.3	565.8	999.2

Anaerobic capacity did not differ significantly as to weeks according to Table 6 ($P=0.168$).

Table 6: Descriptive statistics for anaerobic capacity and the results of Bonferroni Test

Weeks	N		Min	Max
Before	31	555.6± 13.1	375.7	719.7
Second week	31	560.7± 12.3	439.2	720.0
Fourth week	31	541.7± 16.3	256.9	739.9
Sixth week	31	555.6± 13.5	431.0	741.5

DISCUSSION

The core training applied to the main muscle parts is different from commonly used strength trainings in terms of train lower lumbar and abs more efficiently than conventional trainings. This is same for upper and lower torso muscles. The core strengthening exercises applied to the main muscle parts, provide the torso works as a solid unit and helps to move in perfect harmony when the whole body is involved in a movement. It was emphasized in studies that core training was a basis to improve the performance and protected from injuries (Gill 2010; Akuthota and Nadler 2004), reduced back pains in general population (Steven et al. 2011) and it was a prerequisite for protecting appropriate posture (Sun Pil Chun et al. 2015) and also due to the pain-relieving properties for the treatment of patients after surgery, core training was suggested to be done in addition to exercises (Sokunb and Kachall 2015).

As a result of the study conducted on elderly women, it was emphasized that functional core exercises made a contribution to productive usage of extremities and stronger balance (Gora et al. 2015). The core exercises were suggested in the study done on cyclists for painless muscle strength and improving the performance (Preis et al. 2012).

In a different study conducted on Muay Thai athletes for 6 weeks and examining the effects of isometric and dynamic core exercises, it was reported that the effects of isometric core exercises were superior than the effects of dynamic core exercises (Benjamin and Stuart 2015). Pienaa and Coetzee determined that core exercises had positive effects on motor performance of collegiate rugby players (Pienaa and Coetzee 2013).

It was aimed to prove the physiological and physical effects of the isometric and dynamic core trainings in this study, which was conducted on 31 of 44 football players aged between 18-30, studying at Gaziantep University department of Higher School of Physical Education and Sports and play at local or national teams.

It was determined that 10 m speed indicated significant difference in regard to weeks ($P=0.012$) (Table 2). The measurement values taken at the end of the second week were higher than the core training values of fourth week and it was thought that at the end of the second week, the training was effective on 10 m sprint performance of footballers but in the fourth week, the organ-

ism was considered to comply with these studies. Similarly, 20 m sprint performances also indicated significant difference in regard to weeks ($P=0,000$) (Table 3). The measurements taken before the training and in the fourth week found to be significantly higher than measurements taken within the second week and sixth week. It was emphasized that core strength exercises would benefit for the strength balance in lower extremities of young footballers, if it was done in addition to basic trainings (Delo Lucano et al. 2015). In a similar study conducted in young players, a 9-week core training, which was done in addition to the normal training, was reported to contribute positively on 10-20 meters sprint performance (Prieska et al. 2015). 12-week core trainings which were conducted in 16 age group footballers contributed 20 m speed parameter (Afyon 2014), 12 weeks of combined strength and effort trainings of U-14 young footballers contributed 10m and 30 m sprint time (Wong et al. 2010) and 6 week static core exercises provided a positive contribution to 20 m sprint performance (Kelly et al. 2011).

Reed et al. (2012) reported that core trainings provided significant contribution to muscle strength of high school students, however there was not any improvement in their VO_2 max capacity and as a result of core exercises, significant improvements were seen in lower extremity muscle strength and 40 m speed performance of women footballers.

It was reported that there was a significant correlation between 20 m and 40 m sprint values and core trainings of footballers (Nesser et al. 2008). However, Nikolenka et al. (2011) reported that there was not a relation between core training which they performed and 40 m speed performance. It is emphasized in the literature that muscle strength in core is an integral part of the fitness and rehabilitation and there is a strong relationship between body muscle activity and lower limb movement. Based on obtaining a general increase in 10 m and 20 m sprint values, the researchers found that this study coincided with other studies in 10 m and 20 m sprint values. In this case, the core strength exercises are said to contribute positively to the sprint time. When the researchers looked at the studies, it was seen that usually pre-test and post-test measurements were taken. However, taken four interim measurements, before the exercise, in second week, in

fourth week and in sixth week, made this study different.

Agility is defined as the ability to protect a controlled body composition and to change direction quickly without balance, body control, or loss of speed (Raya et al. 2013). Strong core muscles are essential for the sudden movement in the football. It was seen that agility, other parameter of this study, didn't indicate a significant difference in interim measurements in regard to weeks ($P=0.077$) (Table 4). In this case, the core strength exercises not contributing to agility performance could be explained in terms of difference of core strength trainings conducted in subjects, key variables affecting the agility performance or core strength exercises not affecting the agility performance specifically. Therefore, explosive trainings can be more effective in agility exercises.

It was specified in a relation to the subject that 6-week core strength trainings applied to the university students for two times at a week didn't improve the agility performance (Schilling et al. 2013) and again, Nesser and Lee (2009) expressed that there was no relationship between core strength trainings and the agility. However, it was emphasized in the literature that core strength trainings done with different subject groups have contributed positively to the agility indicators in general (Hoppe et al. 2015; Prieske et al. 2015; Balaji and Murugavel 2013). Energy requirements provided by high energy phosphates in some sport branches including football. In this regard, intramuscular high-energy phosphate levels in maximal or supramaximal intensity, affected the performance significantly in short-term activities. Maximum performance was determined to describe the level of phosphate in the literature (Safinaz 2012). Personal anaerobic power was proportional to the amount of lean body mass and improved with regular training (Chia and Lim 2008).

Anaerobic power ($P=0.661$) (Table 5) and anaerobic capacity ($P=0.168$) (Table 6) did not differ in regard to weeks and anaerobic power performance thought to be associated with key variables in this study.

CONCLUSION

In this study, core strength training is thought not to contribute statistically significantly to agility, anaerobic power and anaerobic capacity

but to contribute 10 m and 20 m sprint performance values significantly as a result of repeated measurements taken after 6-week core strength training applied to the footballers. Therefore, strengthening the core of the muscle can lead to positive developments to the athletic performances of the footballers and the application of short-term core strength training may not contribute to for agility and anaerobic power by itself.

RECOMMENDATIONS

It can be say that in this study and the studies like this that the positive impact of static and dynamic core trainings applied to the footballers trained at different levels on the performance would be clear. Football coaches should include core strength training programs in their exercises. It is also thought in the next studies that the effects of core studies should be investigated during rehabilitation after injuries of footballers.

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