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RESEARCH ARTICLE
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A COMPARATIVE STUDY ON CIRCUIT AND PLYOMETRIC TRAINING ON STRENGTH, SPEED AND AGILITY IN SPORTS PLAYERS

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ABSTRACT

BACKGROUND:- Sports need frequent, high-intensity efforts over a prolonged period, including acceleration, declaration, and direction changes. In this case, a variety of training approaches are used to increase sport players' overall athletic performance by enhancing their speed, acceleration, flexibility, balance, and agility. The objective of this study is to examine the impact of circuit training and plyometric exercise on running speed, agility, and strength in sports players.
METHOD:-In this comparative study, 40 sport players between the ages of 18 and 25 were participated. They were randomly divided into 2 groups, each consisting of 20 players, for circuit training group A and plyometric training group B. With the Vertical Jump Test, Agility-T-Test, and 50-meter Dash Test, all players were assessed for lower limb strength, upper limb strength, agility, and running speed. At the beginning, fourth, and end of the eighth week, data were gathered for every variable.
RESULT:-After the eighth week, both groups had made substantial progress, but the circuit training group had significantly better upper and lower limb strength, running speed, and agility than the plyometric training group ($p < 0.05$).The results of the study showed that by the end of the eighth week, agility, speed, and strength in the circuit training group A had each improved by 40, 40, and 41%. While at the end of the eighth week, the plyometric training group B's agility, speed, and strength had increased by 19, 18, and 18%, respectively.
CONCLUSION:-Although lower limb strength, agility, and running speed were all significantly improved for both groups by -the end of the eighth week.The circuit training is a crucial way to increase their lower limb strength, running speed, and agility in sport players.

Key words:-50-meter Dash Test, Agility-T-Test, circuit training, plyometric training, Vertical Jump Test

INTRODUCTION

In sports, frequent high-intensity efforts including acceleration, declaration, and direction changes are necessary over a long period of time. With this instance, numerous training methods are adopted to enhance speed, acceleration, flexibility, balance, and agility to assist players improve their entire athletic performance. All these qualities can be transferred on the field or court by athletes. Strength is a crucial aspect for athletes to perform effectively in sports since it allows them to lift their equipment

or gear appropriately and create the necessary force. Weightlifting and power lifting, strength athletics and strongman competitions, arm wrestling, and track and field's "heavy throws", such as shot put, discus, and hammer, are examples of such events. Depending on the position, specific fitness training is required (Ferley et al., 2020).

Agility is a valuable skill among elite athletes, along with speed. Agility is defined as the ability to change directions quickly and safely. As a result, attacking players may use their speed more effectively. Agility is the capacity to change the direction of the body efficiently and effectively, which requires a combination of balance, speed, strength, and coordination. Agility is defined as the ability to change direction precisely and swiftly in response to a stimulus, such as a ball moving or players moving. Agility abilities are highly significant in sports; they are a key component that improves performance in a variety of sports that require running and changing directions (França et al., 2022). Speed and agility exercises and trainings can improve the performance of all sports. Acceleration, deceleration, foot speed, quickness, and direction change are all improved by these workouts. Your players will get an advantage over their opponents by doing speed and agility workouts. These activities are critical for improving athletic abilities, preventing injury, and increasing confidence. Short sprints, cone exercises, and ladder workouts can help increase speed and agility. Among the several trainings for strengthening, speed and agility, plyometric and circuit training both have a good influence on numerous metrics related to athletic performance (Anitha et al., 2018).

Plyometric training (PT) is one of the training regimens that works on the strength and conditioning of players in order to enhance strength, running speed, and agility.Plyometric training, also known as jump training or plyos, is a type of exercise in which muscles exert maximal effort for brief periods of time in order to increase power (speed-strength). This training focuses on learning to quickly or\ "explosively" transition from a muscular extension to a contraction, as in specialized repetitive leaping. Plyometric training involves combining a rapid eccentric muscle contraction with a rapid concentric muscle contraction to generate a fast, powerful movement. It must be done in combination with a resistance training program since athletes must have a minimum level of fundamental strength before beginning plyometric training (Miller et., 2006). Plyometric training is one of the training methods used to improve an athlete's strength and conditioning. It is extremely important in the last stages of a rehabilitation program since it attempts to improve athletic performance (Guclu et., 2016).

Plyometrics are largely utilized by athletes to increase performance, particularly martial artists, sprinters, and high jumpers, and are employed in the fitness area to a lesser extent. There are three phases of plyometric training. The preload phase, also known as the facilitatory phase, includes extending the muscle at the musculo-tendinous junction. Throughout the concentric phase, the energy accumulated during this phase is released. The second step, known as the amortization phase, entails a little delay from the first to the third and final stage, concentric shortening. The concentric phase entails quick power generation that takes use of the biomechanical features of pre-stretched muscles. As a result of the interaction of these three phases, muscle performance is improved (Yuksel et., 2015).

Circuit training (CT) is a method of body conditioning that involves endurance training, strength training, high-intensity aerobics, and circuit-style exercises like interval training. It emphasises muscular endurance and strength training. A "circuit" of exercises is one round of all the exercises in the programme. When one cycle is completed, the preceding exercise is repeated for the next circuit. The interval between exercises in circuit training is frequently quick, with rapid movement to the next activity. It consists of series of exercises that are performed in a row one after the other with minimal rest period in between, as a result,all these exercises form one circuit. Circuit training is used in sports to develop strength and cardiopulmonary fitness in same exercise session (Mohanta et al., 2019). A circuit includes several exercises that target different aspects of fitness, including as strength, speed, and agility, that a sportsman needs to improve his performance in the game. Circuit training is divided into two types: horizontal and vertical (Chtara et al., 2008).

During a circuit training session, a variety of weights can be employed, starting with lesser weights, and graduating to heavier weights or vice versa. Between sets, a little time of break is usually taken. Because circuit training combines cardiovascular and strength training, it has a wide range of benefits in terms of improved cardio-pulmonary fitness and muscular strength. It's also a terrific method to

burn calories, especially during the high intensity set times. Circuit training not only increases the number of exercises completed, but it also minimises the amount of time spent doing them because different exercises are repeated in a sequence (Kaya et al., 2018).

Objectives of the present study are:-

- To determine the appropriateness of sport players for plyometric and circuit training.
- To assess the efficiency of plyometric training in improving running speed, agility, and strength in sports players.
- To find out how helpful circuit training is at improving strength, speed and ability in athletes.

To study the difference in circuit training and plyometric training on strength, speed, and agility in sports players.

HYPOTHESIS OF RESEARCH

- **NULL HYPOTHESIS**
- Circuit training will be more effective than plyometric training in increasing strength, speed and agility in sports players.

- **ALTERNATE HYPOTHESI**
- Plyometric training will be less effective than circuit training in increasing strength, speed and agility in sports player

METHODOLOGY

This study examined the efficacy of circuit and plyometric training for enhancing strength, speed, and agility in sports participants in gyms and athletic clubs. A sample size of 40 respondents who matched the inclusion and exclusion requirements took part in the study. The study's inclusion criteria included participants who were between the ages of 18 and 25 and had been participating in outdoor activities for at least two years without a recent injury history. Any musculoskeletal ailment that reduced a player's willingness to participate in the study or any illness that would limit their ability to play were also grounds for exclusion from the study.

Inclusion Criteria Participants should be a sports player Age should be at least in between 18 to 25 year Outdoor sports specific players will be priority Exclusion Criteria Any serious injury like fractures, posture deviation, spinal injury, heart related issues Drug intake to enhance the performance.

Circuit training for group A

The circuit training group included a five-minute warm-up, five minutes of sport-specific exercise, circuit training lasting 28 to 42 minutes, and a five-minute cool-down. On different days of the week, the circuit training group had 3 sessions. A 30-minute circuit training session with 8 stations, including a seated row, chest press, lateral pull, sit-up toss, plank, crunches, footwork pattern and depth jump was part of the training protocol. The warm-up period lasted 5 minutes. In a circuit, each exercise lasted 30 seconds, with 60 seconds of rest in between each station.

Plyometric training for group B

The plyometric group engaged in a 5-minute warm-up, 30 to 60 minutes of plyometric exercise, a 5-minute sports-specific workout, and a 5-minute cool-down. The Plyometric training programme included a mix of exercises for lower bodies. A regimen consisting of 4–8 exercises that were done in 2-4 sets with 10-15 repetitions each was used. The trial's rest interval ranged from 15 to 19 seconds depending on the activity and the number of sets completed. The proper procedure was demonstrated and explained. A 30- to 60-minute plyometric activity was followed by a 5-minute coAol-down period. The plyometric group received twice-weekly training.

Statistical analysis

Observational data were taken on the first day of intervention, as well as the last day of the fourth and eighth weeks. The data was analysed using the SPSS 26.0 for Windows software package. All variables' means and standard deviations were computed. The significance level was set at $p<0.05$. The paired t-test was used to compare differences within groups, while the unpaired t-test was used to compare differences between groups.

RESULT

Agility T-test for agility measurement

The study's findings indicated that agility in the circuit training group A had improved by 40% by the end of the eighth week, while agility in the plyometric training group B had improved by 19% by the end of the eighth week (Table 1). Comparing Plyometric training group B to the Circuit training group A, a highly significant ($p< 0.001$) improvement of 24 percent was seen (Table 2). Additionally, agility improvement in the circuit training group A was significantly ($p <0.001$) greater than in the plyometric training group B (Figure 1).

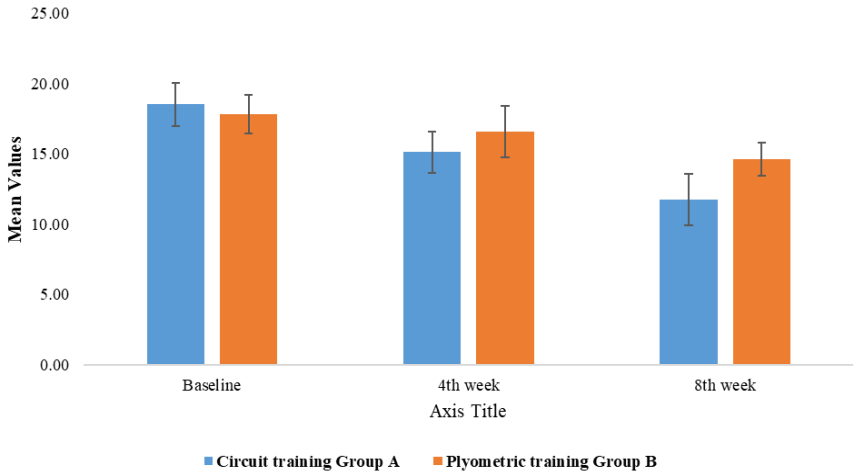
Table 1. Comparison of change in agility within Circuit training Group A and Plyometric training Group B.

Agility T-Test	Duration	Mean	SD	t-value	p-value
Circuit training Group A	Baseline	19.40	1.31	6.443	2E-06
	4th week	16.95	1.43		
	Baseline	19.40	1.31	17.84	1E-13
	8th week	11.65	1.09		
Plyometric training Group B	Baseline	18.65	0.99	3.563	0.001
	4th week	17.20	1.44		
	Baseline	18.65	0.99	11.57	2E-10
	8th week	15.25	1.07		

Table 2. Comparison of means between the Circuit training Group A and Plyometric training Group B for agility measurement.

Agility T-Test	Groups	Mean	SD	t-value	p-value
Baseline	Circuit training Group A	19.40	1.31	1.891	0.037
	Plyometric training Group B	18.65	0.99		
4th week	Circuit training Group A	16.95	1.43	0.539	0.2981
	Plyometric training Group B	17.20	1.09		
8th week	Circuit training Group A	11.65			
	Plyometric training Group B	15.25	1.07		

Figure 1. Comparison of means between Group A and Group B for agility measurement



50-meter dash test for running speed measurement

After reviewing the results of the 50-meter dash test, it was determined circuit training group A had improved by 40% and the plyometric training group B had improved by 18% at the end of the eighth week of training (Table 3). However, compared to plyometric training group B with circuit training group A showed a highly significant ($p < 0.001$) increase of 24 percent at the end of the eighth week of training (Table 4). Additionally, when comparing the 50-meter dash test results between Circuit training Group A and Plyometric training Group B at the end of the eighth week, a significant ($p < 0.001$) improvement was seen (Figure 2).

Table 3. Comparison of change in 50-meter dash test within Circuit training Group A and Plyometric training Group B.

50-meter dash test	Duration	Mean	SD	t-value	p-value
Circuit training Group A	Baseline	19.40	1.31	3.8131	0.0006
	4th week	16.95	1.43		
	Baseline	19.40	1.31	15.534	1E-12
	8th week	11.65	1.09		
Plyometric training Group B	Baseline	18.65	0.99	1.1056	0.1413
	4th week	17.20	1.44		
	Baseline	18.65	0.99	8.1689	6E-08
	8th week	15.25	1.07		

Table 4. Comparison of means between the Circuit training Group A and Plyometric training Group B for speed measurement

50-meter dash test	Groups	Mean	SD	t-value	p-value
Baseline	Circuit training Group A	19.40	1.31	0.6305	0.2679
	Plyometric training Group B	18.65	0.99		
4th week	Circuit training Group A	16.95	1.43	2.695	0.0072
	Plyometric training Group B	17.20	1.44		
8th week	Circuit training Group A	11.65	1.09	14.782	4E-12
	Plyometric training Group B	15.25	1.07		

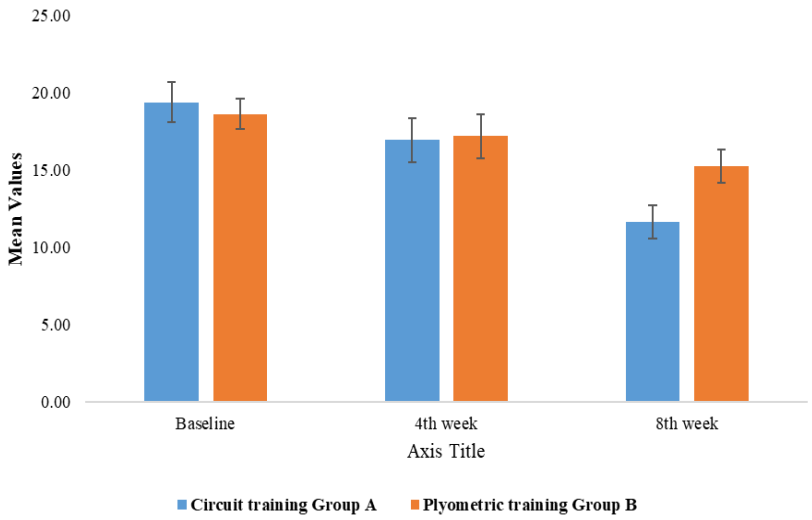


Figure 2. Comparison of means between Group A and Group B for speed measurement

Table 5. Comparison of change in Vertical Leap Test within Circuit training Group A and Plyometric training Group B

Vertical Leap Test	Duration	Mean	SD	t-value	p-value
Circuit training Group A	Baseline	13.20	1.44	7.2762	3E-07
	4th week	16.55	1.05		

	Baseline	13.20	1.44	19.151	3E-14
	8th week	22.30	1.34		
Plyometric training Group B	Baseline	12.45	1.32	1.5085	0.0739
	4th week	13.10	1.17		
	Baseline	12.45	1.32	8.1021	7E-08
	8th week	15.15	1.27		

Table 6. Comparison of means between the Circuit training Group A and Plyometric training Group B for strength measurement

Vertical Leap Test	Groups	Mean	SD	t-value	p-value
Baseline	Circuit training Group A	13.20	1.44	1.5976	0.0633
	Plyometric training Group B	12.45	1.32		
4th week	Circuit training Group A	16.55	1.05	12.089	1E-10
	Plyometric training Group B	13.10	1.17		
8th week	Circuit training Group A	22.30	1.34	18.535	6E-14
	Plyometric training Group B	15.15	1.27		

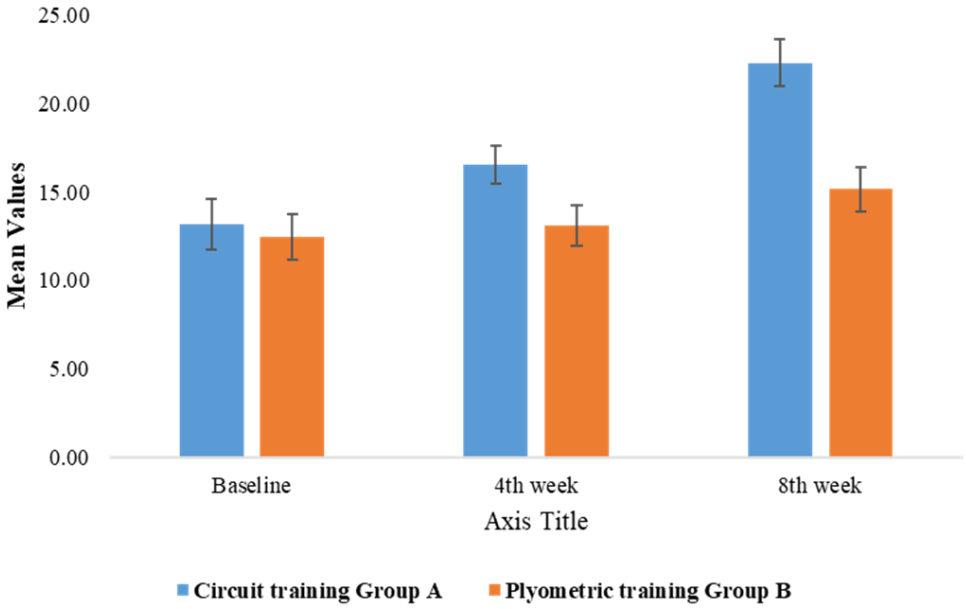


Figure 3. Comparison of means between the Group A and Group B for strength measurement.

DISCUSSION

The study's findings indicated that agility, speed and strength in the circuit training group A had improved by 40, 40 and 41% respectively by the end of the eighth week. While agility, speed and strength in the plyometric training group B had improved by 19, 18, and 18% by the end of the eighth week. Additionally, agility, speed and strength improvement in the circuit training group A was significantly ($p < 0.001$) greater than in the plyometric training group B.The results of this study are consistent with a previous comparative study, which evaluated the effects of circuit training and plyometric exercise on strength, speed, and agility in state-level lawn tennis players. By the eighth week, both groups had made substantial progress, but the circuit training group distinguished itself considerably from the plyometric training group in terms of upper limb strength, lower limb strength, running speed, and agility ($p< 0.05$). The findings show that circuit training is a crucial strategy for improving lawn tennis players' upper and lower limb strength, running speed, and agility (Mohanta et al., 2019).

The results of this study are in accordance with a previously performed study on the impact of an 8-week circuit training programme on the physiological and performance characteristics of university racket game players are comparable. They discovered that the 8th week of the regimen significantly

enhanced leg muscle power, cardio-respiratory endurance, agility, flexibility, and speed (Babalola, 2011). Abdominal muscle strength, jumping distance, speed, and forehand and backhand shot were all significantly improved in the experimental group compared to the control group ($p < 0.05$), according to a study on the effects of high intensity interval training on some of the crucial skills in young badminton players.The strength of the abdominal muscles, the length of the leap, and the speed of the forehand and backhand shot all significantly improved in the experimental group but did not in the control group ($p < 0.05$). Regular coaching sessions were conducted by the control group (Abdullah, 2014).

The benefits of a circuit training programme on muscular strength, agility, anaerobic performance, and cardiovascular endurance were examined in adifferent study. They discovered that anaerobic performance did not improve, despite significant ($p<0.01$) increases in muscular strength and agility (Sonchan et al., 2017). The findings of this study are consistent with those of a study on the impact of circuit training on the agility of male college students. They discovered that an 8-week circuit training regimen significantly ($p<0.005$) boosted agility (Shekhawat and Chauhan, 2021).The findings of this study are consistent with a study that showed impact of specific circuit training workouts on high school girls sprinters. The results of a 6-week circuit training programme showed a significant($p<0.01$)improvement in sprinting ability (Babu and Kumar, 2013).

Additionally, Chaouachi et al. (2014) looked at whether combined balancing and plyometric training, as opposed to single-mode plyometric training, led to larger performance increases on measures of physical fitness in kids. Despite only including half as much plyometric training as the single-mode programme, the combined programme produced superior sprint and shuttle run results than the single intervention plyometric programme. These results imply that inadequate or immature balancing abilities may impair the adaptations to plyometric exercise. But not every training regimen that emphasises stability has succeeded in the long run.Effects of combined balance and plyometric training in the form of plyometric training on uneven surfaces on measurements of physical fitness in pre-pubertal and pubertal young soccer players were studied in a time-efficient manner (Negra et al., 2017). Finally, it was concluded that both groups were successful in increasing strength in the lower limbs, agility, and running speed. In comparison to a plyometric training programme, the study's findings showed that circuit training programmes improved performance more.

CONCLUSION

This study found a substantial improvement in agility, running speed, lower limb strength in both the circuit training and plyometric training groups, with the circuit training group showing a highly significant outcome. Therefore, the study's findings show that circuit training might be a beneficial and effective technique in increasing various fitness components of sport players. The comparative study of circuit training and plyometric training on strength, speed, and agility in aspiring state level sport players concluded that while both groups improved significantly with respect to variables lower limb strength, agility, and running speed, the circuit training group outperformed the plyometric group for all variables at the end of the eighth week.

Conflict of interest

There is no conflict of interest about this study.

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