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RESEARCH ARTICLE

Effect of High Intensity Interval Training on Malondialdehyde And Aerobic Capacity of Male Physical Education Students

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ABSTRACT

The purpose of this study is to find out the efficiency of high intensity interval training on malondialdehyde (MDA) and aerobic capacity of male physical education students. To achieve the purpose thirty (30) male physical education students were selected from Swami Vivekanand Subharti University, Department of Physical Education, Meerut, Utter Pradesh. These subjects were tested on malondialdehyde (MDA) and aerobic capacity before and after eight weeks of high intensity interval training (HIIT). The mean maximal aerobic speed 4.21 m/s was used as a criterion velocity to set running paces for high-intensity interval training. Statistical technique used in the present study was ANCOVA for malondialdehyde and aerobic capacity. The result of the study revealed that eight weeks of high intensity interval training resulted in 8.20% of improvement in aerobic capacity ($F_{(1,27)}$ =108.04, $p < 0.05$), however lipid peroxidation ($F_{(1,27)}$ = 5.47, $p < 0.05$) was reduced by 26.53%. It is concluded that high intensity interval training for eight weeks resulted in improvement of aerobic capacity and reduction in lipid peroxidation for selected male physical education students

INTRODUCTION

To be human is to possess endurance. It's built into our genes. One of the primary ways we've survived as a species is thanks to the role endurance has played in our own evolution. With bipedal and upright posture, feet designed for walking instead of climbing and hanging from tree branches, and the ability to generously sweat, which prevents the body from overheating, early humans were able to travel long distances without fatigue, heat exhaustion, or injury. The search for food or water could lead to newer life-sustaining environments many miles away. If, over the course of several million years, natural selection has given us the gift of endurance.

Today a physical education student requires high level of general and specific fitness. The diversity of efforts requires comprehensive preparation in terms of endurance, speed, flexibility, power and strength. The energy required for sports participation of the students derives from both aerobic and anaerobic processes. Good levels of general fitness, as well as a high aerobic and anaerobic capacity, form the foundation for success in intermittent sports. Several games which possess aerobic energy system as predominant one and anaerobic energy system which is also essential to perform sprints, high-intensity runs, and duel plays, all of which may contribute to the performance in the game and health. It has been shown that traditional endurance training improves aerobic capacity. Physiological adaptations from training, resulting from an increase in mitochondrial density, include changes in skeletal muscle substrate utilization and improved respiratory control sensitivity (Holloszy and Coyle, 1984). High-intensity interval training (HIIT) is a time-efficient way to induce similar adaptations, such as increased maximal mitochondrial enzyme activity (Burgomaster *et al*. 2005) and a reduction in glycogen utilization and lactate accumulation (Harmer *et al.* 2000; Burgomaster *et al*. 2006). In addition, HIIT may be more effective than conventional endurance training at improving muscle buffering capacity (Weston *et al*. 1997; Edge, Bishop and Goodman, 2006). HIIT consists of repeated bouts of short to moderate duration exercise completed at intensities greater than the anaerobic threshold, interspersed with brief periods of low-intensity or passive rest. HIIT is designed to repeatedly stress the body, physiologically, resulting in chronic adaptations and improving metabolic and energy efficiency (Laursen *et al*. 2005; Jenkins and Quigley 1993). Helgerud *et al*. (2007) found that HIIT significantly augmented maximal oxygen consumption (VO_2 max) and time to exhaustion (TTE) greater than a traditional training program with moderately-trained males.

During sports training athletes are continously exposed to various kind of stress. Adaptations to stress occur on numerous levels: from adaptations on subcellular, cellular and tissue level, to adaptations of organs and the whole organism of an athlete. Adaptations to stressors, i.e., structural and functional changes, enable improvement to occur in an athlete's sports performance. However, under physiological conditions, approximately 2-5% of the oxygen in the tissue is converted into reactive oxygen species (ROS) $O_2^{\bullet-}$, H_2O_2 and $OH^{\bullet}$. During acute physical exercise (Bejma 1999), due to higher oxygen consumption, this process increases leading to higher production of ROS. Consequently ROS acting first on

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unsaturated lipids belonging to membrane and other molecules in cells, leads to the formation of certain peroxidation products (Inal *et al*. 2001), which through division generate malondialdehyde (MDA). Few studies had showed that endurance training reduces MDA level which is a byproduct of lipid peroxidation (Goldfarb *et al*. 1993; Rokitzki *et al*. 1994). The purpose of this study is to find out the efficiency of high intensity interval training on malondialdehyde (MDA) and aerobic capacity of male physical education students.

METHODS

Subjects

Thirty (30) male physical education students selected from Swami Vivekanand Subharti University, Department of Physical Education, Meerut, Utter Pradesh. The age of these subjects range between 21 to 26 years, the selected subjects gave willingness to participate in this study. These selected subjects were classified into two groups namely Group I: High intensity interval training and Group II: Control group. These subjects were randomly selected and equally divided into two groups. These subjects were free from diseases.

Variables and Test

Multistage fitness test was administered to measure aerobic capacity of the physical education students. The players ran continuously between 2 lines set 20 m apart at running speeds increased by a pre-recorded beep at appropriate intervals. Velocity was started at 8.5 $km.h^{-1}$ for the first minute, increasing by 0.5 $km.h^{-1}$ every minute thereafter. Players were instructed to complete as many stages as possible and the test was stopped when a subject was unable 3 consecutive times to reach a 3 m zone situated ahead of each 20 m line at the moment of the audio signal (Leger *et al*. 1988).

Blood samples were collected by venous arm puncture into heparinised tubes and the plasma and serum was separated by centrifugation at 3000 rpm for 15 minutes. Yagi (1987) method was adopted to measure Malondialdehyde (MDA). The blood sample and aerobic capacity was collected and measured before and after 8 weeks of high intensity interval training.

Training intervention

Aerobic training was given for 4 days per week (Monday-Morning (07:00 to 08:00 am, Tuesday-Evening (17:00-18:00, Thursday-Morning (07:00 to 08:00 am, Friday-Evening (17:00-18:00) for eight weeks. The formula proposed by Gerbeaux *et al*. (1991) was used to calculate Maximal aerobic speed (MAS). The MAS of 4.21 m/s was used as a criterion velocity to set running paces for high-intensity short intermittent exercises. They performed series of sprints lasting 10, 15 and 20 second for given distance. The training group performed training at 1:1 work rest ratio.

Statistical analysis

Descriptive statistics were derived for all test variables using SPSS (16). Changes in MDA and aerobic capacity and difference between the groups were assessed by Analysis of Covariance (ANCOVA). Statistical significance was accepted at an alpha level of p value ≤ 0.05.

RESULTS

Table 1 clearly shows that there was significant difference between the groups after adjusting pre-test scores, on MDA (F = 5.47, p = 0.001) and aerobic capacity (F = 108.04, p = 0.000. From table 1 it is also inferred that aerobic capacity increased 8.20% and MDA decreased by 26.53% in high intensity interval training group.

Table 1 Mean and standard deviation of Malondialdehyde and aerobic capacity at baseline and following eight weeks of high intensity interval training

Variable	Groups	Pre-Test	Post-Test	Groups (F)	Covariate (F)
MDA (nmol/ml)	HIIT	1.47±0.24	1.08±0.37	5.47 (p = 0.001)	13.24 (p = 0.027)
	CON	1.42±0.46	1.42±0.66		
Aerobic capacity (ml/kg/min)	HIIT	51.93±3.16	56.19±1.28	108.04 (p = 0.000)	14.81 (p = 0.000)
	CON	49.26±2.96	50.40±2.52		

DISCUSSION

High-intensity interval training has been shown to be an effective method for improving endurance performance (Weston *et al*. 1997; Edge, Bishop and Goodman, 2006; Laursen *et al*. 2005; Jenkins and Quigley 1993; Helgerud *et al*. 2007; Burke, Thayer & Belcamino 1994; Daniels, Yarbrough & Foster 1978; Dolgener & Brooks 1978; Thomas, Adeniran & Ethridge 1984; Westgarth-Taylor *et al*. 1997). The results of the present study are in agreement with many studies demonstrating an increase in maximal oxygen consumption after HIIT [Burke, Thayer & Belcamino 1994; Burgomaster *et al*. 2008; Edge *et al*. 2005; Gross, Swensen & King 2007). High intensity interval training may also induce up-regulation of glycolytic and oxidative enzymes, a possible mechanism influencing the improvements in VO_2 max (MacDougall *et al*. 1998). In addition, an increase in stroke volume following high intensity interval training (Helgerud *et al*. 2007) may contribute to an increase in aerobic capacity of the physical education students.

MDA is one of the most important displays of oxidative stress due to lipid peroxidation. MDA amount increases on various tissues along with the exercise (Banerjee, *et al*., 2003; Kerksick and Willoughby, 2005). In the present study high intensity interval training group showed significant decrease in MDA after 8 weeks of training (p< 0.05). In a study it was reported that strenuous endurance training was shown to reduce indices of oxidative stress Miyazaki, *et al*., (2001); Kabasakalis, *et al*., (2011). It is observed on performed studies that acute aerobic exercise increases oxidative stress production and endogenous antioxidant production which increases during chronic aerobic exercise results in reduction in oxidative stress (Alessio *et al*. 2000).

CONCLUSION

It is concluded that 8 weeks of high intensity interval training on physical education students showed increase in aerobic capacity and reduction in lipid peroxidation which results from increase in antioxidants.

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