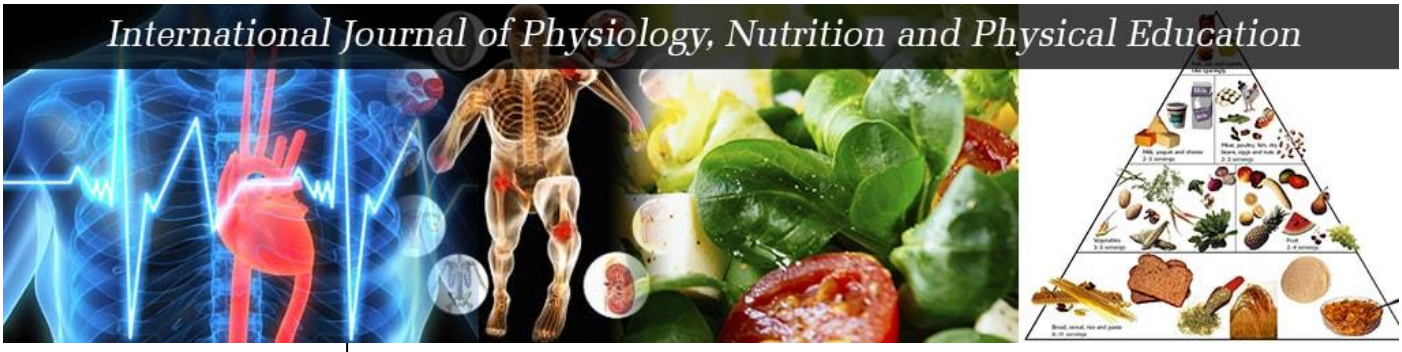

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Bhawani Pratap Singh Shekhawat
Research Scholar, Bhupal Nobles' University, Udaipur, Rajasthan, India

GS Chauhan
Associate Professor, Faculty of Education, Bhupal Nobles' University, Udaipur, Rajasthan, India

Corresponding Author:
Bhawani Pratap Singh Shekhawat
Research Scholar, Bhupal Nobles' University, Udaipur, Rajasthan, India

Effect of circuit training on speed and agility of adolescent male basketball players

Bhawani Pratap Singh Shekhawat and GS Chauhan

Abstract
The purpose of the study was to ascertain the effect of circuit training on speed and agility of adolescent male Basketball Players. The tests used for assessment of speed and agility were 50m sprint and 4x10m shuttle run respectively. The subjects for the study were 30 male students who were in the age range of 15 to 18 years. The duration of the experimental period was twelve weeks. A 10 stations circuit was developed by the research scholar and the subjects trained thrice a week i.e. on Mondays, Wednesdays and Fridays. The adaptation period of two weeks was adopted. After every two weeks the number of circuits was increased. Analysis of data was done employing t-test. The t-ratios obtained were 2.88 for speed and 2.1 for agility. Both the t-ratios were found to be significant at 0.05 level of confidence with 29 degrees of freedom.

Keywords: circuit training, speed, agility, basketball players

Introduction
In the modern system of sports training, development of a sports person in respect of different motor fitness components occupies a very important place. In view of this there has been an ever-increasing interest with respect to the effect of different training programmes on competitive sports performance. For the development of sports performance, there are numerous factors that play an important role but improvement in the level of physical and motor fitness of a sportsperson is of special significance. Improvement of training state of a sportsperson is determined through increased efficiency of speed, agility, strength, endurance, flexibility and coordinative abilities. In view of the above the conditioning status of a sports person is to be enhanced by focusing attention on development of physical and motor fitness components.

In order to ensure improvement in the physical conditioning status of the sports person, the following principles should be given due importance:

1. The entire programme is designed keeping in mind that each person is an individual.
2. Reasonable targets are to be set for the sportsperson.
3. Every sportsperson requires a master plan. It will indicate where the sportsperson has to reach and how to get there.
4. Plan is based on sport/event-specific abilities. To excel in a particular sport/event, the physical traits that are specific to that sport/event must be developed.
5. A good training plan uses a variety of training methods. The more variety a training programme has, the more challenging and interesting the training will be for the sportsperson.
6. Follow the hard-easy approach. A day of hard training should be followed by a day of easy training. The body requires about 48 hours for complete recovery from very hard exercises.
7. Every sportsperson must avoid the use of very heavy training.
8. Proper energy intake is very important to successful sport. A well-balanced nutritional plan will meet most to body's dietary requirements.
9. Give enough rest to the body. Rest is one of the most neglected requirements by sportspersons. Younger players require more rest than older sportspersons.

Speed is used in sports for such muscle reactions (motor movements) that are characterized by maximally quick alternation of contraction and relaxation of muscles. It is also the ability to execute motor actions, under given conditions, in minimum possible time. Speed ability is highly movement specific. Like strength and endurance, speed is also a conditional ability but unlike those two conditional abilities (strength and endurance) speed depends to a considerable extent on the nervous system. As a result of this speed is more complex in nature and is comparatively less trainable as compared to strength and endurance. The efficiency of the nervous system, which can be influenced only to a limited extent, becomes a limiting factor in the development of speed.
Agility helps performance in activities that require you to change direction quickly whilst keeping balance, strength, and speed and body control. Although speed and power can benefit agility, the main improvements in performance come from learning the skill of turning, moving limbs and pivoting quickly. Agility training improves flexibility, balance, and control. It helps the body to maintain proper alignment and posture during movement. Additionally, agility drills encourage our body to learn how to maintain correct body placement. Agility is our body's ability to be fast and nimble, change direction, and change the positioning of our body - while our body is actively in motion. For some athletes, this is easier said than done. However, agility training can help to improve the skills, which result in enhanced athletic performance.
Regardless of the sport you play, speed and agility are essential to taking your athletic performance to the next level. Agility training benefits not only improves athletic performance, agility also improves our daily movement. Whether you want to build explosive strength, increase speed, improve recovery times, or simply want to improve balance, agility training is important for maintaining athletic performance. Both speed and agility play a very significant role in the sport of Basketball. In fast break the basketball player has to literally sprint so that he or she can score the basket before the opponent players provide a defense. The game of basketball also involves quick change of direction and body position while moving towards the opponent basket.
The purpose of the study conducted by Revana and Suthakar (2018) [8] was to find out the effect of combination of sprint training and circuit training on the development of agility and flexibility of the inter-collegiate level male athletes. Sixty athletes from the various colleges in Karnataka are selected as subjects and their age ranged from 18 to 22 years. The subjects were divided into three equal groups. The first group underwent spring training (n=20), the second group performed circuit training (n=20), and the third group acted as a control group. The selected variables were assessed by agility (Illinois ability test) and flexibility (sit and reach test) conducted before and after 12-week of the training regimen. The data was analyzed using t-test, analysis of co- variance. The sprint training group showed significantly greater improvement in the agility and flexibility as compared to the control group.
In their research studies Ellena (1960) [3], Dahl (1977) [2], Shaker (1981) [9], Atkinson (1973) [1], Lamba (1980) [4], Mishra (1983) and Amusa and Onyewadume (1987) have observed that performance in different games and sports is greatly influenced by the level of fitness of a sportsperson.
In order to ensure improvement of sports performance, a sports person has to spend considerable amount of time in developing different components of physical and motor fitness (Uppal, 2001) [10, 11]. The physical and motor fitness of a sportsperson is the sum total of several motor components namely speed, strength, endurance, flexibility, agility and co-ordination. These motor abilities and their complex forms (e.g. strength endurance, speed endurance, explosive strength etc.) are the important and basic pre-requisites for human motor actions. In view of this, sports performance in different games and sports depends to a great extent on these abilities. Some sports like distance running in athletics require a very high level of endurance but a low level of other motor abilities. On the other hand cricket requires high level of strength and speed endurance in addition to general endurance and speed (Li and Mohammad, 2002) [5].
Circuit training is a form of body conditioning that involves endurance training, resistance training, high-intensity aerobics, and exercises performed in a circuit, similar to high-intensity interval training. It targets strength building and muscular endurance. An exercise "circuit" is one completion of all set exercises in the programme. When one circuit is complete, one begins the first exercise again for the next circuit. Traditionally, the time between exercises in circuit training is short, often with rapid movement to the next exercise. This program was developed by R.E. Morgan and G.T. Anderson in 1953 at the University of Leeds in England.
Benefits of circuit training include:

1. Improvements in muscular strength
2. Improvements in cardiovascular fitness
3. Improvements in muscular endurance
4. Increased social interaction during a workout
5. Increased adherence to exercise

The fitness demands required to last a full game of Basketball are very different from those placed on the Football and Volleyball player. Even within a sport, specificity is relevant, e.g. difference between the attacking and defensive players in the game of soccer. A coach who wishes to progress towards peak performance must be aware of both relative and specific fitness and recognize the demands that a change in either can affect performance. Different sports require different components (Tandon *et al*, 2001). General fitness has number of components namely strength, speed, endurance, flexibility and agility and each of these components has an important role to play and contribute to total fitness of a sportsperson. They lay a strong foundation over which other aspects of sports performance could be trained and developed. These components do not exist in isolation, as the development of one will influence the development of another in what is known as cross-components effect (Paish, 2001) [7].

Methodology

The subjects for the study were 30 school level Basketball players training regularly in the Youth Basketball Academy Udaipur, Rajasthan and their age ranged between 15 to 18 years. A ten station circuit (Fig.1.) was developed and the stations included are shown in the following diagram. The subjects worked on each station for 30 seconds and between two stations 30 seconds rest was taken. The duration of the training programme was 12 weeks and subjects trained thrice a week i.e. on Mondays, Wednesdays and Fridays. An adaptation period of two weeks was followed. In the first two weeks the number of repetitions was six and thereafter every two weeks one repetition was added and during the 10th week the number of repetitions was 10. Before starting the training protocol, the subjects were tested for their performance in 50m sprint (speed) and 4x10m shuttle run (agility). After completion of the experimental protocol of ten weeks, the tests were again repeated.

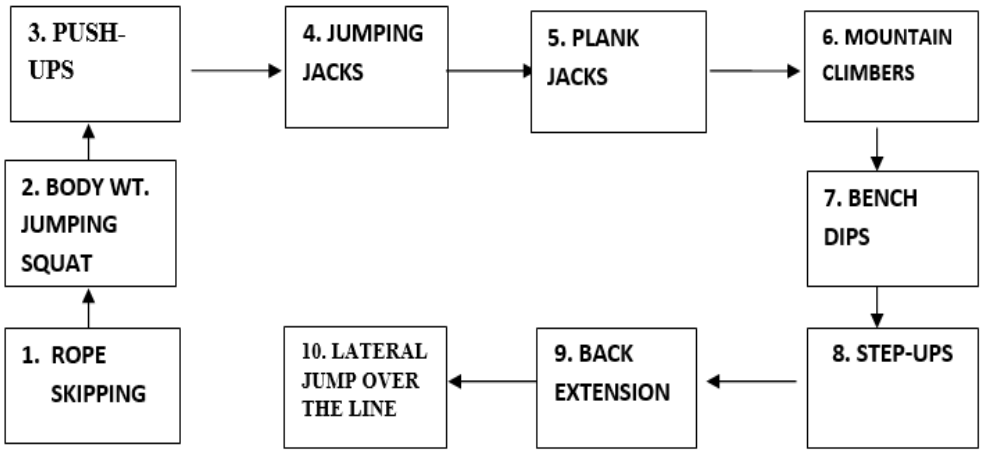

Fig 1: Circuit of ten stations

Collection of data

Before the administration of tests for collection of data, the subjects were familiarized with the tests and testing procedure. They were also allowed to have practice so as to enable them to give their best performance when the test is finally administered. Even though no motivational technique was employed in the study, yet the subjects were urged to put in their maximum effort while performing the tests.

In order to ensure uniform conditions for all the subjects, the tests were administered in the fore noon session. The duration of the tests was adjusted in such a way so that fatigue might not set in. Sufficient time was provided in between the tests to enable the subjects to put in their best. The subjects took all the tests in their proper sports kit.

Analysis of data

The data was analyzed using the following statistical techniques:

a. Computation of mean
b. Computation of standard deviation
c. Computation of standard error of difference between the means
d. Computation of 't' ratio.

The level of significance chosen was 0.05 level of confidence.

Administration of tests

The following tests will be administered to the subjects.

Item number I - Speed (50m dash)

Purpose

To measure running speed

Facilities and Equipment

An area on a track, with a starting line, a 50m course, and a finish line, two stopwatches and a score sheet

Procedure

After a short warm-up period the subject took position behind the starting line. For better result two subjects ran at the same time. The starter used the command, "ready?" and "Go" The latter was accompanied by a downward sweep of the arm as a signal to the timer. The subjects ran across the finish line. One trial was permitted.

Instructions

You may take any position behind the starting line you wish. On the command, "Go" you will run as fast as you can across the finish line. Do not slow down until you have crossed the finish line. Then you may slow down gradually.

Scoring

The score was the elapsed time to the nearest hundredth of a second between the starting signal and the instant the subject crossed the finish line.

Item number II - Shuttle run

Purpose

To measure agility

Facilities and Equipment

Two lines parallel to each other were marked on the ground 10m apart. Since the subject will overrun the starting line at the time of finishing, a several meter more of floor space was kept. Two blocks of wood, 5 by 5 by 10 centimeters, a stopwatch and a score sheet were used.

Procedure

The subject stood at one of the lines with the 2 blocks at the other line. On the signal to start, the subject ran to the blocks, pick up one, and return to the starting line, and placed the block behind that line. He then ran to the second block picked it up and carried it across the starting line on the way back. Two students ran at the same time and two different timekeepers were used. One trial was permitted.

Instructions

On the signal to "Go" run as fast as you can to the next line and pick up a block. You should return the block over the second line where you place it on the floor. Do not throw it. Return to the second block and this time you may run across the starting line as fast as you can without placing the block on the floor.

Scoring

The score was the elapsed time recorded in hundredth of a second.

Findings

The analysis of data pertaining to effect of circuit training on 50m sprint (speed) and 4x10m Shuttle Run (agility) is presented in tables 1 and 2.

Table 1: Significance of difference in the means of 50m sprint (Speed) performance of the subjects as a result of administering circuit training programme

	Mean	Mean diff.	SD	Standard error	t-ratio
Initial	7.96		0.99		
		0.49		0.17	2.88*
Final	7.47		0.89		

*Significant at 0.05 level, $t_{0.05}$ (29) = 2.045

The analysis of data in table 1 clearly shows that a difference of 0.49 in the initial and final means of the subjects with respect to 50m sprint is statistically significant at 0.05 level of confidence. The value of t-ratio obtained is 2.88 and it is higher than the table value of 2.045 with 29 degrees of freedom.

The means and standard deviations in respect of 50m sprint are graphically presented in Fig. 2.

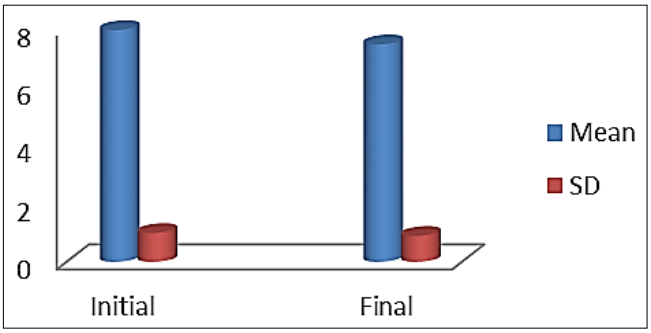

Fig 2: Means and standard deviations of subjects in 50m sprint (Speed)

Table 2: Significance of difference in the means of 4x10m shuttle run (Agility) performance of the subjects as a result of administering circuit training programme

	Mean	Mean diff.	SD	Standard error	t-ratio
Initial	10.20		0.72		
		0.63		0.3	2.1*
Final	9.57		0.55		

*Significant at 0.05 level $t_{0.05}$ (29) = 2.045

The analysis of data in the above table reveals that a difference of 0.63 in the initial and final means of the subjects with respect to 4x10m Shuttle Run (Agility) is statistically significant at 0.05 level of confidence. The value of t-ratio obtained is 2.1 and it is higher than the table value of 2.045 with 29 degrees of freedom.

The means and standard deviations in respect of Bent-knee Sit-ups performance are presented in Fig.3.

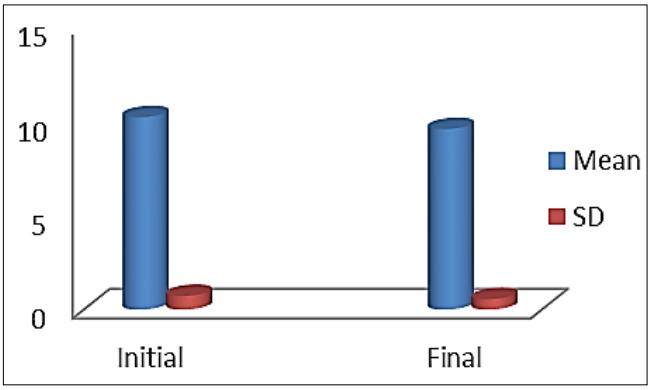

Fig 3: Means and standard deviations of subjects in 4x10m shuttle run (Agility)

Discussion of findings

The analysis of data clearly shows that ten-week circuit training has brought about significant improvement in 50m sprint (speed) shuttle run (agility) performance. This could be explained by the fact that in addition to morphological structure of the muscle fiber and regulating procedure of the nervous system the strength as well as elasticity and relaxing capacity of muscles also help in improving running speed (Uppal, 2001) [10, 11]. Moraru *et al.* (2019) [6] in their research study have observed that circuit training develops strength, strength endurance as well as flexibility and in addition develops overall fitness status of sports persons. Agility is described as ability to change direction and body position as quickly as possible and both these abilities are influenced by strength, speed and flexibility. Circuit training performed regularly enhances muscular strength, speed, cardio-vascular fitness and flexibility and improvement of these motor abilities might have helped in enhancing agility. Most of the stations included in the circuit concentrated on exercising the muscles of the legs, arms and the trunk region and regular participation in the circuit might have enhanced the strength which in turn might have helped in improving speed and agility. Science of sports training clearly reveals that development of different motor components also has cross training effect. This cross training effect might have helped in improving speed as well as agility of the basketball players

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