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EFFECTS OF RECOVERY INTERVENTIONS ON LACTATE REMOVAL OF SHUTTLERS

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ABSTRACT

The purpose of the study was to find out the effects of recovery innervations on lactate removal of shuttlers after matches. Total 30 subjects were purposively selected from Muzaffarpur district of State level and selected subjects were divided into 3 groups of, of 10 subjects in each group. The study was delimited to male players only age ranged 15 to 17 years. The selected variable for the study was Lactic Acid. The reading of Lactic acid was measured and recorded accordingly after match and Recovery method. The subjects performed different recovery method on different days. The data for lactic acid was collected pre match, After match and post recovery methods. Capillary blood samples were taken for lactic acid. Descriptive statistics (mean and standard deviation) were calculated for each group's lactate levels at each time point. 2-way mixed analysis of variance (ANOVA) was conducted to assess the differences in lactate removal between the three recovery modalities at 0.05 level of significance. The descriptive statistics showed that peak lactate value of all the three groups were foam rolling (13.665±0.914), active recovery (13.63±2.003), passive recovery (12.265±2.406) also the post lactate value after recovery modalities were found to be foam rolling (5.04±0.840), active recovery (7.135±1.450), passive recovery (11.105±4.161). The foam rolling group showed the most pronounced decrease in lactate levels across all time points, followed by active recovery. Passive recovery has the smallest effect, though it still led to significant reduction in lactic acid compared to baseline.

INTRODUCTION

Lactate accumulation during high-intensity exercise is a common physiological response that can impair athletic performance, especially in sports characterized by repeated sprints and sudden bursts of energy, such as badminton. As a shuttle-based sport, badminton demands rapid movements, quick directional changes, and sustained anaerobic activity, leading to significant lactate buildup in the muscles. This metabolic byproduct, while essential for energy production during intense exertion, can contribute to muscle fatigue, soreness, and decreased performance if not effectively cleared from the bloodstream. An anaerobic, high-intensity sport, badminton demands quick bursts of speed, agility, and stamina. Intense badminton matches cause players' muscles to build up a lot of lactic acid, which impairs performance and increases the chance of injury. The process of lactate elimination is essential for athletes to recuperate from strenuous exercise and function at their best. A common practice among coaches and athletes is cooling the body to speed up performance recovery. Athletes and coaches need to understand how to teach the body to deal with lactic acid. Training your muscles, body, and mind to achieve performance increases is essential if you want to succeed in today's fiercely competitive sport. Recovery techniques like foam rolling and active recovery have been suggested as ways to increase lactate elimination and boost sports performance. It is unclear, therefore, how well these treatments work to remove lactate from shuttlers. In order to provide evidence-based recovery strategies to maximize performance and lower injury risk in this demanding activity, this study intends to examine the impact of various recovery interventions on lactate elimination in shuttlers. Coaches and athletes now frequently use cooling techniques to speed up performance recovery.

Recovery interventions play a crucial role in accelerating lactate removal from the body, thus promoting faster recovery and reducing the risk of fatigue during subsequent bouts of activity. Various recovery strategies, such as foam rolling, active recovery and passive recovery have been studied for their effects on lactate clearance and overall post-exercise recovery. However, the impact of these interventions specifically on shuttle sports athletes like badminton players remains underexplored. This research aims to investigate the effects of different recovery interventions on lactate removal in shuttle athletes, particularly those involved in badminton, where speed and agility are paramount. By understanding the most effective methods for lactate clearance, this study seeks to contribute to optimizing recovery practices for badminton players, enhancing their performance and minimizing the risk of injury associated with elevated lactate levels.

PURPOSE OF THE STUDY

The main purpose of the study is to find out the effects of recovery innervations on lactate removal of shuttlers after matches.

HYPOTHESIS

On the basis of literatures, discussion with the experts and personal experience it was hypothesized that there might be significant difference in Lactic acid of Shuttler after Foam Rolling, Active Recovery and passive recovery.

SELECTION OF SUBJECT

A total of 30 participants (10 male from each group) aged between 15 to 17 years were recruited for the study. All participants were physically active and had experience in playing badminton. Participants were required to provide written informed consent, and all procedures were approved by an ethics committee to ensure the safety and well-being of the participants.

SELECTION OF VARIABLES

The selected variables for the study were

- **Independent variables:** foam rolling, active recovery and passive recovery
- **Dependent variable:** Lactic acid

METHODOLOGY

First of all, the subjects get introduced about the whole study and the procedure which we were supposed to follow. On day 1 subjects were allowed to play singles match and it was ensured that match must be played between two equivalent players. The shuttlers were given Foam Rolling Recovery method on Group A. On day 2 the second shift data collection process was followed on group 2. This time the shuttlers were given Active Recovery taking all the environment condition same as day 1 similarly on day 3 the shuttlers were given passive recovery the pre-match and post-match data of lactic acid was collected. The study utilized a within-subject design, where each participant was exposed to all three recovery interventions (foam rolling, active recovery, and passive recovery) in random order to minimize any order effects. There was a washout period of at least 48 hours between each condition to ensure full recovery between testing sessions. The research was conducted in a controlled environment to minimize external factors that could affect lactate levels and recovery processes.

PROCEDURES

1) **Pre-Exercise Lactate Measurement**

Before the badminton match, baseline lactate levels were measured for each participant. A small blood sample was obtained by pricking the tip of the participant's finger using a lancet, and lactate readings were taken using a LactoSpark lactate meter. This baseline reading served as a reference for comparing lactate levels after the badminton match and post-recovery.

2) **Badminton Match Protocol**

   Participants played a standard 20-minute badminton match, which was designed to simulate the high-intensity, intermittent activity typical of shuttle sports. During the match, participants were encouraged to play at their normal intensity level to ensure a natural accumulation of lactate.

3) **Post-Match Lactate Measurement**

   Immediately after the badminton match, lactate levels were measured again to assess the accumulation of lactate during exercise. A finger prick blood sample was taken, and lactate levels were recorded using the LactoSpark lactate meter.

4) **Post-Recovery Lactate Measurement**

Following the post-match lactate measurement, participants were assigned to one of three recovery interventions:

- **Foam Rolling:** Participants performed self-myofascial release using a foam roller for 10 minutes, targeting major muscle groups used in badminton, such as the quadriceps, hamstrings, calves, and glutes.
- **Active Recovery:** Participants engaged in 10 minutes of low-intensity cycling or jogging, maintaining a heart rate of approximately 50-60% of their maximal capacity, to promote circulation and lactate clearance.
- **Passive Recovery:** Participants were instructed to rest in a seated position for 10 minutes without engaging in any physical activity. During this period, they were encouraged to relax and allow the body to naturally clear lactate without any additional intervention.

Lactate levels were measured again immediately following the recovery modality. A finger prick blood sample was taken, and lactate levels were recorded using the LactoSpark lactate meter. These readings were compared to post-match lactate levels to determine the effectiveness of each recovery modality.

DATA ANALYSIS

The lactate readings from each measurement point (pre-exercise, post-exercise, and post-recovery) were analyzed using statistical software (e.g., SPSS). Descriptive statistics (mean and standard deviation) were calculated for each group's lactate levels at each time point. 2 way mixed analysis of variance (ANOVA) was conducted to assess the differences in lactate removal between the three recovery modalities. Pairwise comparisons were performed using post-hoc tests to identify significant differences between each recovery modality. The level of significance was set at $p<0.05$.

Ethical Considerations

The study was approved by an ethics committee, and all participants provided written informed consent before participation. Participants were informed of their right to withdraw from the study at any time without penalty. All data were anonymized to maintain confidentiality.

RESULT AND DISCUSSION

Table 1: Descriptive statistics of lactic acid for different recovery modalities at different time intervals.

Recovery modalities		Mean	Standard Deviation	Min	Max
Foam rolling	Lac_1	3.0750	.91587	1.30	4.20
	Lac_2	13.6650	.91495	12.30	15.20
	Lac_3	5.0400	.84068	3.70	6.60
Active recovery	Lac_1	3.0450	.97628	1.10	4.30
	Lac_2	13.6300	2.00318	11.20	19.40
	Lac_3	7.1350	1.45069	4.20	8.90
Passive recovery	Lac_1	3.8700	1.75442	1.30	6.50
	Lac_2	12.2650	2.40641	8.70	16.30
	Lac_3	11.1050	4.16141	3.20	17.30

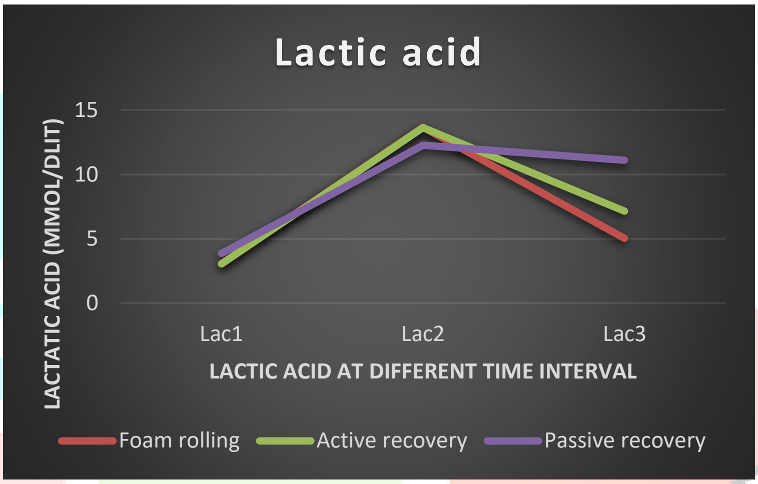

Fig 1: Graphical representation of mean lactic acid for selected recovery modalities at different time interval.

Table 2: Tests of Within Subjects Effects on lactic acid among all the recovery modalities group

Source	Type III sum of squares	Df	Mean square	F	Sig.
Time	4078.352	2	2039.176	574.813	.000
Time * treatment	340.202	6	56.700	15.983	.000

Table 3: Tests of Between-Subjects Effects on lactic acid among different recovery modalities

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	16341.601	1	16341.601	4699.321	.000
Treatments	119.854	3	39.951	11.489	.000
Error	264.285	76	3.477		

Table 4: Post Hoc test of Tukey HSD for comparison of lactic acid of various recovery modality group.

Dependent Variable	Treatment (I)	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.
	Foam rolling	Active recovery	-6.06500*	.76898	.000
		Passive recovery	-2.23000*	.76898	.025
	Active recovery	Foam rolling	-3.97000*	.76898	.000
		Passive recovery	1.74000	.76898	.116
	Passive recovery	Foam rolling	3.97000*	.76898	
		Active recovery			.000

*. The mean difference is significant at the .05 level.

Table 5: Analysis of variance of lactic acid of different recovery modalities group

Modalities	Type III Sum of Squares	df	Mean Square	F	Sig.
Foam rolling	1269.333	2	634.666	927.816	.000
Active recovery group	1139.702	2	569.851	223.584	.000
Passive group	827.779	2	413.890	48.853	.000

Table 6: Pairwise comparison of various readings of lactic acid of foam rolling group

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.b
1	2	-10.590*	.227	.000
	3	-1.965*	.280	.000
2	1	10.590*	.227	.000
	3	8.625*	.274	.000
3	1	1.965*	.280	.000
	2	-8.625*	.274	.000

Table 7: Pairwise comparison of various readings of lactic acid of active recovery group

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.b
1	2	-10.585*	.532	.000
	3	-4.090*	.296	.000
2	1	10.585*	.532	.000
	3	6.495*	.628	.000
3	1	4.090*	.296	.000
	2	-6.495*	.628	.000

Table 8: Pairwise comparison of various readings of lactic acid of passive recovery group

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.[b]
1	2	-8.395*	.714	.000
	3	-7.235*	.968	.000
2	1	8.395*	.714	.000
	3	1.160	1.046	.844
3	1	7.235*	.968	.000
	2	-1.160	1.046	.844

DISCUSSION

The results of this study indicate that all three recovery modalities—foam rolling, active recovery, and passive recovery—significantly affect the removal of lactic acid in badminton players after intense exercise. The analysis of within-subject effects (Table 2) showed a significant time effect on lactic acid levels, with clear reductions observed following the recovery interventions. The interaction between time and treatment also significantly influenced lactate clearance, confirming that the recovery modality chosen can modify the rate of lactate removal.

From the between-subjects effects (Table 3), there was a significant difference between the recovery modalities in their ability to clear lactic acid. This suggests that the type of recovery method used plays a crucial role in post-exercise recovery for shuttle sports athletes.

Tukey's post-hoc analysis (Table 4) further clarified the specific differences between the recovery modalities. Foam rolling was found to be significantly more effective than passive recovery in reducing lactic acid levels (mean difference = -2.23), and it also outperformed active recovery (mean difference = -6.065). However, active recovery and passive recovery did not differ significantly from each other, suggesting that foam rolling may be the most beneficial method for lactate clearance among the three modalities.

Looking at the analysis of variance (Table 5), the foam rolling group showed the most pronounced decrease in lactate levels across all time points, followed by active recovery. Passive recovery had the smallest effect, though it still led to significant reductions in lactic acid levels compared to baseline.

The pairwise comparisons within each modality group (Tables 6–8) confirm these findings, showing significant differences in lactate levels between the pre-exercise, post-exercise, and post-recovery measurements. For instance, in the foam rolling group, the lactate reduction from post-exercise to post-recovery was highly significant (mean difference = -10.59), similar to the active recovery group (mean difference = -10.59), while the passive recovery group demonstrated a smaller but still significant reduction (mean difference = -8.39).

CONCLUSION

In conclusion, foam rolling emerged as the most effective recovery modality for lactate removal in badminton players, followed by active recovery. Passive recovery, while still beneficial, showed the least effect in reducing lactate levels. These findings suggest that incorporating foam rolling into recovery routines could enhance post-exercise recovery, improving performance and reducing fatigue in shuttle sports athletes.

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