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Effects of high intensity interval training and continuous endurance training on cardiovascular endurance capacity in school boys

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Abstract
Background: The study was to examine the effect of High Intensity Interval Training and Continuous Endurance Training on Cardiovascular Endurance Capacity in School Boys.
Methodology: In this experimental study 45 school boys were selected randomly, from Minicoy Island, Lakshadweep, India. Age ranged between 14 to 17 years. They were simplified into three groups HIIT (n=1), CET (n=15) and control (n=15). The tool used for the purpose was Fitness gram- Pacer Test to measure Vo2 Max. The test was conducted Pre and post training programme on all the three groups. The HIIT and CET group underwent a structured training programme three times a week for twelve weeks. Analysis of Variance (ANOVA) and Scheffe's Post –hoc Test was used for analysis of the results.
Result: Following the twelve weeks of structured training programme for HIIT and CET groups' significant difference was found whereas, no significant difference was found in the control group.
Conclusion: According to the obtained results, it can be concluded that both HIIT and CET programme leads to significant improvement in Vo2 max but HIIT have relatively more effective in increase of Vo2 Max as compared to CET group.

Keywords: HIIT, CET, Vo2 Max

1. Introduction

The magnitude of health benefits provided by exercise programs depends mainly on exercise intensity and volume. It is important to know how different training intensities influence adaptations in physiological parameters when selecting an optimum training for a specific sport or for improving fitness in general community. Cardiovascular endurance has long been recognized as one of the fundamental components of health related physical fitness [1].

There is limited research targeting pre- adolescents, given the rising burden of chronic disease, it is essential to implement strategies to improve the cardio vascular endurance capacity in pre- adolescents, as this is a key stage in the development of healthy lifestyle behaviours. Based on the concept of a positive continuum of health/fitness benefits with increased exercise intensity, the old method of training applied for athletes "the interval training" had been used to improve aerobic capacity and causes metabolic adaptations in sedentary healthy individuals and recreationally active adults [2]. In recent years, it has also been used as an effective method to improve functional capacity, cardiac function and peripheral muscular adaptation in general community. More important is the fact that low cardio vascular fitness, one common condition in sedentary pre-adolescent, is associated with an increased prevalence of cardiovascular disease risk factors and death risk [3].

Despite the promising evidence supporting positive effects of high-intensity interval training (HIIT) on the cardio vascular endurance capacity in pre-adolescent [4]. Methodological inconsistencies confound our ability to draw conclusions; however, there is meaningful evidence supporting HIIT as a potentially efficacious exercise modality for use in the pre-adolescent cohort. Some studies have shown that this technique could be superior in comparison with endurance training for improving long-term effects of exercise on cardiovascular system High-intensity interval training (HIIT) consists of alternating periods of intensive aerobic exercise with periods of passive or active moderate/mild intensity recovery [5]. Many people already know about the health benefits of endurance training and try to establish it as a part of daily life. Nevertheless, working people fail to perform training regularly mainly due to a lack of time [6]. Moreover, the time commitment for most High-Intensity interval training (HIIT) programmes is considerably lower than that traditionally prescribed Continuous endurance training (CET) programmes [7]. The variation provided by this method could contribute to motivate the subjects and increase the adherence to the program. However, there are many ways of prescribing this model of training according to literature that make it difficult to reach one consensus about the methodology and real effects of it. The differences in physiological response to exercise bouts of continuous nature and interval exercise schedule [8] have suggested that these exercise types may provide specific stimuli to selectively elicit certain adaptations. For example in increasing the cardiovascular endurance capacity, HIIT may be more effective than CET.

Therefore, the objective of the research was to examine the effects of various HIIT and CET protocols to determine the optimum strategy to deliver cardio vascular health benefits. And also the scope for research to examine the palatability of HIIT and CET as an exercise modality for pre-adolescents

through investigating perceived enjoyment during and after, and consequent long-term exercise adherence.

2. Methodology

2.1 Subjects

To achieve these purpose 45 school boys were selected randomly, from Minicoy Island, Lakshadweep, India. The participant age ranged between 13 and 15 years. They were simplified into three groups. Each group consist of 15participants, which were assumed to be appropriate for the purpose of the study. The experimental treatment assigned as continuous endurance training and High intensity interval training to the two experimental groups.

2.2 Study Design

The experimental design used for this study was formulated as random group design involving forty five subjects, who were divided randomly into three groups of fifteen each. They were be simplified into three group's namely experimental group I, experimental group II and control group. Each group consist of 15 students each, which are assured to be large enough for the purpose of the study. The experimental treatment continuous endurance training and High intensity interval training were assigned as experimental group I and experimental group II respectively, which were stipulated for 12 weeks (3 alternate days per week) they participated in the research voluntarily and cheerfully without any compulsion. Control group did not follow any structure training. All the subjects were tested prior and after the experimental treatment periods on cardio vascular endurance capacity.

2.3 Training Program

Subjects performed three training sessions per week over a 12 week period (36 sessions). The duration of the initial training session was 30 min. All subjects performed a gradual 10 minute warm up and 10 minute cool-down prior to and following the High intensity interval training and continuous endurance training. CET comprised 30 min continuous running at moderate intensity and HIIT followed the training regimen with 2:1 ratio i.e. workout: recovery.

2.4 Measurements

The PACER (Progressive Aerobic Cardiovascular Endurance Run) is the default aerobic capacity test in Fitness gram. The PACER is a multistage fitness test adapted from the 20-meter shuttle run test published by (Leger and Lambert, 1982) [9]. The test is progressive in intensity. It is easy at the beginning and gets more difficult at the end. The progressive nature of the test provides a built-in warm-up and helps children to pace themselves. The test has also been set to music to create a valid, fun alternative to the customary distance run test for measuring aerobic capacity. In the PACER test, a lap is one 20-meter distance (from one end to the other). The scorer records the lap number (crossing off each lap number) on a PACER score sheet. The recorded score is the total number of laps completed by the student.

2.5 Data analysis

The analysis of variance (ANOVA) was used to analyse the significant difference if any, between the groups on each selected variables separately. The confidence interval was fixed at $P<0.05$ in all cases.

3. Results

The analysis in table 1 showed after checking the pre-test and post-test difference using a one way ANOVA. The pre-test mean score of cardio vascular endurance of high intensity interval training, continuous endurance training and control groups are 44.93, 45.33 and 43.46 respectively. Since the obtained 'F' ratio is 0.125 is lesser than the table value 3.22 at 0.05 level of significance for 2 and 42 degrees of freedom. It is evident that there is no significant difference exists among the three groups in the pre-test group testing.

The post-test mean score and standard deviation of training groups (i.e.) high intensity interval training, continuous endurance training and control groups are 56.46, 53.53 and 45.86 respectively. Since the calculated 'F' ratio 4.21 is higher than the table value 3.22 at 0.05 level of significance for 2 and 42 degrees of freedom. Based on the initial and final score, it is found that there is significant difference exists among the three groups on cardio vascular endurance capacity.

Table 1: Analysis of Variance for the two experimental groups and the control group in Cardio Vascular Endurance Capacity

	HIIT	CET	Control	S O V	Sum of squares	df	Mean squares	'F' ratio	Sig.
Pre-test Mean SD	44.93	45.33	43.46	B	28.97	2	14.48	0.12	0.880
	7.42	13.49	10.50	W	4864.00	42	115.81		
Post-test Mean SD	56.46	53.53	45.86	B	898.71	2	449.35	4.21	0.021*
	6.86	13.29	9.80	W	4479.20	42	106.64		

*p < 0.05

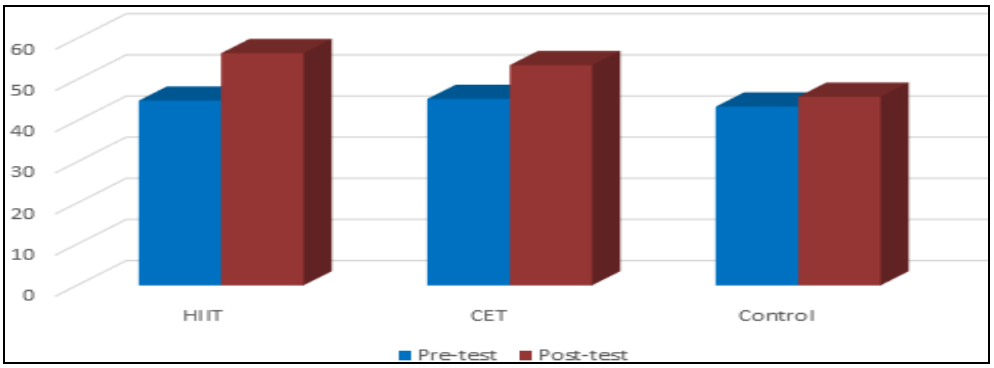

Fig 1: Mean Pre-test and Post-test scores of Cardio Vascular Endurance Capacity

4. Discussion

In this study, a sample of 15 pre- adolescent schools boys took part in HIIT, 15 school boys in CET and 15 were control who was the part of 12-weeks programme. Participants involved in HIIT and CET reported significant improvement on Vo2 max. Moreover, HIIT prove more effective in increasing the relative peak oxygen uptake (Hottenrott *et al.* 2012) [10]. (Helgerud *et al.* 2007) [11] expressed that high aerobic intensity training group expressed absolute Vo2 max compared to long slow distance running and lactate threshold running and significant increase in the stoke volume in high aerobic intensity training while no change was found in both the later groups. Likewise, it was also partially found that aerobic capacity increased by 7.27% in HIIT while 0.86% of change was observed in control group (Prasana, 2014**)** [12]. The principal interest lies in the fact that it offers the possibility to maintain high-intensity exercise for far longer periods than during continuous exercise [13, 14]. Therefore, HIIT elicits a greater training stimulus, which further improves maximal aerobic capacity [15].

5. Conclusions

The results of the present study indicate that high-intensity interval training as well as continuous endurance training led to significant improvements in cardiovascular endurance with less than 2 h 30 min training weekly. Additionally, high-intensity training proved more effective in increasing cardiovascular endurance, both training methods seem to promote health. Although, the pre-adolescent can choose to perform either continuous endurance running or high intensity training along with their additional activity sessions to enhance their aerobic fitness, sport specific performance and general health.

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