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Effect of Selected Recovery Interventions on Heart Rate Recovery of Athletes after High Intensity Endurance Run

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Abstract – The present study was undertaken with the purpose to analyses the effect of the selected recovery interventions on Heart rate recovery of the athletes after high intensity endurance run. For the purpose of the study a total of 10 endurance athletes were selected to act as participants. The recovery interventions selected for the study were active recovery, passive recovery, hyperoxic breathing, massage, contrast water immersion. The participants were administered with the recovery interventions after the cessation of the high intensity endurance run. The data on the blood lactate was collected at baseline i.e. 0 minutes and after 2 minutes, 4 minutes and 6 minutes. Repeated measure design was used in the study. The statistical technique applied to test the significance of the difference was One Way repeated measure ANOVA. The level of significance was 0.05. The result of the s study indicated that contrast water immersion and hyperoxic breathing were the most efficient recovery intervention for the heart rate recovery after high intensity interval training.

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INTRODUCTION

Sports and games have travelled a long way so far and this journey is marked by many scientific and technological advances. Various exercise sciences have evolved as a result of the continued effort to make progress. The field of exercise physiology has become increasingly sophisticated. New research procedures and measurement techniques coupled with advances in equipment, computer technology and other related disciplines such as bio-chemistry have contributed to the rapid advancements of the knowledge base. Exercise chemistry involves examination of the effects of exercise at the cellular level specifically within the muscles. Although the field of exercise is becoming increasingly specialized, many professionals in this field recognize that to fully investigate and understand human performance, an interdisciplinary approach is necessary (Deborah A. Wuest and Charles A. boucher, 1995).

Running is one of the most basic human activities and running against another man, the most basic from of competition. The rivalry of the man against man is the essence of sports and will keep athletics as the foremost Olympic sport (AdrainMetcaffe, 1969).

In games & sports systematic training and conditioning of a sportsman plays a vital role in building up performance. Therefore, specialized training in games and sports has been a necessity to produce superior performance (Ranjot gill, 1987).

Recovery from exercise training is an integral component of the overall training program and is essential for optimal performance and improvement. If rate of recovery is improved, higher training volumes and intensities are possible without the detrimental effects of overtraining. (Bishop, P.Aet. al., 2008)

The purpose during recovery from exercise is to restore the muscles and the rest of the body to their pre exercise condition. During recovery from exercise oxygen consumption is elevated above resting levels. The additional oxygen consumed during rest in termed the recovery oxygen. During the rest of 2-3 minutes of recovery, there is a high rate of oxygen consumption following by a gradual decline to near resting levels. The cardiovascular, hormonal, endocrine or muscular subsystems, for example are involved during and of course after the exercise. (Foster C., 1998)

The recovery process is of particular importance in events where an athlete may have to compete on more than one occasion during a competition in a single day such as track, swimming, cycling, and rowing (Monedero J. and Donne B, 2000).

Athletic coaches and people doing sports research has long been interested in various techniques that might prove helpful in speeding recovery from fatigue and improvement in athletes. Although many techniques have been tried and are currently being used throughout the world, none have been adequately proven through controlled research to actually give more effective recovery. (Aix b. Harrison, 1960)

In present study the research scholar has compared the effect of five recovery interventions on recovery of heart rate after high intensity interval running. Recovery interventions are:-

1) Passive recovery

2) Active recovery

3) Contrast water immersion

4) Massage

5) Hyperoxic breathing

The effect of these recovery interventions are compared on the heart rate recovery of athletes

METHODOLOGY

For the purpose of the study a total of 10 male cross country runners (mean age 20±3 years, height 168 ± 6m, weight 64 ± 6) were randomly selected from Track and Field having represented their university in all India cross country event. The participants have followed approximately a similar kind of training program from last one year and the minimum training age of the participants was two years.

EXPERIMENTAL DESIGN

The same participants underwent the different treatments again and again and data was recorded on selected variables repeatedly after treatment, so, the within-within group design with repeated measures was employed in the study.

		Time Points			
		Time point 0	Time point 1	Time point 2	Time point 3
Interventions	RI 1	S1…..S10	S1…..S10	S1…..S10	S1…..S10
	RI 2	S1…..S10	S1…..S10	S1…..S10	S1…..S10
	RI 3	S1…..S10	S1…..S10	S1…..S10	S1…..S10
	RI 4	S1…..S10	S1…..S10	S1…..S10	S1…..S10
	RI 5	S1…..S10	S1…..S10	S1…..S10	S1…..S10

Figure 1- within – within group design used in the study

S = subjects, RI = recovery interventions.

Data on heart rate was recorded immediately after exercise and at an interval of 2, 4, 6 minutes after the exercise is stopped.The participants ran for 10 minutes at a high intensity i.e. at 80-85% of their maximum heart rate on treadmill. Initial 2 minutes before the workout of 10 minutes were devoted for gradual rise in running velocity and efforts were made to attain the target heart rate of the participants. After 2 minutes, the intensity was maintained by taking note of heart rate on the fully automatic digital heart rate monitor. Just after the cessation of the high intensity run the baseline data for heart rate was collected at the 0 minute time point, 2 minutes, 4 minutes and 6 minutes. The treatments were randomly assigned to the participants in counterbalancing manner.

The procedure adopted for the administration of various recovery interventions are described in this section as follows:

The procedure adopted for the administration of various recovery interventions are described in this section as follows:

Passive recovery: - After the high intensity running for 10 minutes the participants rested laid down in supine position without making any movement for 20 minutes.

Active recovery: - After the high intensity run for 10 minutes the participants continued to run for other 10 minutes at 40% - 45% of their target heart rate. After 10 minutes participants lied down on the floor and rested passively.

Massage: - After the cessation of high intensity run participants were given massage for 10 minutes by an expert massager. The techniques chosen for the massage were basically aimed at increasing the subcutaneous blood flow in the treated area. The participants were given massage in upper and lower parts of the body for duration of 10 minutes.

Contrast water immersion: - The participants were immersed up to neck alternately in two separate water tanks containing hot and cold water. The temperature of the hot and cold water was 10^0 – 14^0 Celsius and 40^0 – 44^0 Celsius respectively. The participants were first immersed in hot water (for 2 minute) and then cold water (for 1 minute).

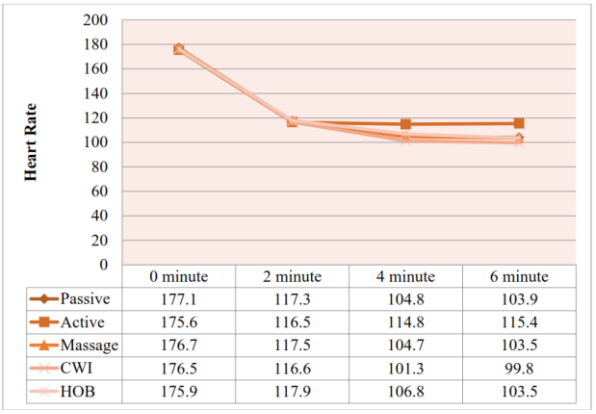
Hyperoxic breathing: - In this intervention the participants inhaled oxygen from a cylinder for 10 minutes from an inhaling mask in supine position.

RESULTS

Descriptive Statistics of the Scores of Heart Rate Recovery after Applying Selected Interventions at Subsequent Regular Time Points

Intervention	Time Point	Mean	Std. Deviation	S.E. Mean	C.V.%	Skewness	Kurtosis
Passive	0 minute	177.10	1.79	0.56	1.01	-.185	-.141
Passive	2 minutes	117.30	5.22	1.65	4.45	-1.110	1.446
Passive	4 minutes	104.80	3.76	1.19	3.59	-.415	-.528
Passive	6 minutes	103.90	3.69	1.16	3.55	.280	-1.165
Active	0 minute	175.60	1.77	0.56	1.01	.464	.054
Active	2 minutes	116.50	3.06	0.96	2.63	-.420	-.205
Active	4 minutes	114.80	2.69	0.85	2.35	-1.133	1.206
Active	6 minutes	115.40	2.27	0.71	1.96	.589	.848
Massage	0 minute	176.70	1.70	0.53	0.96	.415	.502
Massage	2 minutes	117.50	5.01	1.58	4.26	-.937	.675
Massage	4 minutes	104.70	2.83	0.89	2.70	-.906	1.090
Massage	6 minutes	103.50	1.77	0.56	1.71	.222	-1.344
CWI	0 minute	176.50	2.99	0.94	1.69	-.296	-1.645
CWI	2 minutes	116.60	3.06	0.96	2.62	.009	.683
CWI	4 minutes	101.30	2.79	0.88	2.75	.113	-.800
CWI	6 minutes	99.80	2.25	0.71	2.25	.310	-.400
HOB	0 minute	175.90	2.42	0.76	1.37	-.323	-1.379
HOB	2 minutes	117.90	3.03	0.95	2.57	-.776	.393
HOB	4 minutes	106.80	4.51	1.42	4.22	.127	-1.008
HOB	6 minutes	103.50	3.97	1.25	3.84	.370	-.733

The graphical representation of the means of heart rate recovery scores while applying selected interventions after high intensity treadmill running is presented in the figure below.



Tests of Within-Subjects Effects for Interventions, Time Points and Their Interactions on Heart Rate Recovery Scores

Measure: Heart_Rate

Source	Type III Sum of Squares	df	Mean Square	F	P-Value	Partial Eta Squared
Interventions (Sphericity Assumed)	1067.1	4	266.7	22.89	.000	.718
Error(Interventions) (Sphericity Assumed)	419.5	36	11.6			
time_points (Sphericity Assumed)	171337.0	3	57112.3	3665.7	.000	.998
Error(time_points) (Sphericity Assumed)	420.6	27	15.5			
Interventions * time_points (Greenhouse-Geisser)	1390.0	3.9	348.1	23.94	.000	.727
Error(Interventions*time_points) (Greenhouse-Geisser)	522.4	35.9	14.5			

*Significant at 0.05 level of significance

In table 5 it is evident that the main effect for overall interventions was significantly different as the P-Value (0.000) is less than 0.05 level of significance.

Pairwise Comparisons between Overall Interventions of Heart Rate Recovery

(I) Intervention	(J) Intervention	Mean Difference (I-J)	Std. Error	P-Value[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
Passive	Active	-4.800*	1.014	.011	-8.543	-1.057
	Massage	.175	.569	1.000	-1.924	2.274
	CWI	2.225	.659	.082	-.206	4.656
	HOB	-.250	.611	1.000	-2.505	2.005
Active	Massage	4.975*	1.009	.008	1.251	8.699
	CWI	7.025*	.691	.000	4.477	9.573
	HOB	4.550*	1.033	.017	.740	8.360
Massage	CWI	2.050*	.554	.049	.007	4.093
	HOB	-.425	.633	1.000	-2.759	1.909
CWI	HOB	-2.475*	.631	.035	-4.802	-.148

Based on estimated marginal means
b. Adjustment for multiple comparisons: Bonferroni
*Significant at 0.05 level

The results derived from pairwise comparison revealed that there was a significant difference between the active and passive interventions of heart rate recovery as the P-Value is less than 0.05 level of significance. A significant difference also lies in heart rate recovery between active, massage, contrast water immersion and hyperoxic breathing as the P-Value is less than 0.05 level of significance. Significant difference was also observed between massage intervention and contrast water immersion as the P-Value is less than 0.05 level of significance. Heart rate recovery pattern was also different between contrast water immersion and hyperoxic breathing.

DISCUSSION OF FINDINGS

The results of the study revealed that massage and passive recovery were equally effective in heart rate recovery after exercise. As the high intensity workout was stopped, the subjects laid down in supine position. In the passive recovery the subjects were in supine position for 10 minutes without making any movement while various techniques in massage were also applied in same position. As the subjects stopped making any movements, further demand of the oxygen was decreased and recovery of the energy stores was the primary task remained with energy systems. Although massage was given with the purpose to enhance the blood flow in the muscles but it did not appear to facilitate the heart rate recovery significantly better than passive recovery. Cold and hot water immersion was also effective in promoting heart rate recovery, although it did not differ significantly from hyperoxic breathing. The vasoconstriction and vasodilatation mechanism in cold and hot water immersion facilitates rapid supply of blood in needing muscles but during the experiment the subjects had to change the containers of hot and cold water, which may have resulted in frequent increase in heart rate and hence less recovered heart rate at the end. It might be argued that parasympathetic vegetative response associated with massage may have induced improvements in

heart rate variability. Hyperoxic breathing although does not differ significantly in its effectiveness in heart rate recovery after exhaustive exercise but it was found in literature review that it significantly increased PNS activities and facilitates heart rate recovery after maximal exercise.

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