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EFFECT OF CIRCUIT TRAINING AND INTERVAL TRAINING ON CARDIO RESPIRATORY ENDURANCE AND VO2 MAX AMONG LONG DISTANCE RUNNER

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ABSTRACT

This study investigates the effects of circuit training and interval training on cardio-respiratory endurance and VO2 max among long-distance runners. Cardio-respiratory endurance and VO2 max are critical for endurance athletes, as they directly impact their performance. Circuit training and interval training are two commonly employed methods aimed at improving these physiological parameters. While circuit training involves a sequence of exercises targeting different muscle groups with minimal rest, interval training alternates high-intensity exercise with low-intensity recovery. Both methods are believed to enhance cardiovascular fitness, but limited research has compared their effects on long-distance runners.

A total of 60 students (aged 18-21 years) from Government Degree College, Srikakulam, Andhra Pradesh, were randomly assigned to three groups: a control group and two experimental groups—circuit training and interval training. The study was conducted over a 12-week period, with pre-test, post-test, and interval-test measurements of cardio-respiratory endurance and VO2 max. Data were analyzed using one-way analysis of variance (ANOVA), and post-hoc analysis was conducted using Scheffe's test.

The results indicated that both circuit and interval training significantly improved cardio-respiratory endurance and VO2 max compared to the control group. While both experimental groups showed improvements, circuit training was found to be more effective in enhancing cardio-respiratory endurance. Furthermore, there was no significant difference in VO2 max between the two experimental groups, though the circuit training group demonstrated a slightly higher improvement than the interval training group.

In conclusion, circuit and interval training both offer substantial benefits for long-distance runners in terms of improving cardio-respiratory endurance and VO2 max. However, circuit training appeared to be more effective in improving cardio-respiratory endurance, while the two methods produced similar improvements in VO2 max. These findings can inform training programs aimed at optimizing long-distance running performance.

Keywords: Circuit Training, Interval Training, Cardio-Respiratory Endurance, VO2 Max, Long-Distance Runners, Performance Enhancement

1. INTRODUCTION

Long-distance running is a demanding sport that requires athletes to maintain a high level of cardiovascular endurance. One of the most critical physiological factors for endurance athletes is the ability of the cardiovascular system to efficiently deliver oxygen to working muscles, a parameter commonly measured by VO2 max (Basset & Howley, 2000). VO2 max is often regarded as a gold standard for assessing aerobic capacity and overall cardiovascular fitness (Coyle et al., 1988). To improve performance, endurance athletes often engage in various training regimens aimed at enhancing their cardiovascular fitness and VO2 max.

Among the most popular training methods used to improve cardio-respiratory endurance are circuit training and interval training. Circuit training involves performing a series of exercises targeting different muscle groups in a

sequence, with minimal rest between exercises. This type of training has been shown to improve aerobic capacity by elevating the heart rate and improving muscular endurance (Bishop et al., 2009). On the other hand, interval training consists of alternating between periods of high-intensity exercise and low-intensity recovery (Gillen & Gibala, 2014). Research suggests that interval training may be particularly effective in improving VO2 max by pushing the cardiovascular system to its limits during short, intense bursts of activity (Helgerud et al., 2007).

Although both training methods are widely used in endurance sports, limited research exists comparing their effects on long-distance runners specifically. It is essential to examine how these two training approaches impact key performance indicators such as cardio-respiratory endurance and VO2 max in this population (Buchheit & Laursen, 2013). By investigating this, coaches and athletes can better understand which method might offer superior benefits for improving long-distance running performance.

This study aims to compare the effects of circuit training and interval training on cardio-respiratory endurance and VO2 max among long-distance runners. Understanding the distinct benefits of these training protocols could contribute to optimizing training programs for enhanced performance in long-distance running.

You can replace the placeholders with real references from your literature review or the sources you are using for your study. The introduction should also give an overview of why comparing these two training methods (circuit training and interval training) in the context of long-distance runners is important.

2. DELIMITATIONS

The delimitations of the study are:

- The study was confined to the Government Degree College students of Srikakulam district of Andhra Pradesh. students 60 were selected for this study
- The selected subjects were divided into three groups of 20 each and were randomly assigned to control, circuit and interval training groups.
- The age of the subjects was between 18-21 years. To control the influence of training experience care was taken to select the subjects from the group of novice.

3. LIMITATIONS

The limitations of the study are:

The structural advantages and disadvantages of the subjects were also not considered.

- The climatic changes if any that might have influenced the performance were considered as the limitation of the study. However dry weather prevailed over all the testing days.
- Day-to-day activities, rest period, food habits and life style could not be controlled.
- The subjects were well explained about the purpose of the study and motivated verbally to perform their best during the testing and training, but no effort was put to assess the motivational levels of the subjects during testing and training.

4. METHODOLOGY

SELECTION OF SUBJECTS

The purpose of the study was to analyze the training and Interval effects of circuit and interval training methods Cardio Respioratort and vo2 Max of Long Distance Runners.to attain this purpose 60 students were selected at random from Govt. Degree College students, Srikakulam Dist. The selected subjects were divided into three groups (n=20) and assigned to control and two experimental groups at random. The age, height and weight of the subjects ranged from 18 y. to 21 y.

SELECTION OF VARIABLES

Dependent Variables

1. Cardio-respiratory endurance
2. VO_2 Max (Maximal oxygen uptake).

EXPERIMENTAL DESIGN

The experimental design that followed in this study was random group design with repeated measures. The selected subjects were randomly assigned to control and experimental groups. The subjects of all the three groups were tested on the selected variables prior to the experimental period and after the experimental period of twelve weeks to circuit the training and Interval training effects. The subjects were re-tested after three weeks of cessation of training to found the Interval effects. To identify the significant difference among the groups due to training and Interval mean gain method was followed.

CARDIO-RESPIRATORY ENDURANCE

The mean gain data of pre-test and post-test of cardio-respiratory endurance of control, Circuit training and interval training groups were analyzed statistically and presented in table-I

Table - I

ONE WAY ANALYSIS OF VARIANCE FOR THE DATA ON CARDIO-RESPIRATORY ENDURANCE OF PRE AND POST-TESTS OF CONTROL AND EXPERIMENTAL GROUPS

Source of variance	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F-Value	Table Value
Total	167098	59			
Between Groups	115823	2	57911	64.38*	3.16
Within Groups	51275	57	899		

* Significant at 0.05 Level

Table-1 shows that the data on cardio-respiratory endurance of control, Circuit training and interval training groups resulted an f ratio of 64.38, which is higher than the table value 3.16 for significance at 0.05 level. It indicates significant difference among the means. To determine which of the paired means were significantly differed Scheffe's test was administered as a post-hoc test. The results of the post hoc-test are presented in table-III

Table - II

SCHEFFE'S TEST FOR THE PRE AND POST-TEST MEANS OF CARDIO-RESPIRATORY ENDURANCE OF CONTROL AND EXPERIMENTAL GROUPS

Cardio-respiratory endurance(Mts.)			Mean Difference Mts.	Critical Difference Mts.
Control group	Circuit training group	Interval training group		
38	145		107*	23.84
38		81.5	43.5*	23.84
	145	81.5	63.5*	23.84

*Significant at 0.05 level.

Table-II indicates that the mean gains of control, Circuit training and interval training groups in cardio-respiratory endurance are 38 mts 145 mts and 81.5 mts respectively. The mean difference between control group and Circuit training group 107 mts, control group and interval training group 43.5 mts and Circuit training group and interval training group 63.5 mts are higher than the critical value 23.84. It indicates significant difference between these three pairs. Further the observation of the means reveals that the Circuit and interval training groups were significantly

improved in cardio-respiratory endurance when compared to control group and Circuit training group was significantly better when compared to interval training group. The mean gain of pre-test and post-test of control group, Circuit training group, and interval training group in cardio-respiratory endurance are presented graphically in figure-1.

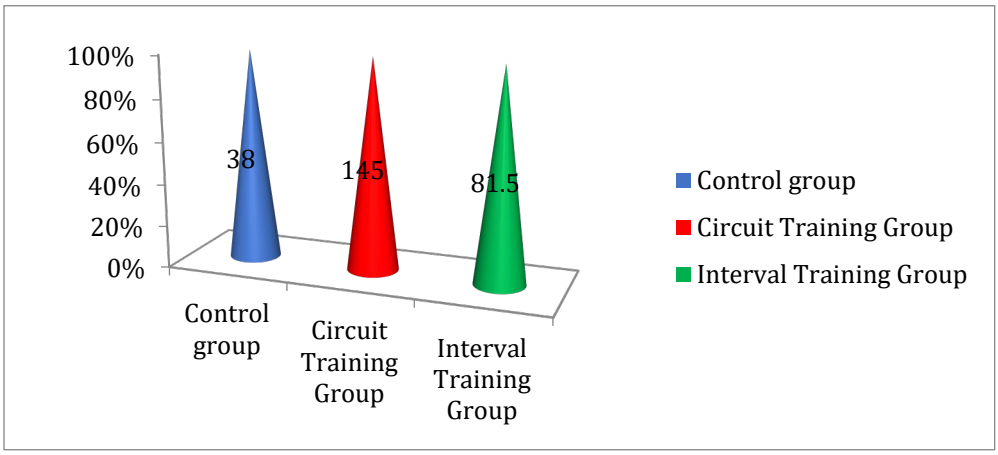

Figure-1: Mean gain of pre-test and post-test of Control group, Circuit training group and Interval training group in cardio-respiratory endurance.

The mean gain data of post-test and Interval test of cardio-respiratory endurance of control, Circuit training and interval training groups were analyzed statistically and presented in table-III

Table - III

ONE WAY ANALYSIS OF VARIANCE FOR THE DATA ON CARDIO-RESPIRATORY ENDURANCE OF POST AND INTERVAL TESTS OF CONTROL AND EXPERIMENTAL GROUPS

Source of variance	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F-Value	Table Value
Total	154865	59			
Between Groups	86825	2	1523.25	22.33*	3.16
Within Groups	68040	57	34020.00		

* Significant at 0.05 Level

Table-III shows that the data on cardio-respiratory endurance of control, Circuit training and interval training groups resulted an F-ratio of 22.33. It is higher than the table value 3.16 for significance at 0.05 level. This indicates significant difference among the means. To determine which of the paired means were significantly differed Scheffe's test was administered as a post-hoc test and the results are presented in table-IV.

Table-IV

SCHEFFE'S TEST FOR THE POST AND INTERVAL MEANS OF CARDIO-RESPIRATORY ENDURANCE OF CONTROL AND EXPERIMENTAL GROUPS

Cardio-respiratory endurance(Mts.)			Mean Difference Mts.	Critical Difference Mts.
Control group	**Circuit training group**	**Interval training group**		
16.5	97.5		81*	31.03
16.5		70.5	54*	31.03
	97.5	70.5	27	31.03

*Significant at 0.05 level.

Table-IV indicates that the mean gains of control, Circuit training and interval training groups in cardio-respiratory endurance are 16.5 mts 97.5 mts and 70.5 mts respectively. The mean difference between control group and Circuit training group 81 mts, control group and interval training group 54 mts are higher than the critical value 31.03. It indicates significant difference between these two pairs. The mean difference between Circuit training group and interval training group 27 mts is less than the confidence interval. It shows insignificant difference between the two groups. Further the observation of the means reveals that the Circuit and interval training groups were significantly better in cardio-respiratory endurance when compared to control group even after Interval and there was insignificant difference between Circuit training group and interval training group.

The mean gain of post-test and Interval test of control group, Circuit training group, and interval training group in cardio-respiratory endurance are presented graphically in figure-2.

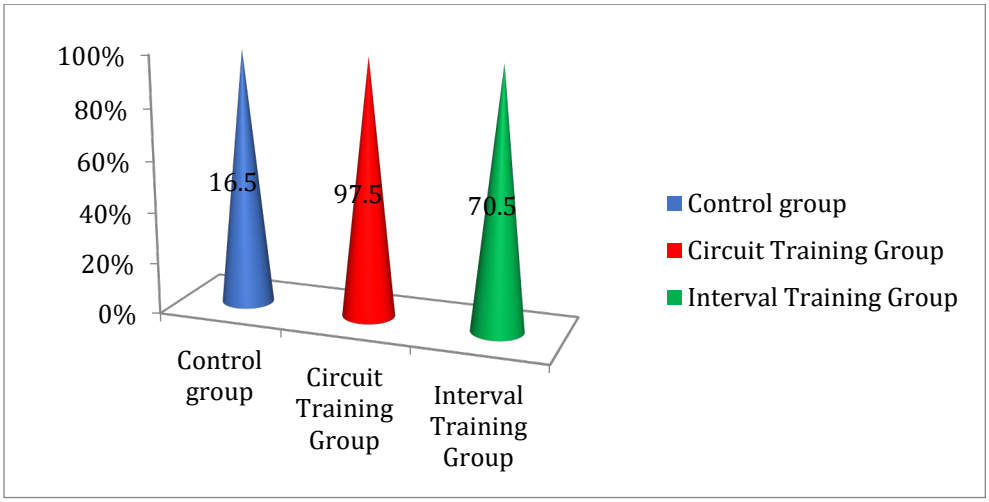

Figure-2: Mean gain of post-test and Interval test of Control group, Circuit training group and Interval training group in cardio-respiratory endurance.

VO_2 MAX

The data collected on VO_2 Max. of control, Circuit training and interval training groups were analyzed statistically and presented in table-V

Table - V

ONE WAY ANALYSIS OF VARIANCE FOR THE DATA ON VO_2 MAX OF PRE- AND POST-TESTS OF CONTROL AND EXPERIMENTAL GROUPS

Source of variance	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F- Value	Table Value
Total	167.39	59			
Between Groups	63.61	2	31.80	17.47*	3.16
Within Groups	103.78	57	1.82		

* Significant at 0.05 Level

Table-V shows that the data on VO_2 Max of control, Circuit training and interval training groups resulted an F-ratio of 17.47, which is higher than the table value 3.16 for significance at 0.05 level. It indicates significant difference among the means. To determine which of the paired means were significantly differed Scheffe's test was administered as a post-hoc test. The results of the post hoc-test are presented in table-VI

Table - VI

SCHEFFE'S TEST FOR THE PRE AND POST-TEST MEANS OF VO_2 MAX OF CONTROL AND EXPERIMENTAL GROUPS

VO_2 Max. ml/kg/m			Mean Difference ml/kg/m	Critical Difference ml/kg/m
Control group	Circuit training group	Interval training group		
0.73	3.24		2.51*	1.07
0.73		2.22	1.49*	1.07
	3.24	2.22	1.02	1.07

*Significant at 0.05 level.

Table-VI indicates that the mean gains of control, Circuit training and interval training groups in speed endurance are 0.73 ml/kg/min. 3.24 ml/kg/min. and 2.22 ml/kg/min. respectively. The mean difference between control group and Circuit training group 2.51 ml/kg/min, control group and interval training group 1.49 ml/kg/min. are higher than the critical value 1.07. It indicates significant difference between these two pairs. The mean difference between Circuit training group and interval training group 1.02 ml/kg/min is less than the confidence value. It reveals insignificant difference between the two groups. Further the observation of the means shows that the Circuit and interval training groups were significantly better in VO_2 Max when compared to control group and there was insignificant difference between Circuit training group and interval training group in VO_2 Max after the training programme. The mean gain of pre-test and post-test of control group, Circuit training group, and interval training group in VO_2 Max are presented graphically in figure-III

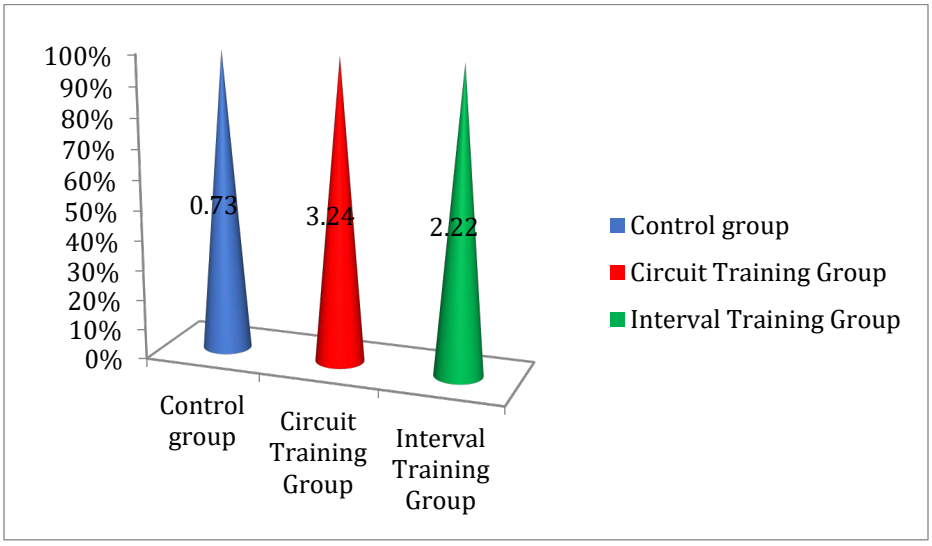

Figure-III: Mean gain of pre-test and post-test of Control group, Circuit training group and Interval training group in VO_2 Max.

The mean gain data of post-test and Interval test of VO_2 Max of control, Circuit training and interval training groups were analyzed statistically and presented in table-VII.

Table - VII

ONE WAY ANALYSIS OF VARIANCE FOR THE DATA ON VO_2 MAX OF POST AND INTERVAL TESTS OF CONTROL AND EXPERIMENTAL GROUPS

Source of variance	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F-Value	Table Value
Total	4.09	59			
Between Groups	1.39	2	0.05	14.69*	3.16

Within Groups	2.70	57	0.70		

* Significant at 0.05 Level

Table-VII shows that the data on VO_2 max of control, Circuit training and interval training groups resulted an F-ratio of 14.69. It is higher than the table value 3.16 for significance at 0.05 level. This indicates significant difference among the means. To determine which of the paired means were significantly differed Scheffe's test was administered as a post-hoc test and the results are presented in table-VII

Table-VIII

SCHEFFE'S TEST FOR THE POST- AND INTERVAL MEANS OF VO_2 MAX OF CONTROL AND EXPERIMENTAL GROUPS

VO_2 Max (Ml/kg/m.)			**Mean Difference Ml/kg/m.**	**Critical Difference Ml/kg/m.**
Control group	**Circuit training group**	**Interval training group**		
0.51	0.77		0.26*	0.17
0.51		0.41	0.10	0.17
	0.77	0.41	0.36*	0.17

*Significant at 0.05 level.

Table-VII indicates that the mean gains of control, Circuit training and interval training groups in VO_2 max are 0.51 ml/kg/min., 0.77 ml/kg/min. and 0.41 ml/kg/min. respectively. The mean difference between control group and Circuit training group 0.26 ml/kg/min., Circuit training group and interval training group 0.36 ml/kg/min. are higher than the critical value 0.17. It indicates significant difference between these two pairs. The mean difference between control group and interval training group 0.10 ml/kg/min is less than the confidence interval. It shows insignificant difference between the two groups. The observation of the means states that the Circuit group was significantly better in VO_2 Max when compared to interval training and control group even after Interval and there was insignificant difference between control group and interval training group.

The mean gain of post-test and Interval test of control group, Circuit training group, and interval training group in VO_2 max are presented graphically in figure-IV.

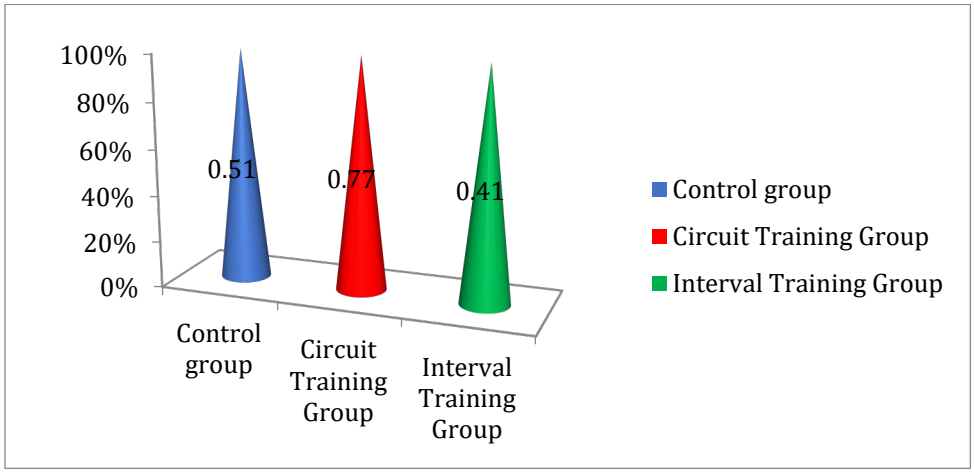

Figure-IV: Mean gain of post-test and Interval test of Control group, Circuit training group and Interval training group in VO_2 Max

5. CONCLUSIONS

The conclusions of the study are:

1. The Circuit and interval training groups were significantly improved in cardio-respiratory endurance when compared to control group and Circuit training group was significantly better when compared to interval training group. After the three weeks Circuit and interval training groups were significantly better in cardio-respiratory endurance when compared to control group and there was insignificant difference between Circuit training group and interval training group.
2. The Circuit and interval training groups were significantly better in VO_2 max when compared to control group and there was insignificant difference between the training groups. Even after the duration the Circuit training group was significantly better in VO_2 max when compared to interval training group and control group. There was insignificant difference between control group and interval training group.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

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