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Effect of Intensive Interval Training on Red Blood Corpuscles and Cardiovascular Endurance

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Abstract. The purpose of the present study was to investigate the effect of intensive interval training on the nature of red blood corpuscles count and cardiovascular endurance. Interval training stresses not only the energy system but the muscular system also. To fulfil the objectives of the study, fifty students from the Department of Physical Education, Lovely Professional University, Punjab were selected to act as subjects. They were divided into two groups of twenty five each i.e. control and experimental group. Data was collected prior and after twelve weeks of training. Comparison of pre-test and post-test training data was done with the application of t-test. Statistically insignificant difference was found between the pre and post-test count of RBC's whereas statistically significant difference was observed between pre-test and post-test data of cardiovascular endurance after twelve weeks of intensive interval training.

Key words: Intensive interval training, red blood corpuscles and cardiovascular endurance.

1. Introduction

Interval training is widely used in the field of sports training and consists of repetitions followed by the rest intervals with complete or incomplete recovery depending upon the aim of the sports training. Since the recovery periods provide time for physiological adaptation, their duration is a very important part of interval training. A very short recovery period may not allow the body to recover sufficiently to perform the next work interval at the desired intensity. On the other hand, a very long recovery period may allow the body to recover too much and some of the training effect would be lost. The duration of the recovery period depends on the length of the work interval and the specific energy system that is being trained. During the process of sports training, there is a change in one or the other biomotor or physiological variables of an athlete. Interval training can be an effective means of enhancing an athlete's lactate threshold - i.e. increase the threshold at which lactate starts to accumulate in the blood. Lactate threshold has been shown to be a significant factor determining performance for long distance running events. One of the studies done in Canada at Mc Master University is often referenced as the Gibala study after lead researcher Martin Gibala. The Gibala study compared 20 minutes of high intensity interval training, consisting of a 30 second sprint followed by a four minute rest, with 90 to 120 minutes in the target heart rate zone. The results have shown that subjects got the same improvement in oxygen utilization from both programs. What is amazing is that the 20 minute program only requires about two minutes and 30 seconds of actual work. These changes can be known through various tests meant to measure different variables. In the present study, the effects of Intensive interval training were recorded by analyzing blood test and recording the cardiovascular endurance in meters by using twelve minutes run and walk test. Red blood corpuscles perform an important duty. Red blood cells are named so because RBC's contain protein chemical called haemoglobin which is bright red in colour. Haemoglobin has affinity to iron which makes it a good agent for carrying oxygen. This characteristics of RBC's helps in performing the activities for long duration even after fatigue. Therefore, this study will be useful in highlighting the effects of interval training on physiological variable and cardiovascular endurance of athletes. Shenbaganvalli (2007) concluded in his study that ten weeks of intensive training programme had significantly increased the physical and physiological fitness of school girls. Brar (1985) studied twelve weeks of comparative effects of circuit training and interval training on selected physiological measurements and running performance of females, and concluded that circuit training and interval training methods are effective in improving the speed and endurance of athletes.

Manna, Indranil, Khanna, Lal G., Dhara & Chandra P. (2010) studied the effect of training on selected physiological and biochemical variables of Indian soccer players of different age groups. The training sessions were divided into 2 phases (a) Preparatory Phase (PP, 8 weeks) and (b) Competitive Phase (CP, 4 weeks). The training program consisted of aerobic, anaerobic and skill development, and were completed 4 hrs/day; 5 days/week. No significant change was found in body mass and maximal heart rate of the players after the training program. This study would provide useful information for training and selection of soccer players of different age groups.

Lamina, S. (March 2011) investigated the effect of interval and continuous training program on blood pressure and serum uric acid (SUA) levels in subjects with hypertension. The interval (work: rest ratio of 1:1) and continuous groups were involved in an 8-week interval and continuous training program of 45-60 minutes, at intensities of 60-79% of heart rate maximum. It was concluded that both moderate-intensity interval and continuous training programs were effective and neither seems superior to the other in the non-pharmacological management of hypertension.

Selection of Subjects: After the prior consent from the subjects, the total fifty (N=50) male subjects were selected from Department of Physical Education, Lovely Professional University, Phagwara, Punjab. They were randomly divided into two groups i.e. twenty five (N=25) in experimental group and twenty five (N=25) in control group. The age of subjects was ranged between eighteen to twenty five years.

Administration of Training Programme (Treatment): The time for each run, the number of repetitions and duration of rest phase were fixed after conducting a pilot study for two weeks with ten subjects who were selected randomly amongst the sample of fifty subjects. Training schedule was prepared by the investigator after thorough discussion with the experts and coaches. Training programme was based on the interval training principles and treatment was intensive in nature.

Intensity was calculated by taking out maximum and by calculating training heart rate. Formulas by which intensity of the subjects were calculated is given as under:-

For example 60- 80 percent intensity of an athlete is to be calculated, by using Karvonen formula.

Target Heart Rate= ((maximum heart rate – resting heart rate) x % intensity) + resting heart rate, maximum heart rate can be taken as 220.

If an athlete having the age of 20 years with 70 beats per minute as a resting heart rate, to calculate training heart with 60%-80% intensity consider the following example:-

Athlete's minimum heart rate will be

220 – 20 (Age) =200

200 – 70 (resting heart rate) = 130

130 x .60 (minimum intensity) + 70 (Resting heart rate) = 148 beats per minute.

Athlete's maximum training heart rate will be

220 – 20 (age) = 200

200 – 70 (resting heart rate) = 130

130 x .80 (maximum intensity) + 70 (resting heart rate) = 174

Athlete's training heart rate zone will be 148 – 174 beats per minute. (Karvonen Formula)

Table 1

Method	**Intensity**	**Recovery**
Intensive	80% - 90%	90sec – 180sec

In table 1 method, intensity and recovery were fixed after discussion with the experts, coaches and after studying Science of Sports Training book written by Singh 1993.

2. Methods

1) **Collection of blood samples for the analysis of Red Blood Cells:** To measure RBC's count, assistance of department of Pharmacy was taken. Blood samples were collected (before the meal) by the experts. Prior to collection of blood samples, subjects were asked to lay down on the bed for ten minutes for proper rest.

Figure 1 above shows the subjects giving blood samples for analysis.

2) 12 minute run / walk for cardiovascular endurance

Objective: to assess cardiovascular endurance.

Figure 2 above shows the subjects competing in 12 minutes run /walk test.

Procedure: Subjects were asked to run/walk for twelve minutes after the command "Go". Participants ran for 12 minutes, and the total distance covered was recorded. Walking was allowed, though the participants were encouraged to push themselves as hard as they could.

Scoring: Total distance covered in meters by the subjects was considered as the final score.

Experimental Design: Pre and post- test design was used by the investigator to find out the differences. Experimental group was given twelve weeks training for three sessions per week during evening hours from 4.30pm to 6.30pm whereas the control group has taken part in their daily routine activities. Sunday remained as the rest day for both the groups. Subjects were trained for two weeks to make them familiarized with the testing procedures and the task ahead, which was to be given to the subjects for the next twelve weeks. A copy of twelve weeks training schedule was also handed over to the subjects during the familiarization of the testing procedures of the subjects.

3. Results

Table 3 presents results regarding Intensive interval training (experimental group) and Control group on Red blood cells. The pre-test mean score of Intensive interval training group was 5.36 whereas post-test mean score was recorded as 5.46 with mean difference of 0.09. The pre-test and post-test SD values were 0.63 and 0.64 respectively whereas SEDM value of Intensive interval training group was found 0.18. The t-value 0.51 was not found to be statistically significant as obtained t-value was found lesser than the tabulated value 2.06 required to be significant at 0.05 level of confidence with degree of freedom=24.

The pre-test mean score of Control group was 4.73. However, post-test mean score was also recorded as 4.73 with zero mean difference. The pre-test and post-test SD values were 0.58 and 0.56 respectively

whereas SEDM value of Control group was found 0.16. The t-value 0.00 was not found to be statistically significant as obtained t-value was found smaller than the tabulated value 2.06 required to be significant at 0.05 level of confidence with degree of freedom=24.

Table 3 Differences between Pre-test and Post- test mean scores of Intensive interval training and control groups regarding RBC's

Groups		MEAN	SD	DM	SEDM	T-Value
Intensive Interval Group	**Pre-Test**	5.36	0.63	0.09	0.18	0.51
	Post-Test	5.46	0.64			
Control Group	**Pre-Test**	4.73	0.58	0	0.16	0
	Post-Test	4.73	0.56			

* significant at .05 level t > 2.06 (df=24) N=25

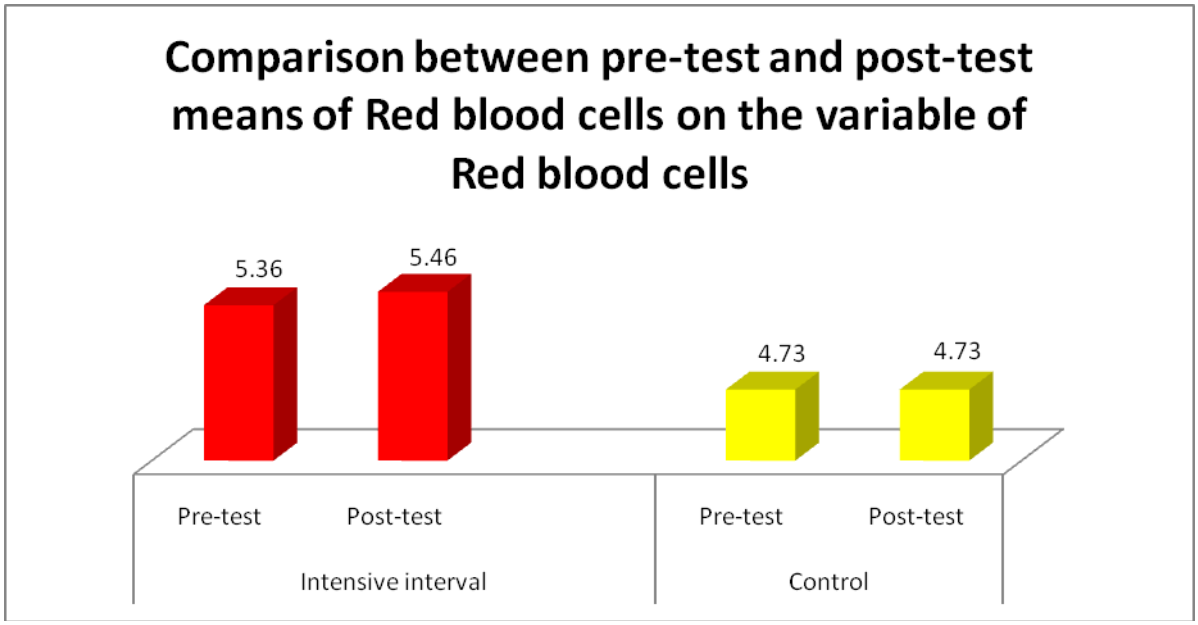

Figure 3 represents the comparison of pre-test and post-test means of both the groups regarding Red blood cells.

4. Discussion

It is evident from table 2 that there has been insignificant difference between pre-test and post-test mean scores of intensive interval group. A microscopic look at mean values with regard to intensive interval group shows that there has been an improvement though not found statistically significant. However, the mean difference of Control group was found zero with no significant difference as obtained t-value was found zero which indicates that there is no change in numbers of RBC's of male subjects in Control group.

The findings of the study with regards to the Intensive interval training confirms the results of the study conducted by Katz Abram et al. (1984) who examined the effect of intensive interval training on Erythrocyte (RBC's) 2,3-diphosphoglycerate (2,3-DPG) levels at rest and after maximal exercise and concluded that training caused no significant differences in Erythrocytes. Another study conducted by Elliott et al. (2002) studied the effects of eight weeks of low intensity resistance training and eight weeks of detraining on muscle strength and blood lipid profiles and described that eight weeks of training did not result in any significant alterations in blood lipid profiles, body composition, or dynamic isokinetic leg strength. No significant differences were found in any of the variables investigated over the 16 week period in the control group. However, the above results suggested that a short, low intensity resistance training programme produces substantial improvements in muscle strength. Training with such intensity and duration was not sufficient to produce significant alterations in blood lipid concentrations. Since insignificant difference was

found on the physiological variable *(RBC's count)* of the athletes and might be attributed to the fact that there were less number of training hours in a week. Further studies may be carried out by varying training schedules.

Table 4 Significance of difference between pre-test and post-test mean scores of Intensive interval training and control group on the variable of Cardiovascular Endurance

Groups		MEAN	SD	DM	SEDM	t-value
Intensive interval group	**Pre-test**	2343.8	409.09	239.6	110.88	2.16*
	Post-test	2583.4	374.2			
Control group	**Pre-test**	2382.4	353.92	9	95.45	0.09
	Post-test	2391.4	320.14			

* significant at .05 level. t > 2.06 (df=24) N=25

Table 4 presents the results regarding Intensive interval training and Control group on the variable of cardiovascular endurance. The pre-test mean score of Intensive interval training (experimental group) was 2343.80 whereas post-test mean score was recorded as 2583.40 with mean difference of 239.60. The pre-test and post-test SD values were 409.09 and 374.20 respectively whereas SEDM value of Intensive interval training group was 110.88. The t-value 2.16 was found to be statistically significant as obtained t-value was found greater than the tabulated value 2.06 required to be significant at 0.05 level of confidence with degree of freedom=24.

The pre-test mean score of Control group was 2382.40. However, post-test mean score was recorded as 2391.40 with mean difference of 9.00. The pre-test and post-test SD values were 353.92 and 320.14 respectively whereas SEDM value of Control group was found 95.45. The t-value 0.09 was not found to be statistically significant as obtained t-value was found lesser than the tabulated value 2.06 required to be significant at 0.05 level of confidence with degree of freedom=24.

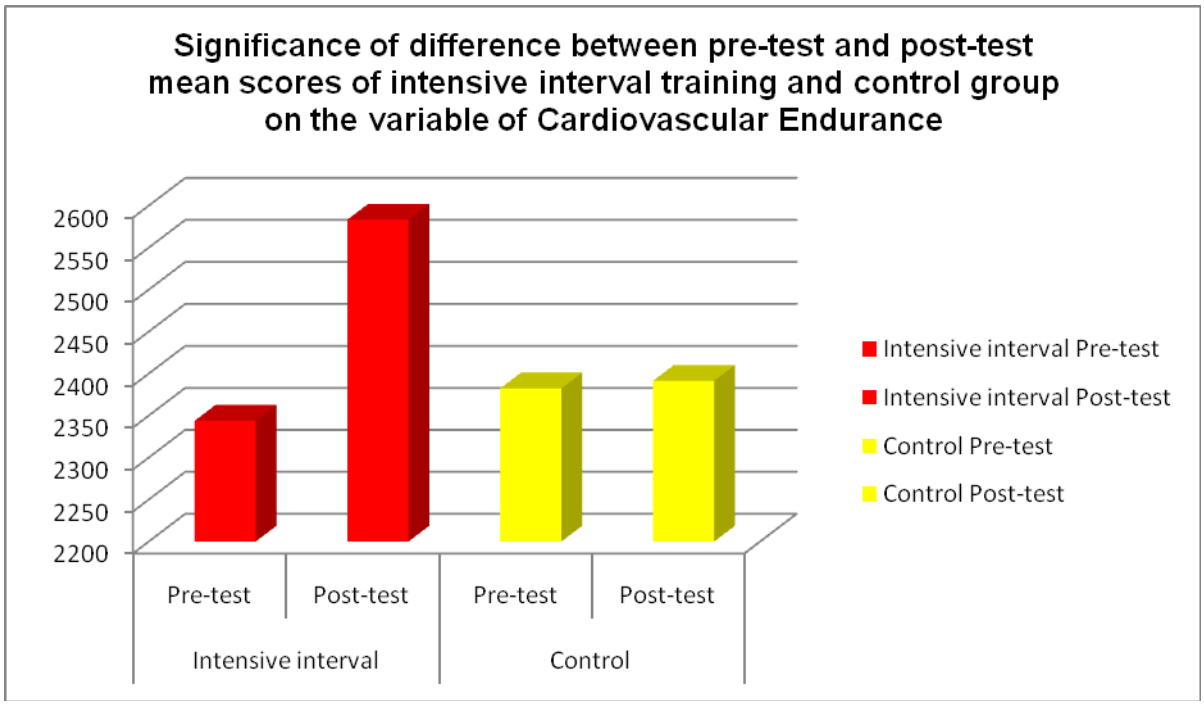

Figure 4 the comparison of pre-test and post-test means of both the groups regarding the variable Cardiovascular Endurance.

It has been observed from table 4 above that significant differences found between pre-test and post-test mean scores of Intensive interval training group on the variable of cardiovascular endurance as the obtained

t-value of 2.16 was found significantly higher than the tabulated value 2.06 required to be significant at 0.05 level of confidence. It can be safely surmised that Intensive interval training was effective in improving the cardiovascular performance of male subjects. The results with regard to Control group have shown almost negligible improvement in cardiovascular endurance as no significant difference has been observed. The findings of the present study were similar to Finn Christian (2001) who concluded in his study on Effects of High-Intensity Intermittent Training on Endurance Performance that high-intensity intermittent training was a form of interval training consisting of short bouts of all-out activity separated by rest periods between 20 seconds and 5 minutes. It was a low-volume strategy for producing gains in aerobic power and endurance normally associated with longer training bouts and found significant gain in endurance run. Another study conducted by Burke et al. (1994) supports the results of present study in which they concluded that both formats of high intensity aerobic interval-training produce similar changes in Vo2max. Millan *(*2005) who summarized that large improvements in oxygen uptake have been shown using interval running has also supported the findings of the present study.

5. Conclusions

On the basis of above findings following conclusions have been drawn:

Significant differences were not found with regard to intensive interval training (experimental group) and control group on the variable of Red blood corpuscles.

Significant difference has been observed with regard to intensive interval training (experimental group) whereas no significant difference was found with regard to control group on the variable of cardiovascular endurance.

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