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ACUTE ANAEROBIC EXERCISE RESPONSE ON RECOVERY HEART RATE OF TRAINED ATHLETES

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ABSTRACT

The aim of the present study was to examine the recovery heart rate response immediately after anaerobic exercise. To achieve the purpose of the study, 15 female sprint trained athletes who attended university coaching camp at Annamalai University, Chidambaram were selected. The age of the subjects ranged between 18 to 25 years as per university record. To assess the variability in recovery heart rate the heart rate was assessed at five different times for 30 seconds at 1:00 to 1:30, 2:00 to 2:30, 3:00 to 3:30, 4:00 to 4:30and 5:00 to 5:30 minutes after immediately cessation of 400 meters run. The collected data was analysed using One-Way Repeated Measure ANOVA for comparisons of mean values among five different times of recovery heart rate. When F is significant Scheffe's test was applied as post hoc test to determine the paired mean difference if any, among different times of the recovery heart rate. The value of 0.05 was set for statistical significance. The results of study showed that there was significant difference in recovery heart rate among first recovery period, second recovery period, third recovery period, fourth recovery period, fifth recovery period as an acute response to anaerobic exercise.

KEY WORDS: Anaerobic exercise, Heart rate recovery, heart rate variability, female Sprinter.

INTRODUCTION

Anaerobic exercise is an exercise intense enough to trigger anaerobic metabolism. It is used by athletes in non-endurance sports to promote strength, speed and power and by body builders to build muscle mass. Muscles which are trained using anaerobic exercise develop differently, compared to aerobic exercise, leading to greater performance in short duration, high intensity activities, which last from more seconds up to about two minutes. Anaerobic training brings out changes in the ATP-CP and lactic acid system. Intensive anaerobic exercises lasting between 30 seconds and 3 minutes activate and exhaust the lactate system to its maximum; thus, the lactate system can be best trained by interval workouts (**Janssen, 2001**).

Medbo and Burges (1990) provided evidence that anaerobic performance can be enhanced by the maximal-intensity intermittent training program. 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, along with brief periods of low-intensity or passive rest.

During exercise, heart rate (HR) and myocardial contractility will be increased to satisfy energy demands of working muscles. Its nervous modulation is considered to be due to the vagal withdrawal at low-intensity exercise and the combination of vagal withdrawal and sympathetic activation at moderate or high-intensity exercise **(Kluess et al., 2000)**. With the cessation of exercise, the decrease in HR immediately after exercise is mainly thought to be a function of a reactivation of the parasympathetic nervous system **(Arai et al., 1989)**. Later, the further decrease in HR to the pre-exercise value also depends on the gradual withdrawal of the sympathetic system **(Perini et al., 1989)**. There are two established, noninvasive methods of detecting sympathetic withdrawal and parasympathetic reactivation in exercising participants: measurement of heart rate recovery (HRRec) and heart rate variability (HRV). The value of heart rate recovery is defined as the rate at which the heart rate decreases to a resting rate after cessation of moderate to heavy exercise

(Buchheit, Papelier et al., 2007). The main adaption for endurance training is increase in heart volume with normal thickness of ventricular cavity. Whereas for anaerobic training the adaptation is due to thickening of ventricular valve. The endurance training increases the aerobic power and as a result the recovery after exercise is faster.

Methodology

To achieve the purpose of the study 15 athlete's sprint- trained athletes who attend university coaching camp at Annamalai University, Chidambaram were selected as subjects. The age group of the subjects was between 18 to 25 years as per university record. The study was intended to assess the response of anaerobic exercise on recovery heart rate Pre-exercise resting short-term heart rate variability (HRV) parameters in time and frequency domains were assessed during the first 30 seconds at five different times of recovery heart rate of the 30 seconds at 1:00 to 1:30, 2:00 to 2:30, 3:00 to 3:30, 4:00 to 4:30and 5:00 to 5:30 minutes for endurance trained Annamalai university athletes.

Statistical technique

The collected data was analysed using One-Way Repeated Measure ANOVA for comparisons of mean values between five different times of recovery heart rate. When *F* is significant Scheffe's test was applied as post hoc test to determine the paired mean difference if any. The value of 0.05 was set for statistical significance.

RESULT OF THE STUDY

TABLE I The mean standard deviation values on exercise heart rate, different time of the minutes recovery heart rate of anaerobic exercise

Groups		Exercise heart rate	1.00-1.30 minutes	2.00-2.30 minutes	3.00-3.30 minutes	4.00-4.30 minutes	5.00-5.30 minutes
Anaerobic exercise	Mean	119.8	117.2	113.8	110.5	107.07	103.6
	S.D	1.50	1.26	1.92	2.32	2.37	2.94

The table I show that the mean values on recovery heart rate immediately after anaerobic exercise of 1.00 -1.30 minutes recovery heart rate, 2.00-2.30 minutes recovery heart rate, 3.00 -3.30 minutes recovery heart rate, 4.00-4.30 minutes recovery heart rate and 5.00-5.30 minutes recovery heart rate are 119.8, 117.2, 113.8, 110.5, 107.07 and 103.6 respectively. The one way ANOVA of repeated measures was applied on recovery heart rate for different time's recovery heart rate and the results are presented in table-II.

TABLE - II Summary of one way ANOVA of repeated measures on recovery heart rate after anaerobic exercise

Source of Variation	SS	df	MS	F
A (Factor)	188234.674	1	188234.674	555.5
Error	47.437	14	3.388	
B (Tests)	2841.822	5	568.364	408.010
Error	97.511	70	1.393	

*Table value required for significance at 0.05 level with df 1, 14 & 5, 70 were 4.60 and 2.15 respectively.

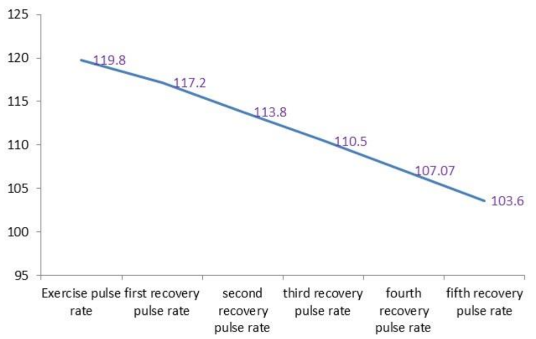
There is a significant change in recovery heart rate of anaerobic exercise during different phases of test. The obtained F ratio of 408.01 is greater than the required table value of 2.35 for the df 5 and 70. Since F ratio is significant scheffe'S post hoc test was applied.

TABLE III Scheffe'S test for the differences among paired means of anaerobic training with different time on recovery heart rate

Exercise heart rate	1.00-1.30 minutes	2.00-2.30 minutes	3.00-3.30 minutes	4.00-4.30 minutes	5.00-5.30 minutes	Mean difference	Confidence interval
119.8	117.2					2.6	1.45
119.8		113.8				6.00	1.45
119.8			110.5			9.3	1.45
119.8				107.07		12.73	1.45
119.8					103.6	16.5	1.45
	117.2	113.8				3.4	1.45
	117.2		110.5			6.7	1.45
	117.2			107.07		10.13	1.45
	117.2				103.6	13.6	1.45
		113.8	110.5			3.3	1.45
		113.8		107.07		6.73	1.45
		113.8			103.6	10.2	1.45
			110.5	107.07		3.43	1.45
			110.5		103.6	6.9	1.45
				107.07	103.6	3.47	1.45

Table-III indicates that there was significant differences were observed on anaerobic exercise recovery heart rate between and also among immediately after exercise, first, second, third, fourth and fifth cessation recovery period. The recovery heart rate was significantly reduced from one stage to other stage till the end of the recovery period.

FIGURE - I Recovery heart rate of sprinter athletes at different times of the recovery period



Discussion

The results of study showed that there was significant decrease in exercise heart rate among and between first recovery period, second recovery period, third recovery period, fourth recovery period and fifth recovery period after high anaerobic capacity is associated with fast HR recovery after exercise. Results of previous studies suggest that autonomic adaptation to exercise varies depending on the training mode and type of exercise performed. Multiple studies have shown that HRRec improves with training in both sedentary and already trained subjects **(Otsuki et al., 2007)**. Other similar studies fourteen well-trained cyclists participated in a 4-week high-intensity training program and showed a significant increase in HRRec at 60 seconds after cessation of a maximal exercise test **(Lamberts et al., 2009)**. Other similar studies have observed a similar improvement in post-exercise HRRec after resistance training and further suggest that the mechanisms of post-exercise HRRec may be slightly different in strength (anaerobic) and endurance (aerobic) trained athletes **(Heffernan et al., 2007)**. As such, the purpose of the study was to compare the effect of a continuous training mode on heart rate recovery of trained track (anaerobic) and road (aerobic) cyclists at one and two minutes post-exercise. **McDonald et al (2014)** conducted a study training mode showed statistically significant effects on the speed of heart rate recovery in trained cyclists. Greater variability in recovery heart rate at minute two versus minute one suggests that the heart rate should be monitored longer than one minute of recovery for a better analysis of post-exercise autonomic shift. **Taskin et al (2014)**, conducted a study which, even if the increase of heart rate occurring after anaerobic run doesn't completely return to normal in 3rd minute of recovery, it will supply the athlete with a suitable condition for the second loading with regard to efficient rest. It is thought that a rest over 3 minutes should be given for athletes to make the heart rate after anaerobic run return to normal.

Conclusions

In summary, anaerobic runners indicated faster HR recovery after exercise and altered cardiac ANS modulation at rest than untrained controls. The higher levels of HRV, higher anaerobic capacity and exaggerated blood pressure response to exercise in the anaerobic runners are suggested to be responsible for their faster HR recovery after exercise. There was a significant reduction recovery pulse at each phases of recovery after anaerobic exercise.

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