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## Effect of circuit training on selected strength variables of adolescent male basketball players

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### Abstract

The purpose of the study was to ascertain the effect of circuit training on Pull-ups (arm and shoulder girdle strength), Bent-knee sit-ups (abdominal strength) and Standing broad-jump (legs explosive strength) of adolescent male Basketball Players. 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. 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 7.24 for pull-ups, 2.88 for bent-knee sit-ups and 3.8 for standing broad jump. All the t-ratios were found to be significant at 0.05 level of confidence with 29 degrees of freedom.

**Keywords:** circuit training, strength variables, basketball players

### Introduction

In the modern system of sports training, the 'conditioning training' of a sportsperson occupies a very important place. In view of this there has been an ever-increasing interest with respect to the effect of different training regimens on competitive sports performance. Although for the development of sports performance, there are multiple factors that play an important role yet enhancement in the level of physical and motor fitness of a sportsperson is of special significance. Improvement of condition in the physical and physiological training state of a sportsperson is determined through increased efficiency of strength, endurance, speed, flexibility and coordinative abilities. In the light of the above conditioning is a process of gradually preparing the body for strenuous physical activity thus focusing attention on development of physical and motor fitness components and indirectly enhancing sports performance.

### The physical conditioning process is based on certain set principles, which are as follows

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. The master plan must be flexible enough that it can be adapted to changing conditions or requirements.
6. 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.
7. 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.
8. Every sportsperson must avoid the use of very heavy training.
9. Proper energy intake is very important to successful sport. A well-balanced nutritional plan will meet most to body's dietary requirements.

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10. Give enough rest to the body. Rest is one of the most neglected requirements by sportspersons.

Younger players require more rest than older sportspersons. 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]. 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 Hockey or Football 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].

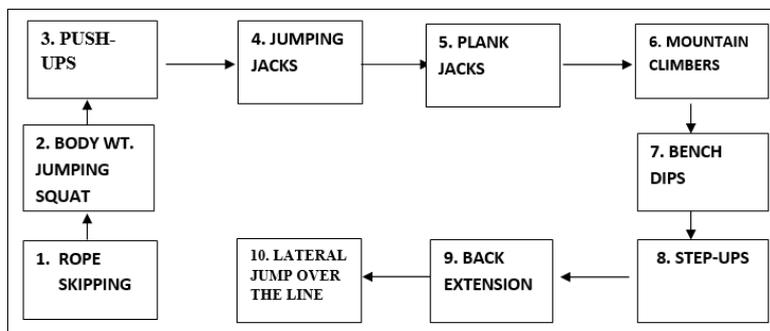
In their research studies Ellena (1960) [3], Dahl (1977) [2], Shaker (1981) [8], Atkinson (1973) [1], Lamba (1980) [4], Mishra (1983) and Amusa and Onyewadume (1987) have observed that performance in different games and sports is greatly influenced by the level of fitness of a sportsperson.

According to Moraru *et al.*, (2019) [6] circuit is a methodical procedure with highly efficient effects in the development of motor qualities, mainly strength and resistance. The purpose of their study was to demonstrate the efficiency of training in the circuit in the development of this motor quality. The sample within the research comprised 30 women aged 25-35 and who practiced 3 practices per week for 6 months. The independent variable included circuits for beginners (30" workout - 30" pause), circuits for middle level (45" workout - 30" pause) and circuits for advanced (50" workout - 30" pause). The tests applied concerned the strength and resistance of abdominal muscles, of the back, of the legs and of the arms. Findings. In the test for the strength and resistance of abdominal muscles, the values of the average and of standard deviation were  $13.8 \pm 1.52$  initially and  $15.2 \pm 1.08$  finally; concerning the strength and resistance of the back muscles, the values increased from  $21.46 \pm 1.684$  initially to  $23.53 \pm 1.641$  finally; in the strength and muscles of the legs, the values ranged between  $14.86 \pm 1.767$  initially and  $16.80 \pm 1.473$ ; in the strength and muscles of the arms, the values recorded an increase from  $14.40 \pm 0.985$  initially to  $16.26 \pm 0.961$  finally. The present research demonstrated that the use of circuit workout can improve the motor qualities of strength and it can also improve the motor qualities of strength and resistance, which confirms the purpose of the paper.

In the light of the above, it is important for a coach to evaluate the status of his sportspersons in respect of physical and motor fitness components and then develop an effective plan of training keeping in mind specific requirements of a sport.

#### **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 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 10<sup>th</sup> week the number of repetitions was 10. Before starting the training protocol, the subjects were tested for their performance in standing broad jump, bent-knee sit-ups and pull-ups. 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.

**The following tests were administered**

**Test-1 Standing broad jump**

Purpose: To measure power.

Equipment: Measuring tape and a mat.

Procedure: The subject stood behind the take-off line with feet several centimeters apart. He then jumped forward by bending knees and swinging arms backward. Three trials were permitted. Measurement was taken from the closest heel mark to the take-off line.

Instructions: Jump as far as possible but take-off must be from both feet simultaneously and land on both the feet. Crouch before jump and swing your arms.

Scoring: The score was the distance between the take-off line and the nearest point where any part of the student's body touched the landing area. It was measured in meter and centimeter to the nearest centimeter. Three trials were given and only the best trial was recorded as the score of the subject.

**Test-2 Bent-knee sit-ups**

Purpose: To measure abdominal strength

Equipment: Floor or a mat.

Procedure: The subject lay flat on the back with knees bent and feet on the floor. The angle of knees was 90°. Fingers were interlocked behind the neck with elbows touching the floor. The feet were held by a partner. The student then curled up to a sitting position and touched the elbows to the knees. The exercise was repeated as many times as possible in 60 seconds (1 minute).

Instructions: Fingers must remain interlocked. When curling up in sitting position the elbows must be flat on the floor or mat before next sit-up.

Scoring: The score was the maximum number of bent-knee sit-ups completed in 60 seconds.

**Test-3 pull-ups**

Purpose: To measure arm and shoulder girdle strength.

Equipment required: A metal or wooden bar at a convenient height.

Procedure: The bar was fixed at a height where students could freely hang off the floor. With the overhand grip, the subject raised his body until his chin was over the bar and lowered it again to the starting position with his arms fully extended.

Instructions: Swinging, Knee bending or snapping was not allowed.

Scoring: One point was scored each time the student completed a pull-up. Part scores were not counted.

**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.

**Findings**

The analysis of data pertaining to three strength variable chosen in the study is presented in the following tables:

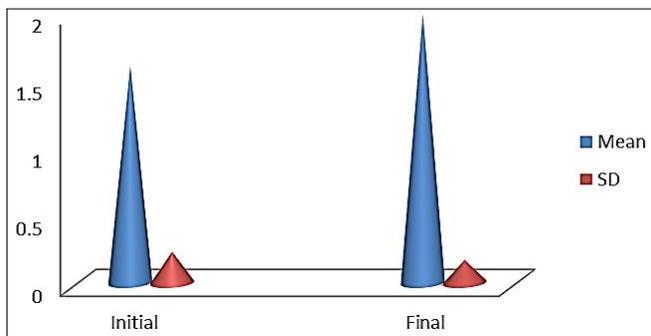
**Table 1:** Significance of difference in the means of standing broad jump performance of the subjects as a result of administering circuit training programme

	Mean	Mean diff.	SD	Standard error	t-ratio
Initial	1.60		0.23		
		0.38		0.1	3.8*
Final	1.98		0.17		

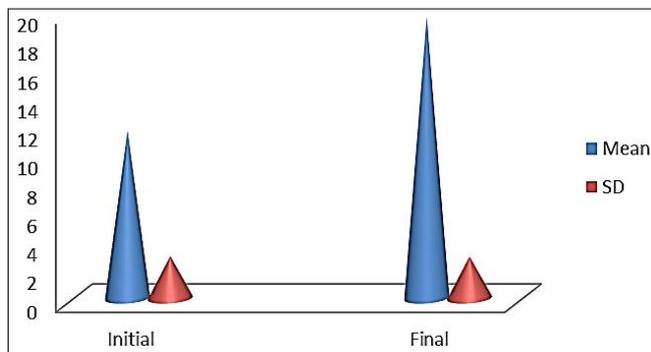
\*Significant at 0.05 level  $t_{0.05}(29) = 2.045$

The analysis of data in table 1 clearly shows that a difference of 0.38 in the initial and final means of the subjects with respect to standing broad jump is statistically significant at 0.05 level of confidence. The value of t-ratio obtained is 3.8 and it is higher than the table value of 2.045 with 29 degrees of freedom.

The means and standard deviations in respect of Standing Broad performance are presented in Fig.2.



**Fig 2:** Means and standard deviation of subjects in respect of standing broad jump



**Fig 4:** Means and standard deviation of subjects in respect of pull-ups

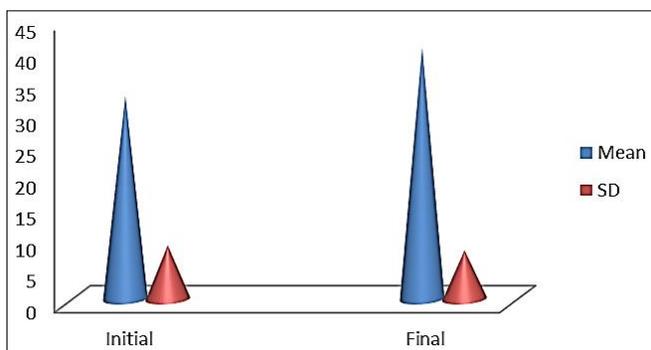
**Table 2:** Significance of difference in the means of bent-knee sit-ups performance of the subjects as a result of administering circuit training programme

	Mean	Mean diff.	SD	Standard error	t-ratio
Initial	32.47		8.61		
		7.70		2.67	2.88*
Final	40.17		7.81		

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

The analysis of data in the above table reveals that a difference of 7.70 in the initial and final means of the subjects with respect to bent-knee sit-ups 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 Bent-knee Sit-ups performance are presented in Fig.3.



**Fig 3:** Means and standard deviation of subjects in respect of bent-knee sit-ups

**Table 3:** Significance of difference in the means of pull-ups performance of the subjects as a result of administering circuit training programme

	Mean	Mean diff.	SD	Standard error	t-ratio
Initial	11.63		2.93		
		7.90		1.09	7.24*
Final	19.53		2.90		

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

The analysis of data in table 3 clearly shows that a difference of 7.90 in the initial and final means of the subjects with respect to pull-ups is statistically significant at 0.05 level of confidence. The value of t-ratio obtained is 7.24 and it is higher than the table value of 2.045 with 29 degrees of freedom.

The means and standard deviations in respect of Pull-ups performance are presented in Fig.4.

**Discussion of findings**

From the analysis of data it is evident that the a ten-week circuit training has brought about significant improvement in standing broad jump (legs explosive strength), bent-knee sit-ups (abdominal strength) and pull ups (arms and shoulder girdle strength) performance. This could be explained by the fact that circuit training develops strength endurance and in addition develops overall fitness status of sports persons. Circuit training performed regularly also enhances muscular strength, cardio-vascular fitness and flexibility. 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 of those muscles that are important for performing standing broad jump, bent-knee sit-ups as well as pull-ups. The findings of the present study are in consonance with the results arrived at by Moraru *et al* (2019) [6].

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