



PROSPECTIVE EFFECTS OF LADDER TRAINING AND CIRCUIT TRAINING ON THE STRENGTH ENDURANCE PERFORMANCE OF BOYS STUDENTS

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ABSTRACT

Objectives: To determine the prospective effects of ladder training and circuit training on the strength endurance performance of boys students. **Design:** The students were divided randomly into 3 groups' circuit training (CT; n = 15), ladder training (LT; n = 15) and control group (CG; n = 15). **Setting:** The three groups did not significantly ($p > 0.05$) after randomisation in the dependent variable. The data obtained from the subjects are analysed statistically by applying analysis covariance (ANACOVA) at a 0.05 level of significance. **Participants:** 45 boys students were chosen age: 15.9 ± 1.6 years; body height: 172.9 ± 6.3 cm; body mass: 68.37 ± 5.1 kg; BMI: 23.08 ± 2.7 to take part in the study. **Main Outcome Measures:** Abdominal strength and endurance performance were assessed using sit-ups. **Results:** The study's findings indicated that 12 weeks of circuit training increased abdominal strength and endurance performance by 48.3% and that ladder training increased abdominal strength and endurance performance by 28.4%. **Conclusions:** The circuit training method can improve abdominal strength and endurance performance.

Keywords: Strength, Endurance, Ancova, sit-ups, Abdominal power.

INTRODUCTION

Sports training, as it is commonly known, refers to the process of getting athletes ready for their best possible performance (Bompa & Carrera, 2005). Nowadays, however, sports training is more than just a concept; it is a crucial topic that impacts everyone who participates in physical activity or sports, whether for health and fitness purposes or competition at various levels (RATHOD & PAWAR, 2019). So, we may define sports training as the preparation of an athlete or player on a physical, technical, intellectual, psychological, and moral level through physical workouts (Singh, 1984).

Maintaining or increasing physical fitness depends on physical training. The physical capacity words, their activity will be more fruitful if their physical health improves (**Hendrawan Koestanto et al., 2017**). Much knowledge has been amassed in the contemporary scientific literature about the peculiarities of the growth of strength and speed in athletes of different sports over many years of training(**Phulkar, 2017**). Several publications present experimental data on the specifics of the effect of the different to carry out daily tasks depending on one's state of fitness. One's physical work efficiency increased with their level of physical fitness. In other training modes and the physiological reactions to the application of strength and speed loads (**Strelnikowa & Polevoy, 2018**). The majority of earlier studies focused on analysing how various training methods affected the adult athlete's performance variables(**Naikoo et al., 2017**). Because training today must begin at a young age to achieve in sports. Physical fitness and a balanced ratio of growth of all components of physical fitness are prerequisites for reaching a greater level of performance at any stage. It is important to build the fitness components in the beginning, while kids are still in school so that no part of fitness is neglected. Vital capacity is a measure of a person's aerobic fitness. The person's ability to function and endurance is improved by exercise(**Kaur & Goswami, 2019**)

Agility ladders are a piece of sporting equipment used for exercise and training to increase speed and agility(**Pramod & Divya, 2019**). They are set up. The perforations between the rungs and rails of the ladder form a series of spaces in which an athlete is to step, much as regular ladders where rungs are separated between opposing Groups of rails and are put out on the ground. Athletes can learn to control their centre of gravity while moving with the help of different ladder training drills that emphasize different rhythms or patterns of steps, jumps, hops, bounds, or combinations of these elements. These drills can also help athletes improve their foot speed and reaction time (**Ravi, 2023**). There are two previously mentioned agility ladders. A first-generation ladder's rails and rungs are made of nylon webbing. The Second Prior Ladder's rails are made of nylon webbing, while the rungs are made of hollow plastic tubes. To gather the ladders for storage, the rails of both ladders may be folded and their rungs collected. They have, however, proven to be quite difficult to use insofar as they twist and tangle both when they are folded for storage and when they are subsequently unfolded for usage. The previous ladders have also been observed to be readily knocked over during usage if a user steps on a rung or railing, necessitating repeated re-entry of the ladder(**Myrland, 1999**).

To sustain the perfectly timed and rhythmic motions that are essential to the exercise, ladder training calls upon the coordination of several muscle groups(Mickle et al., 2011). The ability to maintain equilibrium while executing complicated and intense directional movements is increased by the coordination of various muscle groups in the athlete(Ravindran, n.d.).The majority of human motions necessitate a constant adjustment in a posture to account for the changes in the body's centre of gravity as people go about their everyday lives. Dynamic balance, or the capacity to hold a steady stance while carrying out a task that demands movement, is what these motions are(Ricotti, 2011). In terms of preventing injuries, dynamic balance is more crucial than static balance, and it improves a child's capacity to take part in a range of activities requiring movement. Children are more likely to participate in a range of physical activities and are less likely to sustain accidents if they have superior dynamic balance(Meng et al., 2014).To assist athletes to develop quick legs, body control, and kinaesthetic awareness, trainers frequently utilize ladder workouts. Also, enhance fundamental movement abilities. A variety of ladder drills that use equipment that resembles steps on the floor are used to teach agility(Kusnanik & Rattray, 2017). Jumping with one foot or two feet is how to use this instrument. Several leg muscles are impacted by this workout. One of them has a ladder gadget he may use to boost his agility. Training with ladders helps develop balanced motion synchronization and leg agility(Nawir & Jamaluddin, 2020).

The circuit training program has become a popular fitness method in recent years(Sonchan et al., 2017).A very popular and productive method of exercising is called circuit training(Ravi, 2023). The circuit includes several exercises, usually nine to twelve, selected to improve the general muscular condition, and circulatory and respiratory response (Adamson & Morgan, 1956). In circuit training, a set number of exercises are performed in a row. Circuit training may be utilized to enhance technical and tactical components as well as conditional abilities when this circuit is done three times or more(Velmurugan & P Kulothungan, 2016).During the game, repetitive motions might make some muscles tired. Athletes must incorporate certain muscular endurance workouts into their strength training programs as a result. Stride frequency, stride length, speed endurance, and movement form efficiency all affect how fast you can run. Several aspects of running speed are influenced by a variety of physical traits, including strength, power, flexibility, and neurological systems(Myers et al., 2015). Strength training that is general, velocity-specific, and movement-specific has traditionally been used to improve sprint performance. The quantity of repetitions is a significant factor since it has been shown that the amount of loading can affect how many repetitions can be completed(Taskin, 2009).

It is well recognized that creating long-term workout plans is the most effective strategy to enhance these elements. The circuit training technique could be one of the approaches that fit these requirements(**Gopinathan, 2019**). Circuit training efficiently cuts down on training time while yet providing a sufficient amount of exercise. Also, it enables longer periods of motor engagement, which are crucial for a program's effectiveness. Also, this practice affects fitness on several levels, especially for beginners(**Mayorga-Vega et al., 2013**). For the team and the athletes individually, having a strong explosive ability is tremendously advantageous. By progressively increasing the load and intensity, training is a methodical process that is done over and over again(**Yuliandra et al., 2020**). When free or stationary weights are used in an exercise program called circuit training, the goal is to increase muscular strength, endurance, and power so that abilities can be improved(**Ravi, 2023**). Changing the load through the stations should be considered when creating circuit training units in a way that is compatible with the major muscle groups. Circuit training is a good environment for the growth of functional elements. Circuit training offers several opportunities for self-reliance and self-evaluation in this regard(**Al-Haliq, 2015**). Exercise is a physical activity that is organized, prescribed, and performed repeatedly to condition any area of the body.

Circuit training is crucial for physical recovery because it helps maintain fitness and enhance overall health. Strengthening workouts boost the body's metabolism, bone density, muscular strength and bulk. Resistance exercise can result in changes in body composition, strength, muscle hypertrophy, and motor function that many people want. Adhering to some fundamental principles is required to create the best results in these areas(**Naikoo et al., 2017**).

METHODS

An experimental approach to the problem

The investigation was done using a randomised control design. Randomly selected, 45 participants were divided into two experimental groups and one control group. Throughout the study, the control group (CG) was advised to carry on as usual while refraining from strenuous exercise. The circuit training (CT) and ladder training groups (LT) were the experimental groups. Three days each week for 12 weeks, both experimental groups underwent exercise training. Before and after the training session, the performance pre-test and post-test were administered. To prevent circadian fluctuation in performance, all of the training and performance tests took done at the

same location and time. Before the research began, participants had a four-day adaption period to get used to the training and testing process.

Subjects Testing and Training Procedure

After receiving concerns from their parents before the inquiry, 45 boys students were chosen (mean SD; age: 15.9 ± 1.6 years; body height: 172.9 ± 6.3 cm; body mass: 68.3 ± 5.1 kg; BMI: 23.08 ± 2.7) to take part in the study. Circuit training (CT; $n = 15$), ladder training (LT; $n = 15$), and control group (CG; $n = 15$) were the three groups into which the students were randomly assigned. After randomization, there was no difference between the three groups in the dependent variable ($p > 0.05$). We used a testing approach that included assessments of one particular motor quality: abdomen power performance was evaluated using a sit-ups test. This allowed us to determine the impact of circuit training and ladder training on muscular strength and endurance.

During a period of 12 weeks, both the circuit training and ladder training groups had to complete three training sessions each week on alternate days. Hence, each participant in both experimental groups receives 36 training sessions as part of the program. Each training session began with a 20-minute warm-up, which included 10 minutes of running, was followed by stretching and free-hand exercises, followed by 60-minute workouts and concluded with a 15-minute cool-down. All individuals were particularly told not to engage in any other form of exercise while the research was underway, and they were all counselled to continue eating normally.

STATISTICAL ANALYSIS

To determine the significant difference between the experimental groups and control groups on selected one dependent variable, muscular strength and endurance, the data about the variables under research have been evaluated by evaluating the variables independently. Moreover, find any differences between the groups (Control and Experimental groups) at various stages (Pre and Post-test). The descriptive statistics of Groups have been checked for pre-experimentation in one preliminary phase. Scheef's post hoc test on selected variables can be used to conclude when the analysis of covariance determines that the differences are significant. Analysis covariance (ANACOVA) is used for the data collected from the individuals in a statistical analysis with a 0.05 level of significance.

RESULTS OF THE STUDY

Table I
**Analysis of covariance for muscular strength and endurance on circuit training,
ladder training and control group students**

	CTG	LTG	CG	SOV	SS	df	M.Sq	'F'Ratio	Sig
Pretest Mean	23.07	24.00	22.40	B	19.38	2	9.689	0.63	.536
				W	642.53	4	15.298		
S.D	4.63	3.00	3.92			2			
Posttest Mean	35.07	31.67	23.87	B	989.20	2	494.6	23.08*	0.00
				W	900.00	4	21.439		
S.D	5.46	3.37	4.81			2			
Adjusted Posttest Mean	35.15	30.83	24.62	B	835.498	2	417.74	64.14	0.000
				W	267.031	4	9		
						1	6.513		

***Significant at 0.05 level**

The value for df 2, 42 at 0.05 level =3.21,and The value for df 2, 41 at 0.05 level =3.21

Table I shows that the pretest means in muscular strength and endurance of the circuit training group is 23.07, ladder training group is 24, and the control group is 22.40 and they had an 'F' ratio of 0.63, which is insignificant at 0.05 level of confidence. The posttest means of the circuit training group is 35.07, the Ladder training group is 31.67, and the control group is 23.87 and which resulted in an 'F' ratio of 23.08. It shows there is a significant difference among the posttest means at a 0.05 level of confidence. The adjusted means of the circuit training group (35.15), Ladder training group (30.83) and control group (24.62) were shown in the table. The calculated F ratio (64.14) is well above the table value. So it was significant at 0.05 level of confidence of the selected group in muscular strength and endurance.

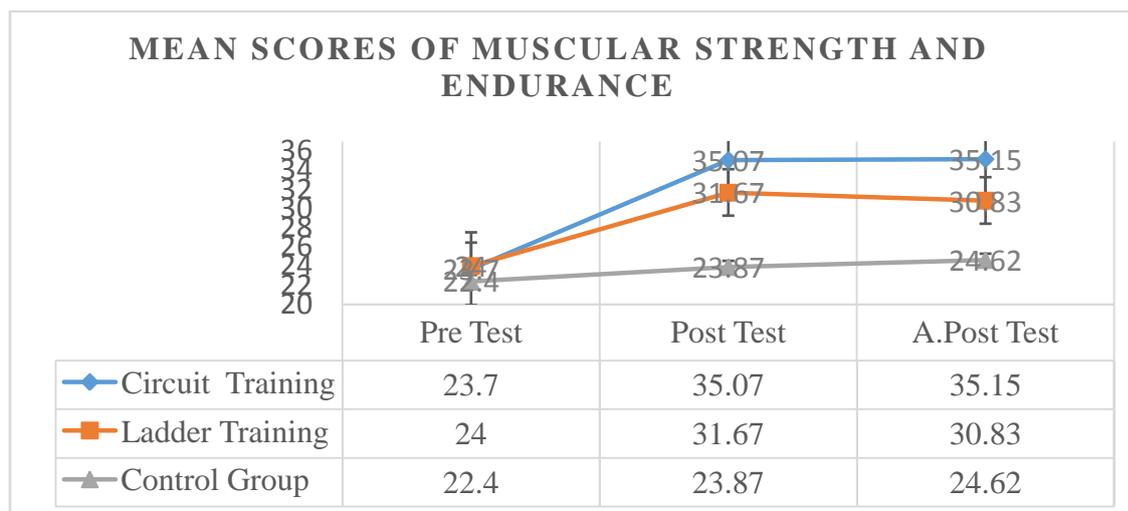


Figure I; Bar Diagram Showing the Pre, Post and Adjusted Post Test Mean of Ladder training, Circuit Training and Control group on Muscular Strength and Endurance

Table II

Scheffes post-hoc test for paired mean difference among the groups for muscular strength and endurance

Ladder Training Group	Circuit Training Group	Control Group	Mean Difference	F Value
35.15	30.83		4.32*	2.36
35.15		24.62	10.53*	
	30.83	24.62	6.21*	

***Significant at 0.05 level, Scheffe's F value 0.05 Level=2.36**

Scheffe's Post hoc test showed that there is a significant difference between the control group and Ladder training with a mean difference of 10.53, also there is a significant difference between the control group and the circuit training group with a mean difference of 6.21. There is no significant difference between the circuit training group and the ladder training group with a mean difference of 4.32. Since F Value is 2.36.

DISCUSSION

The findings of this study confirmed our assumptions that circuit training will enhance student boys' physical strength and endurance performance over ladder training approaches. The boys' students' 48.3% gain in abdominal strength and endurance after 12 weeks of circuit training

serves as evidence of the training's temporal effectiveness. Only abdominal strength and endurance improve by 28.4% when ladder training is employed after the same amount of time spent on ladder training with a typical rest period in between sets and exercises. Circuit training is a different group of exercise regimens that may be effective in developing strength and keeping athletes ready for competition (Adamson & Morgan, 1956). This kind of program comprises several "stations" when an exercise is carried out, often within a certain duration (Doffana, 2018). After finishing the exercise at one station, (Ravi, 2023) the individual quickly moves on to the next station where they complete another task within the allotted time. Once the exercises are performed at each station, the circuit is finished (Taskin, 2009). Because of the incredibly short rest periods between sets, it is necessary to reduce training intensity over successive sets to maintain repetitions within the range necessary for this training goal (Doma et al., 2013). As a result, building up a large training volume is more crucial than maintaining a high level of intensity (Gettman et al., 1978). Short rest periods combined with regular training, however, may lead to changes that enable prolonged training intensity. Exercise in a circuit that alternates upper- and lower-body movements may be the best method for boosting muscle endurance (Kraemer et al., 1987).

Several sets are preferable to single sets for developing maximum strength and endurance, according to research. Yet, the capacity to maintain a constant number of repetitions across several sets may determine whether or not maximal strength endurance increases are made. An ideal training regimen for developing muscular endurance might involve performing a series of resistance exercises, with shorter rest periods between exercises involving different muscle groups and longer rest periods between exercises involving similar muscle groups (Willardson, 2006, n.d.). A 10-week research that looked at the advantages of circuit training, which is done twice a week, discovered significant improvements in sit-up ability (Gamble et al., 1993).

The results of this study are in line with those of a study by (Mayorga-Vega et al., 2013), which discovered that circuit training can increase the strength and endurance (Chtara et al., 2008) gains made possible by circuit training, directly confirming the current study's results. According to the findings of the current study, (Dorgo et al., 2009), circuit training can be utilized to preserve and improve physical strength and endurance (Park et al., 2019). In their study, other researchers find that circuit training techniques help people of all ages build their abdominal strength. The results of the current research are strongly supported by these research papers.

It is necessary to admit that the current study has several limitations. The results of this study came from a somewhat limited sample size. Also, we did not monitor dietary intake during

the research, although we did urge individuals to maintain their regular eating patterns throughout the intervention period. Last but not least, we skipped a formal familiarization exam for the muscular endurance test. All test subjects were students, and they were all experienced with all types of muscular endurance exercise tests, it should be noted.

CONCLUSION

The circuit training method and the ladder training method are two approaches that can enhance muscular strength and endurance, as seen by the improvement in post-test data when compared to pre-test data. But in both cases, the end consequence is very different. After 12 weeks of intervention, circuit training techniques significantly outperform ladder training techniques in terms of abdominal strength and endurance.

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ETHICAL DECLARATIONS

Ethics approval and Consent Participation

The Alagappa University College of Physical Education at Alagappa University in Karaikudi, Tamil Nadu, India, authorized the project named "Prospective Effects of Ladder Training and Circuit Training on the Strength Endurance performance of Boy's Students" on December 15, 2018. The WMA Declaration of Helsinki -Ethical Guidelines for Medical Research Involving Human Subjects was followed in the creation of this paper, and all individuals provided written consent to take part in the research. Also, all procedures were carried out by the necessary rules and laws.

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