International Journal of
PHYSICAL EDUCATION, FITNESS AND SPORTS

FULL LENGTH ARTICLE

Acute aerobic exercise response on recovery heart rate of trained athletes

Received 10th July 2016,
Accepted 27th August 2016

www.ijpefs.com

DOI:10.26524/1631

P. Kulothungan[a, *]

[a] Department of Physical Education and Sports & Sciences, Annamalai University, Chidambaram, Tamil Nadu. India.
*Corresponding Author Ph: +91 9842359006; Email: pkuloth@gmail.com

Abstract: The aim of the present study was to examine the recovery heart rate response immediately after aerobic exercise. To achieve the purpose of the study, 15 female endurance-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 time of 30 second 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 Coopper twelve minutes run\walk test. 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 pulse rate among first recovery period, second recovery period, third recovery period, fourth recovery period, fifth recovery period as an acute response to aerobic exercise.

Keywords: Aerobic exercise, Heart rate recovery, heart rate variability, female endurance runner

1 Introduction

Aerobic training developed the oxygen transport system This specific training improves the ability to continue exercising for a prolonged period and the ability to quickly recover from high-intensity exercises [1].The oxygen system is best trained by endurance workouts, that is, exercises of relatively long duration at sub-maximal level [2]. Usually, the intensity and volume of aerobic exercise are inversely related. Increasing the volume (time) of aerobic training will reduce the intensity to a tolerable level.

Aerobic performance is influenced by three factors, maximal aerobic power, anaerobic threshold, and work economy [3]. Estimates of the contribution of aerobic energy to performance have varied. Based on the length of the game (90 minutes), at least 90% of energy requirements would have to come from aerobic energy sources [3]. In later research, it was estimated as much as 98% of all energy requirements in any game come from aerobic sources, with only 2% from anaerobic sources [4]. Other reports of game 8% of total game time is spent performing high intensity activities such as sprinting, jumping and tackling while other studies report as high as 12% contribution from anaerobic sources [5-6].Aerobic exercise includes lower intensity activities performed for longer periods of time. Activities such as walking, running, swimming and cycling are aerobic and require a great deal of oxygen to generate the energy needed for prolonged exercise.

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 [7]. 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 [8]. Later, the further decrease in HR to the pre-exercise value also depends on the gradual withdrawal of the sympathetic system [9]. The main adaption for endurance training is increase in heart volume with normal thickness of ventricular cavity. Whereas for anaerobic training the adaptation in due to thickening of ventricular value. The endurance training increases the aerobic power and as a result the recovery immediately after exercise is faster.

2 Methods

2.1 Subject

To achieve the purpose of the study 15 athlete's endurance-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 aerobic exercise on recovery pulse rate Pre-exercise resting short-term heart rate variability (HRV) parameters in time and frequency domains were assessed during the first 30 s, 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.

3 Statistical techniques

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.

4 Result of the study

Table I

The mean standard deviation values on exercise pulse rate, different time of the minutes recovery pulse rate of aerobic exercise

Groups		Exercise pulse rate	1.00-1.30 min	2.00-2.30 min	3.00-3.30 min	4.00-4.30 min	5-5.30 min
Aerobic exercise	Mean	123.8	120.67	116.9	113.73	110.9	108.5
	S.D	4.53	5.32	5.44	4.83	4.46	4.68

The table I shows the mean values on recovery pulse rate immediately after aerobic exercise of 1.00 -1.30 minutes recovery pulse rate, 2.00-2.30 minutes recovery pulse rate, 3.00 -3.30 minutes recovery pulse rate, 4.00-4.30 minutes recovery pulse rate and 5.00-5.30 minutes recovery pulse rate are 123.8, 120.67, 116.9, 113.73, 110.9 and 108.5 respectively. The one way ANOVA of repeated measures was applied recovery pulse rate for different time's recovery pulse rate and the results are presented in table-II.

Table - II

Summary of one way ANOVA of repeated measures on recovery pulse rate after aerobic exercise*

Source of Variation	SS	df	MS	F
A (Factor)	201067.407	1	201067.407	881.7
Error	319.259	14	22.804	
B (Tests)	2561.956	5	512.391	365.82
Error	98.044	70	1.401	

*Table value required for significance at 0.05 level with df 1, 14& 5,70 were 4.60 and 2.35 respectively.

There is a significant change in recovery pulse rate after performing aerobic exercise at different phases of test. The obtained F ratio of 365.82 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 aerobic training with different time on recovery pulse rate

Exercise pulse rate	1.00-1.30 min	2.00-2.30 min	3.00-3.30 min	4.00-4.30 min	5.00-5.30 min	Mean difference	Confidence interval
123.8	120.67					3.13	1.45
123.8		116.9				6.9	1.45
123.8			113.73			10.07	1.45
123.8				110.9		12.9	1.45
123.8					108.5	15.3	1.45
	120.67	116.9				3.77	1.45
	120.67		113.73			6.94	1.45
	120.67			110.9		9.77	1.45
	120.67				108.5	12.17	1.45
		116.9	113.73			3.17	1.45
		116.9		110.9		6	1.45
		116.9			108.5	8.4	1.45
			113.73	110.9		2.83	1.45
			113.73		108.5	5.23	1.45
				110.9	108.5	2.4	1.45

Table-III indicates that there were significant differences were observed on recovery pulse 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 the end of the recovery period.

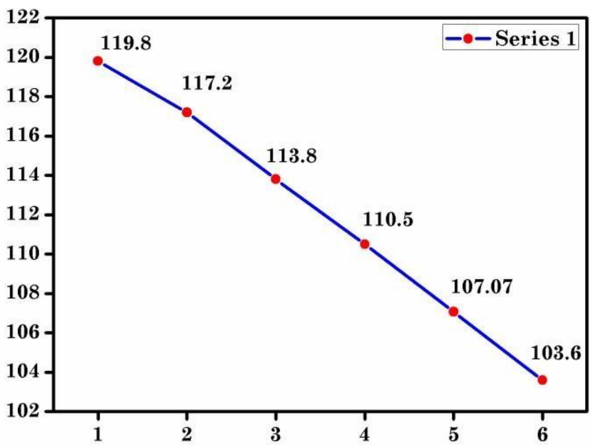

Figure 1. Recovery heart rate of endurance athletes at different times of the recovery period

5 Discussion

The results of study showed that there was significant decrease in exercise pulse rate among and between first recovery period, second recovery period, third recovery period, fourth recovery period and fifth recovery period after high aerobic capacity is associated with fast HR recovery after exercise. For males, HR recovery was shown to be faster in athletes, who had a higher aerobic capacity than non-athletes [10]. In the present study shown females endurance trained runner had faster HR recovery after exercise and an indicating higher aerobic capacity as compared to untrained controls. This could imply that faster heart rate recoveries are evident not only for males but also for females and it is inferred that recovery depends upon aerobic capacity rather than gender. A number of studies have shown that physically active men or women demonstrated higher levels of HRV compared with sedentary controls [11-13]. Early studies showed that the female runners had significantly higher SDRR, HF power at rest and slightly higher HF power at recovery after exercise than untrained controls. High levels of HRV are associated with rapid HR recovery after exercise. Ohuchi et al. (2000) demonstrated that the greater cardiac parasympathetic activity at rest should be in part responsible for the faster HR recovery after exercise [14]. Dixon et al. (1992) found that athletes, who had higher vagal activity and lower sympathetic activity, also had faster HR recovery after exercise than non-athletes [15]. It is unlikely that hormonal changes contribute to the faster HR recovery in the aerobic runners because according to some studies, endurance training could enhance plasma catecholamine concentration in response to moderate or strenuous exercise and the clearance rate of post-exercise plasma catecholamine was shown not to be significantly changed by training [16-18].

6 Conclusions

In summary, aerobic runners indicated faster HR recovery after exercise and altered cardiac ANS modulation at rest than untrained controls. The higher levels of HRV, higher aerobic capacity and exaggerated blood pressure response to exercise in the aerobic 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 aerobic exercise.

References

1. E. Rampinini, A. J. Coutts, C. Castagna, R. Sassi, F. M. Impellizzeri, Variation in top level soccer match performance, *International Journal of Sports Medicine*, 28 (2007) 1018–1024.
2. P. Janssen (2001) Lactate Threshold Training, Champaign, IL: Human Kinetics, 1–150.
3. J. Hoff, U. Wisloff, L. C. Engen, O. J. Kemi J. Helgerud, Soccer specific aerobic endurance training, *British Journal of Sports Medicine*, 36 (2002) 218-221.
4. J. Hoff, J. Helgerud, Endurance and strength training for soccer players: physiological considerations, *Journal of Sports Medicine*, 34 (2004) 165-180.
5. J. Bangsbo, L. Norregand, F. Thorsoe, Activity profile of competition soccer, *Canadian Journal of Sports Science*, 16 (1991) 110-116.
6. E. Rampini, A. Sassi, A. Morelli, S. Mazzoni, M. Fanchini, A. J. Coutts, Repeated-sprint ability in professional and amateur soccer players, *Applied Physiology Nutrition*, and Metabolism, 34 (2009) 1048- 1054.
7. H. A. Kluess, R. H. Wood, M. A. Welsch, Vagal modulation of the heart and central hemodynamics during handgrip exercise, *American Journal of Physiology*, 279 (2000) H1648-H1652.
8. Y. Arai, J. P. Saul, P. Albrecht, L. H. Hartley, L. S. Lilly, R. J. Cohen, W. S. Colucci, Modulation of cardiac autonomic activity during and immediately after exercise, *American Journal of Physiology*, 256 (1989) H132-H141.
9. R. Perini, C. Orizio, A. Comande, M. Castellano, M. Beschi, A. Veicsteinas, Plasma norepinephrine and heart rate dynamics during recovery from submaximal exercise in man, *European Journal of Applied Physiology and Occupational Physiology*, 58 (1989) 879-883.
10. K. C. Darr, D. R. Bassett, B. J. Morgan, D. P. Thomas, Effects of age and training status on heart rate recovery after peak exercise, *American Journal of Physiology,* 254 (1988) H340-H343.
11. K. Jensen-Urstad, B. Saltin, M. Ericson, N. Storck, M. Jensen-Urstad,, Pronounced resting bradycardia in male elite runners is associated with high heart rate variability, *Scandinavian Journal of Medicine & Science in Sports,* 7 (1997) 274-278.
12. K. P. Davy, C. A. DeSouza, P. P. Jones, D. R. Seals, Elevated heart rate variability in physically active young and older adult women, *Clinical Science London,* 94 (1998) 579-584.
13. L. A. Rossy, J. F. Thayer, Fitness and gender-related differences in heart period variability, *Psychosomatic Medicine*, 60 (1998) 773-781.
14. H. Ohuchi, H. Suzuki, K. Yasuda, Y. Arakaki, S. Echigo, T. Kamiya, Heart Rate Recovery after Exercise and Cardiac Autonomic Nervous Activity in Children, *Pediatric Research*, 47 (2000) 329-335.
15. E. M. Dixon, M. V. Kamath, N. McCartney, E. L. Fallen, Neural regulation of heart rate variability in endurance athletes and sedentary controls, *Cardiovascular Research*, 26 (1992) 713-719.
16. M. Kjaer, P. A. Farrell, N. J. Christensen, H. Galbo, Increased epinephrine response and inaccurate glucoregulation in exercising athletes, *Journal of Applied Physiology*, 61 (1986) 1693-1700.
17. C. Jacob, H. Zouhal,J. Prioux, A. Gratas-Delamarche, D. Bentue-Ferrer, P. Delamarche, Effect of the intensity of training on catecholamine responses to supramaximal exercise in endurance-trained men, *European Journal of Applied Physiology*, 91 (2004) 35-40.
18. J. M. Hagberg, R. C. Hickson, J. A. Mvlane, A. A. Ehsani, W. W. Winder, Disappearance of norepinephrine from the circulation following strenuous exercise, *Journal of Applied Physiology,* 47 (1979) 1311-1314.