REVIEW OF RESEARCH

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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

Human beings are by nature competitive and ambitious for their excellence in all athletic performances. Every men or nation wants to show their supremacy by challenging other men or countries. Thus, this challenge stimulates, inspires and motivates all the nations to sweat and strive to run faster, jump higher, throw farther and exhibit greater strength, endurance and skills in present competitive sports world.(Lawrence E. Morehouse and Augustus T. miller1971). Running is one of the most basic human activities and running against another man, the most basic from of competition. (Adrain Metcaffe, 1969). Training causes fatigue which occasions a temporary lowering of performance. Calder, A (1996).This impairment may be transitory, lasting minutes or hours after training or competition, or last for a longer period, up to several days.(Cheung K, et.al., 2003)

KEYWORDS:*Recovery intervention, Heart Rate, Passive recovery, Active recovery, Contrast water immersion, Massage and Hyperoxic breathing.*

INTRODUCTION

The processes occurring during recovery from exercise are just as important as those occurring during exercise itself. Incomplete recovery between exercise and athletic contests ultimately lead to a decrement in performance. During recovery from exercise oxygen consumption is elevated above resting levels. Also, during recovery, lactic acid is converted to muscles and liver glycogen, blood glucose, protein and particularly CO2 and H2O.

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)

Recovery processes involve various organism subsystems that monitor our bodies and perform important functions before, during and after exercise. The cardiovascular, hormonal, endocrine or muscular subsystems, for example are involved during and of course after the exercise.(Foster C.,. 1998)

For many years efforts have been made to develop procedures which will accelerate recovery. If the recovery is repeatedly insufficient; fatigue develops with repeated work. Depending on the degree of over fatigue, there is a weakening of effectiveness of the training or its effectiveness of training or its effects are completely lost while the level of performance declines. (Dietrish Hare, 1982)
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

Interventions		Time point 0	Time point 1	Time point 2	Time point 3
	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.

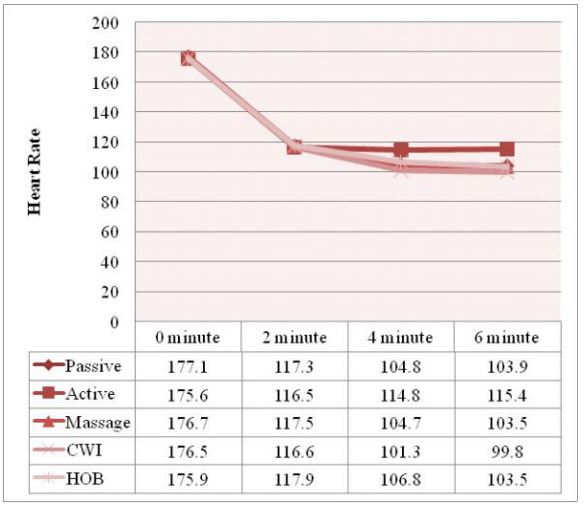
Massage: - After the cessation of high intensity run participants were given massage for 10 minutes by an expert massager. The techniques chosen for the massage were basically aimed at increasing the subcutaneous blood flow in the treated area. The participants were given massage in upper and lower parts 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 100 – 140 Celsius and 400 – 440 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

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 stopped 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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