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Effect of circuit training on cardiovascular endurance

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Abstract
The purpose of the current study was to determine the effect of circuit training on the cardiovascular endurance. Fifteen male athlete of age group 16-18, from "SAI- Kailash Prkash Stadium Meerut" were randomly selected for a 8 week circuit training programme which was 5 days a week. The selected dependent variable was the performance of participants in Harvard step up test. Pre- and post-test data was collected, on basis which paired sample t-test was applied to identify difference between the groups. The level of significance was set at 0.05. A Significant differences was seen in the pre-post data as the p value obtained (0.028) was less than $p<0.05$.

Keywords: circuit training, cardiovascular endurance

Introduction
Physical fitness is a general state of health and well-being and, more specifically, the ability to perform in sports. Physical fitness is generally achieved through correct nutrition, exercise, hygiene and rest. It is a set of qualities or characteristics, seen in the people and which can be relate to the ability to perform a given set of physical activities. Fitness is the capacity to carry out the day's activities without undue fatigue. However with mechanism and changes in lifestyle as physical fitness is now considered a measure of the body's ability to function efficiently and effectively in work and leisure activities, to be healthy, to resist hypokinetic diseases, and to meet emergency situations. Physical activity relates to any movement produced by the individual's skeletal muscles that results in energy expenditure (Caspersen CJ, 1985). Physical fitness is a set of traits of a person has or achieved, which is linked to the person's capability to do physical activity. Fitness is divided into health and skill related components, with the health component further consists of cardiorespiratory endurance, muscular endurance, muscular strength, and flexibility. An individual is considered to be fit for a particular task or activity when he can accomplish it with a reasonable degree of efficiency without excessive fatigue and with rapid recovery from the effect of exertion. Physiological fitness implies the capacity for skilful performance and rapid recovery. Physiological effort is estimated from the magnitude of the heart rate change during exercise and from the quick return of the heart rate to normal. Over the past two decades cardiovascular fitness, i.e. the efficiency of the cardiovascular systems, has been the subject of a very large number of studies involving endurance-trained athletes. It is quite evident that endurance in sport is closely tied to the execution of skill and technique. An elite athlete can be defined as, the athlete who executes his or her technique consistently and effectively with the least effort (Yessis, 2008).

Objectives of the study
1. To find out the effect of circuit training on cardiovascular endurance of "SAI- Kailash Prkash Stadium Meerut".

Selection of Subjects
The subjects for this study were selected from "SAI- Kailash Prkash Stadium Meerut" fifteen male athletes, who had participated in various state level competitions ranged from 16-18 years of age, were selected for the experimental program utilizing the purposive random sampling technique.

Selection of Variables
Keeping in mind the feasibility criteria and specific purpose of the study. *Cardiovascular endurance* was analysed by the Harvard step up test performance and recorded as fitness index score.

Experimental Design
Pre-test and post-test randomized group design was employed in this study. The initial test was conducted, followed by 8-weeks of selected training program. After completion of the experimental period, the final test was conducted.

Analysis of Data
Statistical analysis was done using paired sample t test. The level of significance was set at 0.05 percent.

Findings
In order to determine the significance difference between the pre-tests and post test scores were collected. The initial and final test scores were analysed manually using t-test. The results of the study are presented in tables and figure for selected parameter of cardiovascular endurance are shown.

Table 1: Descriptive Statistics showing pre-test Mean and Standard Deviation of fitness index score of selected subjects

Group Statistics					
	pre test	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
cardiovascular endurance	Pre-test data	15	60.86	6.49	1.18

Table 1 reveals that the Mean and Standard Deviation of pre-test conducted to obtain fitness index score with the help of Harvard Step up test, for assessment of cardiovascular endurance of subjects are 60.86 and 6.49 respectively.

Table 2: Descriptive Statistics showing post-test Mean and Standard Deviation of fitness index score of selected subjects

Group Statistics					
	post test	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
cardiovascular endurance	post test data	15	64.26	5.08	.92

Table 2demonstrates the Mean and Standard Deviation as 64.26 and 5.08 respectively for the post test. Harvard step test was conducted again after completion of circuit training program on the same group to collect post experiment fitness index score. For checking significant differences between both the obtained mean (pre-test and post-test) t-test was employed.

Table 3: Table showing significance of difference obtained with the help of t-test, Along with mean difference and standard error difference

t-test for Equality of Means					
	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
cardiovascular endurance	-2.258	58	.028	-3.40000	1.50605

Table 3shows the calculated p value is 0.028 a significant difference found in the means of pre-test and post-test fitness index score, as p>0.05. So, it may me concluded that the circuit training plan implemented on young athletes was effective in developing cardiovascular endurance.

Descriptive statistics showing mean and standard deviation for pre-test and post-test of subjects is illustrated below with the help of a bar diagram for the better understanding of differences in mean.

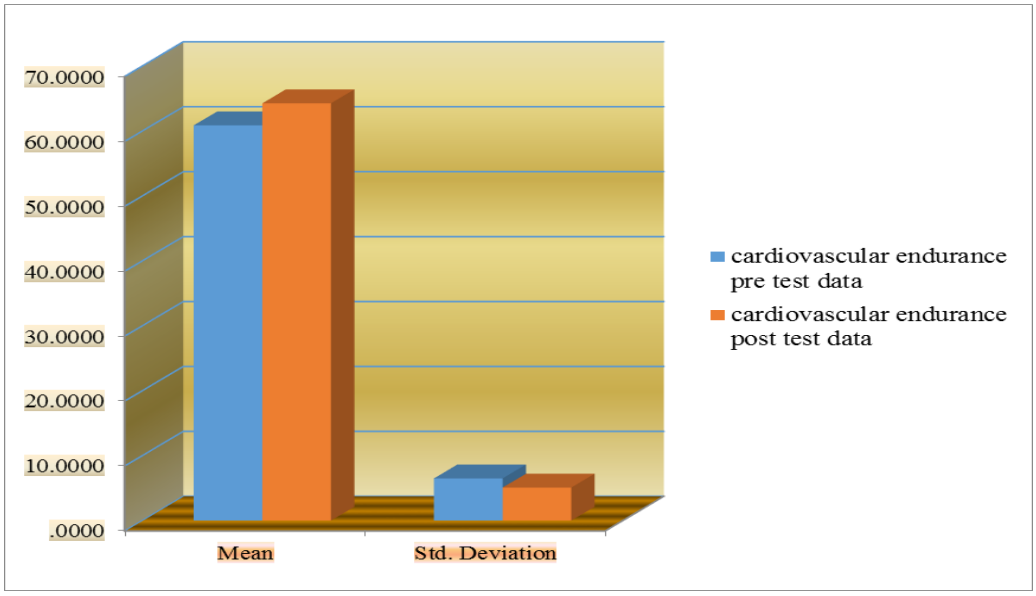

Fig 1: Bar Diagram showing Descriptive Statistics of Mean of Pre-test and post-test Harvard step up test scores.

Result and discussion

Harvard step up test is one of the best mean to assess the cardiovascular endurance of athletes. The analysis of data revealed that the mean of pre- test data which was taken before the 8 week circuit training program is less than the mean of post test data which was taken after athletes have completed 8 week training program. It clearly describes that fitness index score of the athletes has increased which means improvement in their cardiovascular endurance. But weather the changes or differences of significant paired sample t- test was used, where the result showed the significant differences between pre-test and post-test means. These significant differences were due to effectively planned and executed circuit training program, so it can be stated that 8 weeks of circuit training program can enhance the cardiovascular endurance of athletes. Similar type of results were obtained by Simmons (1967)when he conducted a research on the effect of circuit training upon cardio vascular condition and motor performance showing statistically significant mean improvement in nine to fourteen cardiovascular variables and in all thirteen motor fitness variables.

Conclusion & Recommendations

On the basis of findings of the study, the following conclusions& recommendations were drawn:

1. The Circuit training program is useful to improve the cardiovascular endurance.
2. The effect of circuit Training programme on improvement of performance can also be performed.
3. Various other training programmes can be compared to circuit training programme to access the best suitable training programme for improvement of cardiovascular endurance.
4. This training program can be recommended for young budding Athletes.

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