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Impact of Active Vs Passive Recovery on Blood Lactate Dynamics after an Anaerobic Power Test

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ABSTRACT

Objective: This study's objective was to observe the lactate dynamics following a supramaximal exercise test.

Method: Following the Wingate Anaerobic Power Test (WAPT), 40 college-bound students with ages of 23.05 ± 2.42 years, heights of 173.63 ± 5.57 cm, and body weights of 69.40 ± 4.31kg were measured to determine the amount of blood lactate at 10, 0, 3, 5, 10, 15, 30, and 60 minutes. Using Stat strip Xpress 2, the blood lactate level was measured instantaneously in millimole/litter.

Results: Ten minutes prior to the test, the resting level was measured; the results for the active and passive recovery groups were 1.19 ± 0.31 and 1.44 ± 0.24 mMol/L, respectively. Blood lactate levels increased dramatically after the WAPT treatment, reaching 14.65 ± 0.91 mMol/L in the active recovery group and 16.20 ± 1.41 mMol/L in the passive recovery group. In both groups, the blood lactate value peaked at the fifth minute and then gradually decreased.

Conclusion: By the end of the trial, the active recovery group significantly outperformed the passive recovery group in terms of blood lactate removal in sixty minutes time line and a quicker recovery to baseline lactate levels.

Key words: Wingate Anaerobic Power Test, Lactate Dynamics, Active and Passive Recovery.

OVERVIEW

Lactate has been misrepresented for almost a century as a metabolic waste product, an irritant, and the source of muscular weariness. But since the lactate shuttle was discovered in 1985 [1] and further developed [2], [3], there has been increasing consensus regarding the several functions lactate plays in biology [4], [5]. Lactate serves as a signalling molecule, oxidative energy source, and gluconeogenic precursor in physiology [1], [3], [4].

During both rest and steady-state exercise, your blood creates and excretes lactate in a balanced manner. During this time, the heart, muscles, and liver can all use lactate as fuel. During this time, the heart, muscles, and liver can all use lactate as fuel. While the body can readily absorb lactate during steady-state, moderate exercise, during high-intensity exercise, the body produces lactate more quickly than it can absorb it. Glycolysis is a linear, biphasic metabolic pathway whose terminal substrate is lactate. Pyruvate is converted to lactate in

anaerobic conditions, such as during vigorous skeletal muscular contractions. Anaerobic glycolysis is the term used to describe this process [6].

Anaerobic capacity is a measurement of the combined ability of both anaerobic routes (glycolysis and ATP-PC) to produce energy, an indicator of the ATP-CP system is anaerobic power. The fatigue index, which is a percentage decrease in power, is used in the Wingate test to assess a person's capacity to produce metabolic energy and their fatigability.

It also measures the maximum power output attained and indirectly examines anaerobic power and anaerobic fatigue [7]. This supramaximal exercise test consists of 30 seconds of riding on a manually or electrically braked cycle ergometer at maximum speed against constant force [8], [9]. Weight of the body and degree of fitness of the subjects are used to decide how much force is applied during the test [10].

Exercises that increase heart beat and breathing rate above basal levels like in cycling, jogging, walking and running are examples of the "active recovery" submaximal recovery. Blood lactate mobilisation and maintaining a higher mean and peak power output during repeated testing have been observed to benefit from passive recuperation, which entails the person reclining comfortably for an extended period of time [11], [12].

MATERIALS AND METHOD

The study had 40 participants who were chosen from among Navi Mumbai, Maharashtra college students. The participants' average age was 23.05 ± 2.42 years, their average height was 173.63 ± 5.57 cm, and their average body weight was 69.40 ± 4.31 kg (Table 1). They were split into two groups: Control/Passive Recovery (N=20) and Experimental/Active Recovery (N=20).

To measure the blood lactate subjects were made to sit and relax comfortably. The area chosen for blood sample collection was index finger tip. The area was steriled and pricked with lancet device. Hand held StatStrip Xpress 2 lactate meter used to detect the blood lactate (Nova Biomedical, USA) process by electrochemical biosensor for the sample volume of 0.7 mL. The time for reading was 13 seconds, with measurement range from 0.3 – 20.0 µM/L[13]. As the supramaximal exercise, the Wingate Anaerobic Power Test (WAPT) was selected, and a leg ergometric bicycle (COSCO Fitness 170 R Recumbent Bike) with a weight bearing device was utilised. Due to the intense nature of the exercise, the subjects warmed up at a rate of 60 cycles per minute and received a 1.5 kg workload before to the exercise. Every 20 seconds, workloads ranging from 3 to 5 seconds were imposed in the meantime.

A cycling ergometer with mechanical brakes serves as the testing apparatus. After five minutes and after the three sprints at different resistances that make up the warm-up, the athlete can off the bike by either remain on the bike and spin gently for three minutes, or during the recovery. The sportsperson then starts to Pedal as quickly as you can with little to no resistance. Three seconds later, the subject continues to pedal to maximum output for 30 seconds, while resistance is provided to the flywheel [14], [15], [16]. While the passive recovery group was given comfortable sitting with back support, the active recovery group engaged in 20 minutes of activity at a 50% intensity of the observed peak output achieved on a cycle ergometer [17], [18].

Table 1

	Warm-up	**Resistance (% TBW)**	**Start (rpm)**
Male	5 min @ 2.0 % TBW 5 sec sprint @ 4.1% TBW 3 min recovery @ 0% TBW	8.3	60
Female	5 min @ 2.0 % TBW	7.5	60
	5 sec sprint @ 3.7% TBW 3 min recovery @ 0% TBW		

STATISTICAL ANALYSIS

The SPSS 23.0 package was utilised for data calculation and evaluation. Normal distribution of data was analysed with Kolmogorov-Smirnov and Shapiro-Wilk tests. The mean and standard deviation were used to summarise the measured variables. Repeated measures of ANOVA utilised to determine group differences, whereas an unpaired 't' test employed to find between group differences.

RESULTS

Blood lactate levels were shown to have steadily increased from baseline values of 1.19 ± 0.31 and 1.44 ± 0.24 in the Active and Passive recovery groups, respectively, immediately following the anaerobic power test (Table No 2). Blood lactate levels increased gradually in both groups; in the fifth minute, the experimental group's value peaked at 16.64 ± 0.54 while the control group's value was 17.74 ± 0.97. Furthermore, no discernible variation was discovered in the group analysis between Group B at 0 and 5 minutes and Group A in 3 and 5 minutes. We also noted that the blood lactate gradually disappeared in both groups starting in the tenth minute, seen in experimental group showing superior results than the control group at the end of 60th minute

This study exhibited a significant difference ($p<0.005$) between the experimental and control groups at the 0, 3, 5, 30, and 60-minute marks. The active recovery group had a better mean difference (-0.925) than the passive recovery group (-1.830), despite the fact that both groups had a substantial difference at the conclusion of the 60th minute compared with resting blood lactate level (i.e., BL rest -10 min).

Table 2

Group	**N**	**Age (yr)**	**Height (cms)**	**Body Weight (kgs)**
Experimental	20	23.2 ± 1.91	171.12 ± 4.10	69.57 ± 4.01
Control	20	22.9 ± 2.9	174.03 ± 3.56	69.24 ± 4.69

Table 3

Time	**Experimental Group A (in mMol/L)**	**Control Group B (in mMol/L)**
BL rest -10 min	1.19 ± 0.31	1.44 ± 0.24
BL 0 min	14.65 ± 0.91*	16.20 ± 1.41*
BL 3 min	16.16 ± 0.80*	16.84 ± 1.14*
BL 5 min	16.64 ± 0.54*	17.74 ± 0.97*
BL 10 min	13.20 ± 1.46*	12.57 ± 1.24*
BL 15 min	10.50 ± 0.99*	10.11 ± 1.05*

BL 30 min	8.47 ± 0.78*	7.30 ± 0.64*
BL 60 min	2.11 ± 0.48*	3.27 ± 0.62*

Figure 1

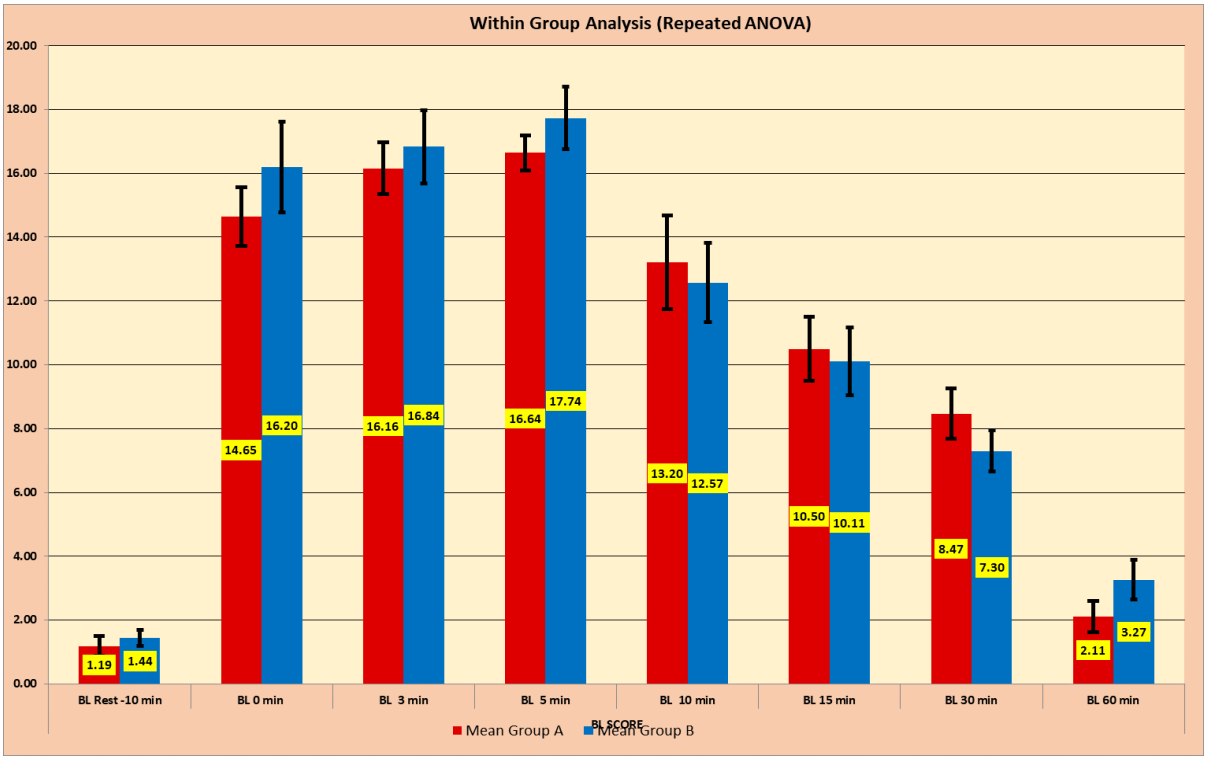

Figure 2

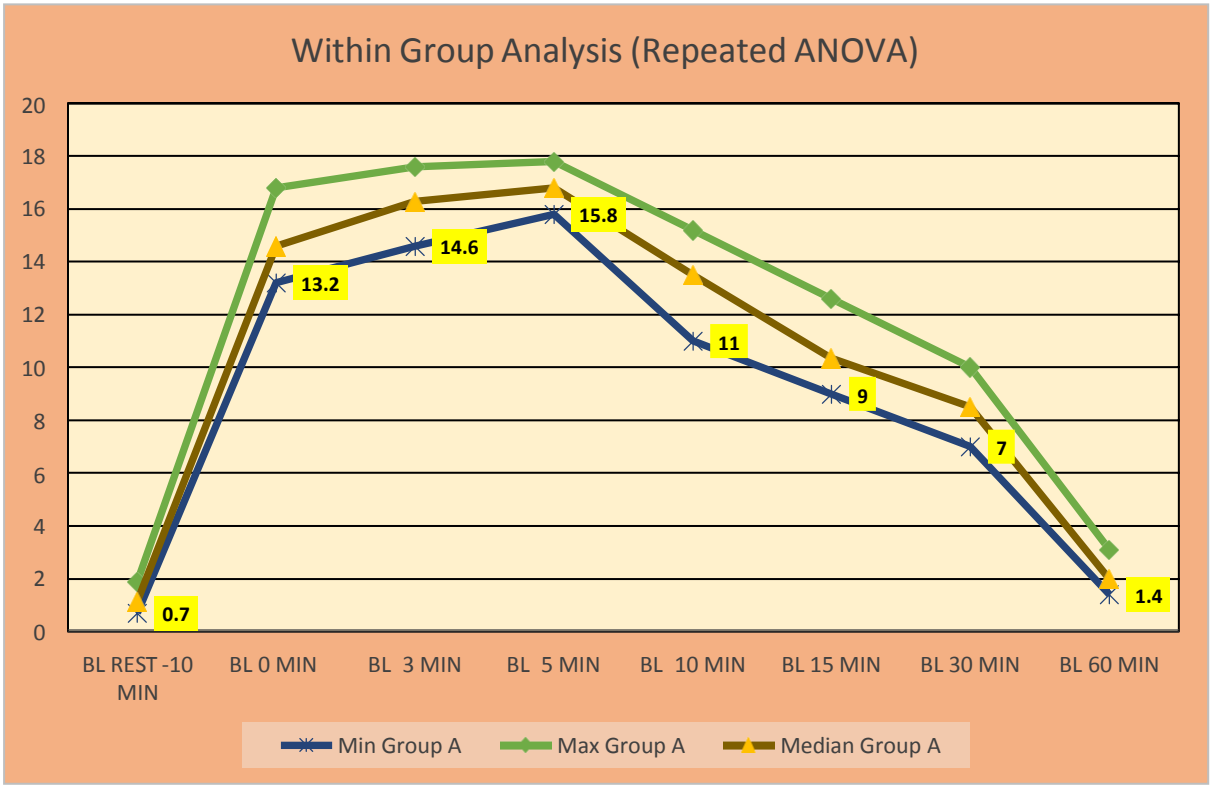

Figure 3

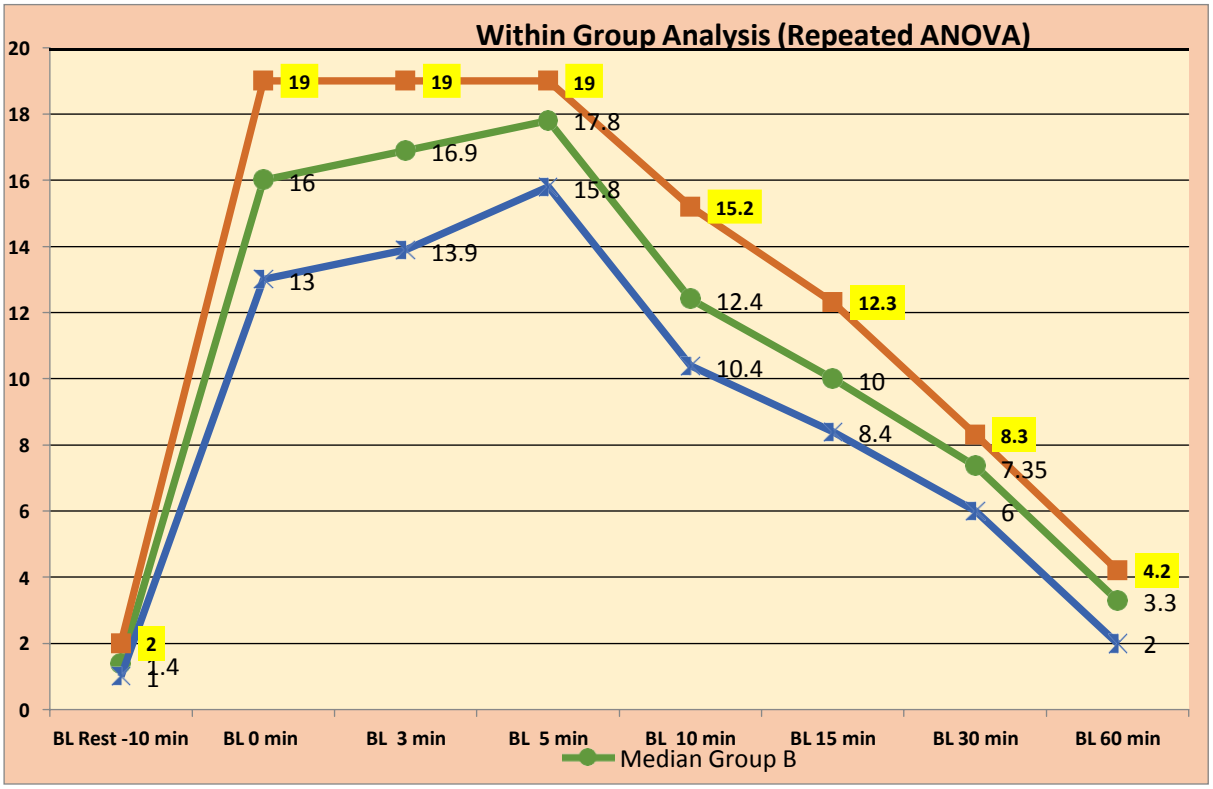

Table 4

t -Test			
Active Recovery Vs Passive Recovery		t	P-Value
Pair 1	BL Rest-10 min	-2.897	.009*
Pair 2	BL 0 min)	-4.948	.000*
Pair 3	BL 3 min	-2.160	.044*
Pair 4	BL 5 min	-4.997	.000*
Pair 5	BL 10 min	1.662	.113
Pair 6	BL 15 min	.986	.336
Pair 7	BL 30 min	5.397	.000*
Pair 8	BL 60 min	-9.374	.000*
Pair 9	Summation of All min	-3.211	.005*

*P<0.05 Indicates significance

DISCUSSION

Recovery plays a critical role in sustaining performance because it lowers tiredness, stabilises the acid-base balance, and speeds up the pace of energy regeneration [19], [20]. Studies have indicated that active recovery is superior than passive recovery in terms of enhancing exercise ability and reducing blood lactate concentration after multiple sessions of moderate-to-high resistance [10], [21]. It is believed that a moderate exercise is more advantageous in removing lactate level because it preserves blood supply to working muscles and encourages the elimination of metabolic waste products like inorganic phosphate, which reduce muscular contractility [7], [22], [23]. Blood lactate can be more easily eliminated because lactate is carried to the liver by the circulation[22].

Conversion of lactate into glucose is called as gluconeogenesis and lactate dehydrogenase happening at Liver (Cori Cycle). The blood circulation then transports the glucose produced by the Cori Cycle again to the working muscles where it is utilised to produce ATP. It has been also found that the blood lactate disappearance seen better when the workout at 15-65% of VO_2 max [18], [19], [24], [25]. Whereas, Menzies et al. [26] concluded that active recovery was better for lactate clearance than both passive recovery and active recovery at work load between 80 and 100% of lactate threshold level.

Following strenuous activity, large levels of metabolic byproducts are created, including H^+ ions and inorganic phosphate, which may not be fully recovered from in a short amount of time [27]. It is thought that in order to lower blood lactate levels, promote phosphocreatine and ATP regeneration, and clear hydrogen ions to correct acidosis, a long-time active recovery—one that lasts five minutes or longer—is superior than a short duration active recovery [7], [19], [28]. In addition, a 10-to 20-minute active recovery period was sufficient to achieve complete phosphocreatine resynthesis as well as a notable recovery of muscle pH and lactate [28], [29]. The overwhelming weight of evidence indicates that moderate to high intensity active recovery is better than lower intensity active recovery, despite the fact that a lot of data indicates that lower intensity active recovery is superior to passive recovery for lactate removal and increased peak power and mean power output values [17], [18].

CONCLUSION

Active recovery after maximal, all-out exercise that quickly raises blood [La-] to >10 mM is advantageous for blood lactate clearance. Additionally, because of the intensity-based nature of active recovery, it generates the fastest rate and shortest time constant for removing accumulated lactate. This could help develop plans for quick recovery and lactate excretion removal following intense and prolonged workout sessions.

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