Research Paper Physical Education

Effect of High Intensity Interval Training on Aerobic Power and Anaerobic Power of Male Handball Players

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ABSTRACT

The purpose of this study is to find out the efficiency of high intensity interval training on aerobic power and anaerobic power of male handball players. To achieve the purpose thirty (30) male handball players were selected from Department of Physical Education and Sports Sciences, Annamalai University, Tamilnadu, India. These subjects were tested on aerobic power and anaerobic power 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 aerobic power and anaerobic power. The result of the study revealed that eight weeks of high intensity interval training resulted in 8.20% of improvement in aerobic power ($F(1,27) = 108.04$, $p < 0.05$) and 28.58% in anaerobic power ($F(1,27) = 28.54$, $p < 0.05$). It is concluded that high intensity interval training for eight weeks resulted in improvement of aerobic power and anaerobic power of male handball players.

KEYWORDS Aerobic power, Anaerobic power, maximal aerobic speed, RAST, ANCOVA, handball, players.

Introduction

Handball is a fast body contact sport which requires both aerobic and anaerobic fitness. During the game the players has to perform more repeated sprints without getting fatigue. The ability to perform (and recover from) repeated high intensity activities over a prolonged period of time coupled with a good aerobic capacity is deemed essential physiological requirements for success in handball. The game handball composed of repeated sprint of players for fast breaks and quick counter attacks which require great aerobic capacity. The players with greater aerobic capacity tend to show lower fatigue index which show negative correlation in handball players (Chittibabu 2014).

Chittibabu (2013) in his study showed that handball specific repeated sprint training for eight weeks is more effective in increasing aerobic capacity of men handball players. The training load adopted in repeated – sprint training with game specific which resulted in 11.79% of changes in aerobic capacity. The energy required for handball players during handball match derives energy 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 all 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. The purpose of this study is to find out the efficiency of high intensity interval training on aerobic power and anaerobic power of male handball players.

Methods

Subjects

Thirty (30) male handball players were selected from Department of Physical Education and Sports Sciences, Annamalai University, Tamilnadu, India. 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 power 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).

Anaerobic power was measured by running based anaerobic sprint test (RAST). Subjects completed six 35 m runs at maximum pace (10 s allowed between each sprint for turnaround). Power output in watts for each sprint was calculated according to the following equation: power =weight (kg) × distance (m) × time (s).

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 aerobic power and anaerobic power, 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 aerobic power (F = 108.04, p = 0.000) and anaerobic power (F = 28.54, p = 0.000). From table 1 it is also inferred that aerobic power increased 8.20% and anaerobic power by 28.58% in high intensity interval training group.

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

Variable	Groups	Pre-Test	Post-Test	Groups (F)	Covariate(F)
Aerobic power (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		
Anaerobic power (Watts)	HIIT	372.09±66.88	478.45±140.99	28.54 (p = 0.000)	75.13 (p = 0.000)
	CON	375.80±41.75	377.79±43.35		

Discussion
High-intensity interval training has been shown to be an effective method for improving endurance performance (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 power of male handball players.

Recent studies reported that high intensity interval endurance training influenced by anaerobic and aerobic metabolism. Additionally, training studies showed that RSA training positively affects intermittent high-intensity performance (Chaouachi *et al.* 2010). Moreover, and consistent with the findings of other authors, the repetition of short bouts of exercise stress not only many of the physiological or biochemical systems used in aerobic efforts (Buchheit *et al.* 2010; Burgomaster, Heigenhauser & Gibala 2006; Burgomaster *et al*. 2008; Burgomaster *et al*. 2005), but it also induces alterations in glycolytic enzymes, muscle buffering, and ionic regulation resulting in improved anaerobic performance (Bishop *et al*. 2009; Dawson *et al*. 1998; Harmer *et al*. 2000). This conclusion is supported by the observed increase in the anaerobic power (i.e., increase of 28.58%) among male handball players.

Conclusion
It is concluded that 8 weeks of high intensity interval training on male handball players showed increase in aerobic power and anaerobic power. The training program was sufficient enough to trigger a consequent adaptive response cardiorespiratory fitness.

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