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Effect of Circuit Training on Agility and Anaerobic Power among College-Level Football Players

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ABSTRACT

Football is an intermittent sport which requires acceleration, deceleration, power, speed and endurance. It places a high demand on the aerobic, anaerobic as well as neuromuscular system of the body. Sport performance in football players is determined by many factors including agility and anaerobic power. Anaerobic power is the ability to exert great force in a short time while agility is the ability to move and change direction quickly. Many training programmes have been designed to improve the agility and anaerobic power of the players. The Purpose of this study is to evaluate the effects of the circuit training program on agility and anaerobic power among college-level football players. A total no. of 41 healthy male and female participants were selected. Baseline data on weight, height, Agility (Agility T-test), and Anaerobic Power (RAST) were collected. A Circuit training consisting of 8 stations was applied to all the subjects for 3 days per week for 8 weeks. Post-test data of Agility (Agility T-test), and Anaerobic power (RAST) were collected after 8 weeks of training. Paired t-test was used to find out the significant difference within the group for agility by agility T-test. Paired t-test was used to find out the significant difference within the group for anaerobic power by RAST. Data was analyzed using paired T-test. Following training, there was a significant difference (p-value <.0001) in agility pre and post-testing of the participants. Also, there was a significant difference (p-value <.0001) in anaerobic power between the pre and post-testing of the participants. The result of this study suggests that the circuit training program designed for 8 weeks improved the Agility and Anaerobic power of the participants significantly. This study can be concluded by stating that 8 weeks of circuit training improves agility and anaerobic power significantly among college-level football players.
Keywords*: Football, Agility, Circuit training, Anaerobic power, Running based anaerobic sprint test, Agility T-test*

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INTRODUCTION

Football is the most popular sport in the world, played by around 200 million players licensed players. Physiologically, football is characterized as a high-intensity, intermittent, non-continuous exercise [1]. It includes functional activities like accelerations, decelerations, jumping, cutting, pivoting, turning, and kicking off the ball and a large percentage of the game is performed at maximum speed.

Muscle injuries are among the most common injuries in sports and a major concern because of training and competition time loss,treatment and rehabilitation as well as return to the sport. Owing to the characteristics of the game, Football is one of the high-risk sports in terms of injuries than many other contact or collision sports. A vast number of football injuries may be expected. The occurrence of muscle injury is as high as 31% in soccer and 28.2% in track and field. In professional football, between 92 and 97% of all muscle injuries are found in the lower extremity: hamstrings (28–37%), quadriceps (19–32%), adductors (19–23%), and calf muscles (12–13%). Football teams with lower season injury rates have better performance in their national and international competitions. A sports injury can be prevented by different kinds of strength training, proprioception exercises, stretching activities, and combinations of these, which are accessible to essentially everyone and requires limited medical staff assistance.

The fundamental movement patterns in football require quick force development and high power output, as well as the ability to efficiently utilize the stretch-shortening cycle in ballistic movements. The essential components of any sport are speed, flexibility, skill, agility, endurance and strength. It is familiar that muscular strength is one of the most important components of physical performance in sports. Muscle strength as well as anaerobic power of the lower extremities are types of neuromuscular variables that influence performance in many sports activities, including football.

Football consists of short-duration speed runs, jumps, heading and ball disputes as also low-speed running and walking. Most of the part of football is in intervals and the motion does not last for long periods. These high-intensity bouts of exercises are performed by using anaerobic power [2]. When the

muscular activity is rapid and intense then the source of energy is through the anaerobic mechanism. Therefore, sprinting performance relies upon anaerobic mechanisms. The source of energy for rapid and violent muscular activity is the anaerobic system. This being the most significant factor in this sport requires one to consideranaerobic football conditioning. The high level of the anaerobic capacities in football players impacts match results by enabling them to carry out high-speed runs, which in the end plays a very important roleto impact the match results. Physical activities contribute to anaerobic power performance as well as isometric and explosive strength. Proper anaerobic conditioning can alter the anaerobic performance of athletes [3]. Because of this reason, it is very important to incorporate anaerobic training into overall conditioning training protocols.

Agility is the ability to change directions quickly and to start and stop quickly [4]. Agility is an important factor for athlete performance as it makes it possible to perform movements quickly, smoothly and efficiently [5]. Agility is dependent upon different factors such as coordination and movement control as well as on mobility of joints, dynamic balance, power,flexibility, level of energy resources, strength, speed and optimal biomechanical structure of the movement. Several studies proved that lower limb and core strength training improves agility significantly. Many strength training techniques like isometrics, isotonics, resistant trainings, plyometric, circuit training, etc. has been done to study agility performance of athletes. Agility training can help in reducing the ankle injuries as the kinematic chain is trained to face the challenge of sudden changes in direction and force. These basic movement structures have vital importance for successful participation in any sport. Gregory d. Myer (2006) shown in their study that Protocols that supplement plyometric and technique training with strength training significantly reduce ACL injuries in female athletes [6]. Therefore, agility also plays a vital role in prevention of injuries as well.

Recently, the combination of different methods including high-intensity strength training comprising resistance exercise, plyometrics and sprint training as well as complex strength training have received attention.Circuit training is one of the forms of body conditioning or resistance training or endurance training programmes which includes moderate to high-intensity exercises. Circuit training is a type of exercise program in which an athlete moves from one exercise station to another exercise station in a planned sequence and it is done in the shortest possible form. Circuit training has a series of exercises or stations which should be completed in sequence with minimal rest in between. An athlete or coach can add an endless number of workouts and a variety of training exercises. These days circuit training become a common mode of exercise, in part because of time efficiency and because lighter loads typically are implemented in such a program. The main aim of circuit training is to improve muscular strength and muscle endurance. By increasing the repetitions of an exercise at each station or by doing the needed frequencies of each exercise in the shortest possible form, one can increase strength and endurance through circuit training [7].

The 5 essential elements of physical fitness for any sport are speed, flexibility, skill, endurance, and strength. These components are required to maintain the performance of football players. These can be achieved through different training programmes.The purpose of this study is to determine the effectiveness of a circuit training programme on agility and anaerobic power in football players.

MATERIAL AND METHODS

This study was conducted in the Krupanidhi group of institutions as a pre and post-Quasi- Experimental study involving young football players, both male and female between the age group 18 – 25 years for 8 weeks. 50 players were conveniently selected and 41 players qualified for the inclusive criteria. The participants had to be players for at least 1 year. Participants are encouraged not to be a part of any other training program or to have discontinued sports activity [8]. Screening procedures involved those who suffered from ankle sprain/ ankle injury, lower limb soft tissue injuries and fractures in the last 6-12 months [9]. Materials required are Cone, Measuring tape, Stopwatch, Measuring tape, Recording sheet, and Dumbbells/weight cuff. Consent was obtained from the players and the respective authorities.

Agility T-Test [10,11] and Running-based anaerobic sprint test (RAST) [12,13] are used as the outcome measures. Agility T-Test is used to measure agility. In the agility T-test, the participant stands at Cone A. The researcher gives the signal 'Go', and starts the stopwatch and the test initiates. The participant runs with their maximum speed to Cone B and touches the base of the cone, side steps to Cone C and touches it, then moves to Cone D with side steps and touches it, side steps back again to Cone B and touches it, and then runs back to the Cone A. The researcher stops the stopwatch and ends the test when the participant completes the full circuit, and records the time.

The RAST test is used to measure anaerobic capacity and anaerobic power. It is measured via the running protocol. In RAST the participants stand at starting position A. On the “GO” signal the examiner presses the stopwatch and the participant has to sprint at the maximal effort to the end of the 35m track at point

B. At this point,a B recovery period of 10 secs should be given. The participant has to perform 6 sprints with 10-sec intervals between each sprint. The examiner should be recording the duration of each sprint individually.

Procedure

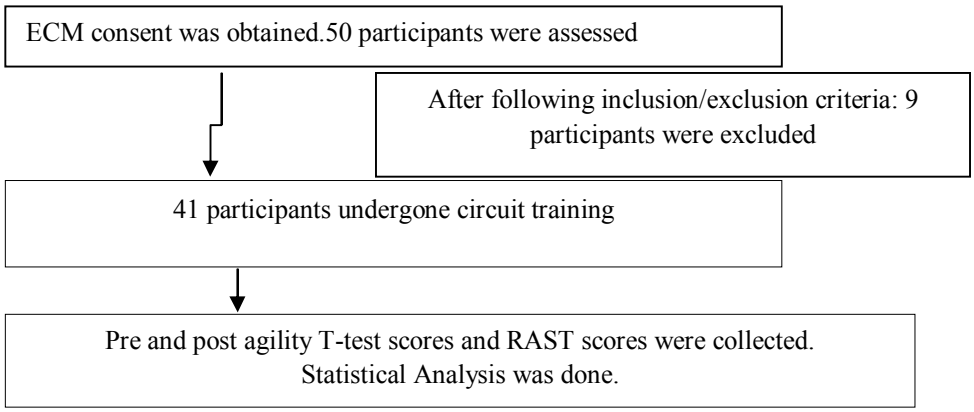

Figure 1. The data collection procedure

Figure 1 gives the data collection procedure. The training was given 3 consecutive days per week for 8 weeks. Participants were assessed before and after the training programmes by the Agility T-test and RAST. The participants performed Circuit training following the exercise programme developed according to ACSM guidelines [14]. The exercises were properly explained to the participants. The participants performed 5 min warm-up and cool-down prior to and at the end of the procedure respectively.

The warm-up consisted of; Jogging, Dynamic stretching and activities like - Kick-off, Jump and throw, Jumping and Heading.The cooldown included static stretching exercises and icing. The Circuit training consisted of 6 stations, which were as follows:–

- Jump squat [8].
- Single leg hop [8].
- Bounding [15].
- Jumps over the line [15].
- Dumbbell split squat [16].
- Weighted step-ups [16].

The protocol for Circuit training is as given in Table 1: [8, 17]

Table 1. Circuit Training Programme

Weeks	Cycles	Duration of exercises at each station(sec.)	Rest period between stations(sec.)	Rest period between cycles(min.)	Total training duration(min.)
1-4	2	30	60	2	20
5-8	3	60	90	2	34

Statistical Analysis

Descriptive statistics were performed to find out the mean, and standard deviation for the demographic variable and outcome variables. Paired t-test was used to find out the significant difference between participants for Agility and anaerobic power.

RESULTS

Table 2 represents the data collection of 41 participants where the mean age was 21.98 and the standard deviation was 1.956 with a standard error mean of 0.305.

Table 2. Baseline data for Age

Variable	N	Mean	Std. Deviation	Std. Error Mean
Age	41	21.98	1.956	.305

Table 3. Baseline data for Gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
F	12	29.3	29.3	29.3
M	29	70.7	70.7	100.0
Total	41	100.0	100.0	

Table 3 gives the baseline data for gender. Among 41 participants, there were 12 females and 29 males with the percentage of 29.3 and 70.7 respectively.

Table 4. Pre-post Agility T-test within the group

Agility T-test Paired Samples Test		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre-test - Post-test	2.857	1.072	.165	2.523	3.191	17.268	41	.000

Table 4 is the Agility T-test score the mean of paired difference of the pre-test and post-test agility t-test was 2.857 with a standard deviation of 1.072 which was statistically significant (p-value <.0001). The pre-test scores are greater than post scores which is why the mean of paired difference was positive, this shows that in Agility T-test the time taken by the participants reduced significantly which indicates a significant improvement in the agility T-test scores.

Table 5. Pre-post RAST (Time and Power) within the group

Rast Paired Samples Test		Paired Differences					T	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	RAST Pre–Post (secs)	1.037	.730	.047	.945	1.128	22.262	245	.000
Pair 2	POWER Pre-Post (watts)	-83.923	58.812	3.750	-91.309	-76.537	-22.381	245	.000

Table 5 gives the RAST score the mean of the paired difference between pre-RAST time and post-RAST time was 1.037 with a standard deviation of .730 which was statistically significant (p-value <.0001). The pre-test scores are greater than post scores which is why the mean of paired difference was positive it shows that the time taken by the participants reduced in the post-test.

The mean of paired difference of pre-RAST power and post-RAST power was -83.923 with a standard deviation of58.812 which was statistically significant (p-value <.0001). In this the pre-test scores were less than the post-test scores whichare why the mean of paired difference was negative, this shows that the power of the participants was increased during the post-test.

Table 6. Pre-post RAST (Fatigue index) within the group

RAST Paired Samples Test		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Fatigue Index - Fatigue Index	.707	.814	.127	.450	.964	5.566	40	.000

In this RAST score, the mean of paired difference of the pre-RAST Fatigue index and post-RAST Fatigue index was .707 with a standard deviation of .814 which was statistically significant (p-value <.0001). The pre-test scores are greater than post scores which is why the mean of paired difference was positive, it shows that the fatigue index of the participants reduced in the post-test which indicates a significant improvement in the RAST scores.

In the outcome measure of Agility, the time taken by the participants reduced in the post-test which indicatesa significant improvement (p-value <.0001) in the agility T-test scores of the participants. It shows that Circuit Training significantly improves agility among college-level football players.
In the outcome measure of anaerobic power, the power of the participants was increased during the post-test and the fatigue index and time taken by the participants reduced in the post-test which indicatesa significant improvement (p-value <.0001) in RAST scores of the participants. It shows that Circuit Training significantly improves anaerobic power among college-level football players.

DISCUSSION

The essential components of any sport are speed, flexibility, skill, agility, endurance and strength. Agility is an important factor for athlete performance as it makes it possible to perform movements quickly, smoothly and efficiently. The performance of football players greatly depends on their agility. This research aims to evaluate the effects of the circuit training program on agility and anaerobic power among college-level football players. Previous studies (Ab Raoof Bhat et al) [7] in which male going college students performed a different design and procedure of circuit training confirmed an improvement in agility. Studies have been done to find out the effect of differently designed circuit training programs on anaerobic power as well [18, 8].
In this study, a designed circuit training program was performed by the participants 3 times a week for 8 weeks. Analysis of the agility performance of the participants was done by using the Agility T-test and for anaerobic power Running Based Anaerobic Sprint Test was used. The findings of this study indicate that circuit training shows significant improvement in agility and anaerobic power among college-level football players. According to statistical analysis, the mean age of 41 participants (including both females) was 21.98 and the standard deviation was 1.956. The Agility T-test score the mean of paired difference of pre-test and post-test agility t-test was 2.857 with a standard deviation of 1.072 which was statistically significant (p-value <.0001). In this RAST score, the mean of the paired difference between pre-RAST time and post-RAST time was 1.037 with a standard deviation of .730.The mean of the paired difference between pre-RAST power and post-RAST power was -83.923 with a standard deviation of 58.812 and the mean of paired difference of pre-RAST Fatigue index and post-RAST Fatigue index was .707with a standard deviation of .814 which was statistically significant (p-value <.0001). The comparison of Age, pre and post-agility T-test and RAST scores of the samples were shown in tables and concluded that there is a statistically significant improvement of the agility T-test and RAST scores of the participants.
Plisk [19] mentioned the reason in his study that movements such as Olympic-style lifts, plyometrics, and medicine ball drills are so effective in improving speed is that they cannot be performed without high power production, rapid force application, and acceleration that results in significant improvement in the agility of the participants performed Circuit training. S.P.Surwase [20] explained in a study that the source of energy in rapid and violent muscular activity is the anaerobic mechanism and the source of prolonged muscular activity is initially an anaerobic process which is followed by an aerobic process. The short-term muscle power depends upon the degradation of ATP as well as its replenishment from PCr in which the rate of both processes is high but PCr stores are limited. These PCr stores need to be replenished by slower, oxidative metabolism, so the high phosphate-based power can be sustained only for a limited time. Hence, the sprinting performance of the individual depends upon the anaerobic mechanism of the body.
The data obtained in these studies form the basis for the design of training programs specifically focused on the improvement of agility skills and anaerobic power among football players. The present results indicate that the design proposed in this research could be effective for training the participants in sports.

CONCLUSION

This study can be concluded by stating that 8 weeks of circuit training improves agility and anaerobic power significantly among college-level football players.

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