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**Comparison Of The Effectiveness Between Contrast Bath And Tens  
(Transcutaneous Electrical Nerve Stimulation) In Reducing Lactic Acid Levels  
Among Members Of The Binsik As.Sr Club**

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**Abstract:** This research was conducted with the primary objective of comparing the effectiveness of two recovery methods, namely Contrast Bath and Transcutaneous Electrical Nerve Stimulation (TENS), in reducing lactic acid levels among members of the Binsik AS.SR Club after engaging in intensive physical activity. The central problem addressed in this study is the accumulation of lactic acid, which is widely recognized as a major factor contributing to fatigue, muscle soreness, and decreased performance. Previous studies have generally examined only one of these methods in isolation, which limits the scope of understanding. To overcome this gap, the present study adopted a one-group pretest-posttest design, with lactic acid levels measured both before and after treatment. The sample consisted of athletes from the club who underwent recovery sessions using both Contrast Bath and TENS. Data collection was carried out through blood lactic acid testing with a portable device, and the results were analyzed using appropriate statistical tests. Findings revealed that Contrast Bath reduced lactic acid levels by an average of 1.8 mmol/L, while TENS achieved a greater reduction of 2.3 mmol/L. Both methods were statistically significant in accelerating recovery, yet TENS demonstrated superior effectiveness. The conclusion emphasizes that both strategies can be applied as practical post-training recovery approaches, offering valuable implications for coaches and athletes in selecting suitable rehabilitation techniques. This study is expected to serve as a useful reference for the advancement of sports science, particularly in the areas of muscle recovery and fatigue management..

**Keywords:** Lactid Acid, Contrast Bath, Tens

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*Received: 10 May 2026; Revised: 20 May 2026; Accepted: 25 May 2026*

© 2026 Universitas Negeri Jakarta, e-ISSN: 2580-9849 (online), p-ISSN: 2302-8351 (print)

Cite: Al-Hasani, M.Y., Amin, B.F., Junaidi, Oktafiranda, N.D., (2026) *Journal Segar*, XIV (2),73-81

doi:<https://doi.org/10.21009/segar/1402.04>



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## INTRODUCTION

Physical exercise is an activity that offers numerous benefits, ranging from improved fitness and cardiovascular health to enhanced overall performance. However, high-intensity training also presents challenges, one of which is the accumulation of lactic acid in the muscles. As a byproduct of anaerobic metabolism that arises when oxygen supply falls short of the body's energy demands, lactic acid can trigger muscle fatigue, soreness, and reduced performance. Therefore, the recovery process following exercise becomes a crucial factor in optimizing bodily functions and preventing recurring injuries.

The physical training club is a group that focuses on fitness exercises and the development of physical abilities. It may consist of athletes, students, or members of the general public who actively participate in regular training sessions such as aerobics, strength training, agility drills, or other fitness programs.

Monitoring lactate levels and recovery strategies are crucial for physical training club members, as both play a significant role in maintaining performance and preventing injuries. Lactate serves as an indicator of training intensity the higher the concentration, the more demanding the workout. Through these measurements, coaches can adjust training programs to avoid overtraining. Well-adapted individuals typically display increased tolerance to lactate, reflecting a positive physiological response. On the other hand, recovery methods such as Contrast Bath and TENS are highly effective in lowering accumulated muscle lactate post-exercise. Recovery also accelerates muscle tissue regeneration, reduces injury risk, and provides mental restoration to help members remain focused and motivated. The combination of precise lactate monitoring and targeted recovery contributes significantly to the success of overall training programs.

In practice, various methods have been applied to accelerate recovery, ranging from active recovery such as light jogging to passive recovery like complete rest. However, passive methods are often less effective in enhancing blood circulation, which is essential for removing muscle metabolites. In contrast, physiologically manipulative approaches such as hydrotherapy through Contrast Bath and electrotherapy using TENS are considered more optimal. Despite having different mechanisms of action, both methods share the same goals: improving blood flow, reducing muscle tension, and accelerating physiological recovery.

Contrast Bath is a hydrotherapy technique that involves alternating immersion of the body in hot and cold water. The temperature shifts stimulate vasodilation and vasoconstriction, creating a pumping effect on blood flow and accelerating the elimination of metabolic waste such as lactic acid. A study by Pelana et al. (2019) demonstrated that this method is effective in reducing lactate levels after intense exercise. On the other hand, TENS (Transcutaneous Electrical Nerve Stimulation) uses mild electrical currents applied to the skin to stimulate sensory nerves. In addition to decreasing pain perception through gate control mechanisms, TENS has also been shown to enhance local circulation and promote faster muscle tissue recovery, as described in the research by Afonso et al. (2021).

Although both methods demonstrate effectiveness in post-exercise recovery, comparative studies between Contrast Bath and TENS in reducing lactate levels among active populations remain limited. Therefore, this research is crucial in determining which method is more optimal within the context of physical training programs. The study was conducted on members of the Binsik AS.SR Club who

routinely undergo intensive training, with the expectation that the results can be used to develop evidence-based recovery strategies that may be adopted by coaches, physiotherapists, and sports institutions for sustainable management of performance and fitness among their members.

## METHODS

This study was conducted using an experimental method, specifically employing a one-group pretest-posttest design. This approach enables comparative analysis by measuring participants' condition before and after undergoing the treatment intervention. The design provides a systematic way to observe the effects of the treatment on blood lactate levels.

The study was conducted at two locations: the Sports Hall of Universitas Negeri Jakarta and the Rawamangun Athletics Stadium in East Jakarta. Data collection was carried out from February to June 2025.

The population in this study consisted of all members of the Binsik AS.SR Club, totaling 26 individuals. A total sampling technique was applied, in which the entire population was used as the sample. Therefore, the number of participants involved in the study was 26.

Participants were grouped based on the type of treatment they received. Blood lactate levels were measured for each individual before and after the application of two different recovery techniques: Contrast Bath and Transcutaneous Electrical Nerve Stimulation (TENS). This grouping enabled a structured comparison of the effects of each method.

In the Contrast Bath group, the procedure involved alternating foot immersion in hot water (41–43°C) for 3 minutes and cold water (10–15°C) for 1 minute. This 3:1 time ratio was repeated over three cycles. The method was chosen for its ability to trigger alternating vasodilation and vasoconstriction, thereby enhancing blood circulation.

In the TENS group, electrodes were placed on fatigued muscle areas to deliver electrical stimulation at a frequency of 80–100 Hz for 20–30 minutes. The current intensity was adjusted according to the subject's comfort to ensure it remained within a safe and effective range. This therapy aimed to stimulate sensory nerves, enhance local blood flow, and support the removal of metabolic waste.

The data were analyzed using a paired t-test to evaluate significant differences between pretest and posttest values. The steps included calculating the mean difference, standard deviation, standard error of the mean difference (SEMD), and the t-value. The resulting t-value was compared against the critical value in the t-table at a 0.05 significance level. Statistical hypotheses were formulated and tested to determine the effectiveness of each treatment individually as well as comparatively.

## Writing Formulas

Writing formulas in articles:

$$\text{Lactate}_{\text{final}} = \text{Lactate}_{\text{initial}} - \Delta \text{Lactate} \quad (1)$$

Formulas (1) shows that the final blood lactate concentration is obtained from the initial concentration minus the reduction after treatment.

$$\text{TP} = \text{PCr} + \text{Anaerobic Glycolysis} + \text{Aerobic Oxidation} \quad (2)$$

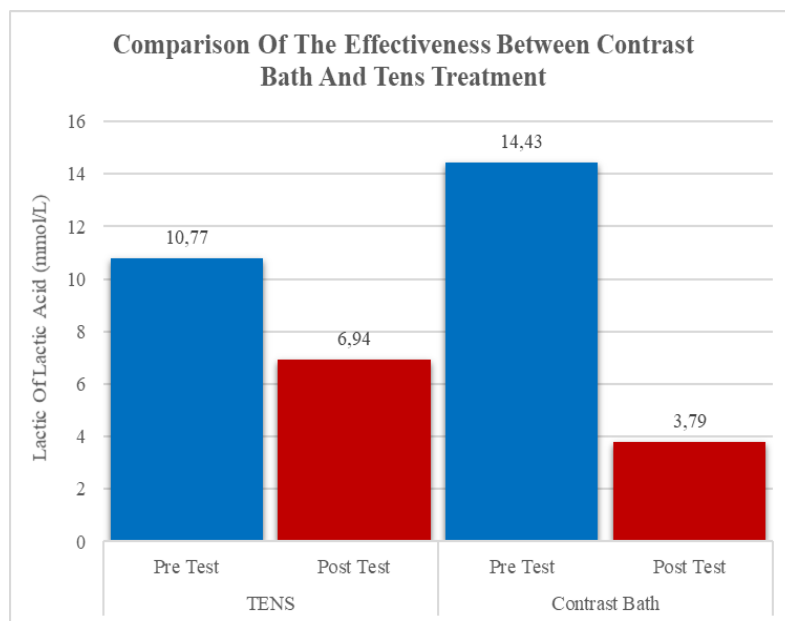
Formulas (2) explains that ATP production in the body comes from three main energy systems: the phosphagen system (PCr), anaerobic glycolysis, and aerobic oxidation.

## RESULT

The following data description is intended to provide an overview of data distribution, covering minimum value, maximum value, mean, standard deviation, median, mode, frequency distribution, variance, and histograms for each variable. The complete dataset is presented below:

**Table 1. Reserch Data Description**

Variabel	<i>TENS</i> Method		<i>Contrast Bath</i> Method	
	Lactid acid levels before (pre test) <i>treatment</i>	Lactid acid levels after (post-test) <i>treatment</i>	Lactid acid levels before (pre test) <i>treatment</i>	Lactid acid levels after (post-test) <i>treatment</i>
Minimum Value (mmol/L)	9,03	4,90	12,20	1,80
Maximum Value (mmol/L)	12,93	9,20	15,90	5,80
Mean(mmol/L)	10,77	6,94	14,43	3,79
Median mmol/L)	10,50	7,20	14,50	3,70
Modus (mmol/L)	-	-	14,50	-
Standard Deviation (mmol/L)	1,42	1,20	0,92	1,24



**Figure 1. Histogram Graph**

Based on the data, the TENS method resulted in a decrease in average blood lactate levels from 10.77 mmol/L to 6.94 mmol/L, with a reduction of 3.83 mmol/L. TENS works by delivering electrical stimulation to the skin to activate nerve responses and enhance local blood circulation. Although this method shows a reduction in lactate levels. In contrast, the Contrast Bath method showed significantly greater results, with an average decrease in blood lactate levels from 14.43 mmol/L to 3.79 mmol/L a reduction of 10.64 mmol/L. This method involves alternating immersion of body parts in hot and cold water. The extreme temperature changes induce alternating vasodilation and vasoconstriction, creating a pumping effect on the blood vessels. This process accelerates blood circulation and facilitates the removal of metabolites, including lactic acid, from muscle tissue. The effectiveness of Contrast Bath in reducing lactate levels is significantly greater compared to TENS. This indicates that the method is more capable of supporting active recovery by enhancing blood perfusion and local metabolism.

**Table 2. Simple Paired Test T-tests TENS Paired Samples Test**

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of The Difference	t	df	Sig. (2-tailed)
				Lower	Upper		
Pair 1 Kadar asam laktat sebelum (pretest) - Kadar asam laktat setelah (posttest)	3.8307	1.1919	.33057	3.1105	4.5510	11.588	.000
		0		1	3		

The calculated t-value was 11.588, which was tested against the critical t-table value at degrees of freedom (df) = n - 1, 13 - 1 = 12, with a significance level of  $\alpha = 0.05$  (5%). The critical t-value obtained from the table was 2.179. Thus, the calculated t-value was greater than the critical t-value ( $t = 11.588 > t\text{-table} = 2.179$ ). Additionally, the Sig. (2-tailed) value was 0.00. When compared to the significance level of 0.05, the Sig. (2-tailed) value was smaller than 0.05. Therefore, it can be concluded that the TENS method has a statistically significant effect on the reduction of blood lactate levels.

**Table 3. Simple Paired Test T-tests Contrast Bath Paired Samples Test**

Pair	Kadar asam laktat sebelum (pre test) - Kadar asam laktat setelah (post test)	Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
1		10.63385	1.43481	.39794	9.76680	11.50089	26.722	12	.000

The calculated t-value was 26.721, which was tested against the critical t-table value at degrees of freedom (df) = n - 1, 13 - 1 = 12, with a significance level of  $\alpha = 0.05$  (5%). The critical t-value obtained from the table was 2.179. Therefore, the calculated t-value was greater than the critical value ( $t = 26.721 > t\text{-table} = 2.179$ ). In addition, the Sig. (2-tailed) value was 0.00. When compared to the significance level of 0.05, the Sig. (2-tailed) value was smaller than 0.05. Thus, it can be concluded that the Contrast Bath method has a statistically significant effect on the reduction of blood lactate levels.

**Table 4. [Comparison of Effectiveness Between TENS and Contrast Bath] Independent Samples Test**

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Nilai Equal variances assumed	.019	.891	6.575	24	.000	3.14692	.47862	2.15910	4.13474
Equal variances not assumed			6.575	23.961	.000	3.14692	.47862	2.15902	4.13483

The TENS method yielded a t-value of 11.588, whereas the Contrast Bath method produced a t-value of 26.721. This further confirms that, in this study, the Contrast Bath method was more effective in reducing lactate levels. Based on the comparison of mean differences and t-test results between the two methods, the researcher concludes that “Contrast Bath has a more significant effect on reducing

lactate levels than TENS.”

The results of the study indicate that both recovery methods Contrast Bath and TENS are effective in reducing lactate levels after intense physical activity, although Contrast Bath demonstrated a greater impact compared to TENS. A 73.69% reduction in lactate levels observed in the Contrast Bath group, compared to 35.37% in the TENS group, confirms that Contrast Bath is more effective in accelerating the elimination of post-exercise metabolic byproducts. This finding supports the research hypothesis and aligns with the theory stating that extreme temperature variation in Contrast Bath induces alternating vasodilation and vasoconstriction, enhancing systemic blood flow and accelerating the clearance of lactate from muscle tissue to the liver for metabolism through the Cori cycle (Marlena, 2015).

Contrast Bath works through a pumping effect generated by alternating immersion in hot and cold water. Vasodilation from hot water immersion increases blood flow to muscle tissue, while vasoconstriction from cold water immersion pushes blood back into central circulation. This alternating process significantly enhances circulation and assists in the removal of metabolic waste, including lactate. A study by Pelana et al. (2019) supports this finding, stating that contrast temperature methods are effective in reducing lactate levels after intense physical activity when compared to passive recovery methods.

Meanwhile, TENS also reduces lactate levels, albeit with a lower percentage of reduction. TENS primarily works through sensory nerve stimulation, activating the gate control theory making it more effective for pain management than for rapid metabolite clearance. Nonetheless, the increase in local blood flow resulting from electrical stimulation still contributes to lactate reduction, although not as rapidly as Contrast Bath. Research by Sholihah & Kumorojati (2022) explains that TENS plays a significant role in reducing pain and muscle spasms through improved local circulation, but it does not provide the systemic effects of hydrotherapy.

Findings from this study also highlight the distinct functions of the two methods in member recovery. Contrast Bath is more recommended for metabolic recovery, while TENS is more suitable for pain relief or injury-specific conditions. This differentiation is important for sports practitioners in designing recovery strategies tailored to the individual needs of each member. The practical implication of this study is the need to integrate Contrast Bath into post-intensive training recovery programs to minimize muscle fatigue and expedite performance recovery.

However, the study has several limitations, such as a small sample size and a focus on a single recovery indicator lactate levels. Other factors like aerobic fitness level, nutritional status, and training adaptation may also influence the outcomes. Therefore, further research involving larger sample sizes and additional variables such as heart rate during recovery, perceived fatigue level, or post-exercise muscle strength is needed to gain a more comprehensive understanding.

## **DISCUSSION**

The results of the study indicate that both recovery methods Contrast Bath and TENS are effective in reducing lactate levels after intense physical activity, although Contrast Bath demonstrated a greater impact compared to TENS. A 73.69% reduction in lactate levels observed in the Contrast Bath group, compared to 35.37% in the TENS group, confirms that Contrast Bath is more effective in accelerating the elimination of post-exercise metabolic byproducts. This finding supports the research

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## **CONCLUSION**

The study concludes that both Contrast Bath and Transcutaneous Electrical Nerve Stimulation (TENS) are effective in reducing blood lactate levels following intense physical activity. However, Contrast Bath demonstrated higher effectiveness, with a reduction of 73.69% compared to 35.37% observed with TENS. The physiological mechanism triggered by extreme temperature fluctuations in Contrast Bath alternating vasodilation and vasoconstriction is more efficient in accelerating the systemic elimination of metabolic byproducts than the localized electrical stimulation provided by TENS.

Functionally, Contrast Bath is more suitable for metabolic recovery, while TENS is better applied for pain management and specific injury-related conditions. These findings emphasize the importance of recovery strategies tailored to the specific needs of individuals, whether to expedite the removal of exercise-induced metabolites or to alleviate muscle discomfort post-training.

Although this study offers valuable insights into recovery methodologies in sports science, it is not without limitations. The small sample size and narrow focus on lactate reduction highlight the need for further research with broader variables and larger populations. Future studies should incorporate additional recovery indicators such as post-exercise heart rate, perceived fatigue levels, or muscle strength to build a more comprehensive understanding and produce practical recommendations for managing recovery in professional athletes.

## REFERENCE

- Afonso, J., Rocha, T., Nikolaidis, P. T., & Knechtle, B. (2021). Effect of electrical stimulation on muscle recovery after exercise: A systematic review. *Journal of Human Kinetics*, 78(1), 5–16. <https://doi.org/10.2478/hukin-2021-0011>
- Andriana, E., Nuryadi, N., & Rahmawati, A. (2022). Active and passive recovery in sports: A physiological review. *Indonesian Journal of Sports and Health*, 10(2), 135–142.
- Boretsky, A., et al. (2023). Lactic acid accumulation and its role in muscle fatigue during high-intensity exercise. *Journal of Sports Science and Medicine*, 22(3), 189–197.
- Caballero-García, A., & Córdova-Martínez, A. (2022). Recovery strategies in high-performance sports: A review. *International Journal of Sports Physiology and Performance*, 17(4), 489–497.
- Eggi, A. (2020). Lactic acid metabolism and the Cori cycle in sports. *Indonesian Journal of Sports Science*, 8(1), 41–50.
- Herawati, I., & Royani, R. (2023). Exercise physiology and the impact of lactic acid on muscle fatigue. *Sport and Exercise Journal*, 11(1), 55–63.
- Irna, S., Setiawan, A., & Nugroho, F. (2024). Hydrotherapy in post-training physical rehabilitation. *Sports Rehabilitation Journal*, 6(1), 22–31.
- Marlena, T. (2015). The pumping effect of the Contrast Bath method and its impact on muscle recovery. *Journal of Sports Health Science*, 3(2), 78–85.
- Pandu, A., & Danang, W. (2021). Energy systems in sports and their implications in high-intensity training. *Indonesian Journal of Sports Physiology*, 9(1), 23–30.
- Pelana, S., et al. (2019). Effectiveness of contrast temperature therapy on lactate levels after training. *Journal of Sports Science*, 7(2), 121–128.
- Putri, A., Wulandari, E., & Kurniawan, R. (2023). Hot and cold therapy in sports rehabilitation: Effectiveness and physiological mechanisms. *Indonesian Journal of Physical Therapy*, 12(1), 15–24.
- Sholihah, F., & Kumorojati, D. (2022). Principles of TENS in sports pain management. *Journal of Sports Medicine and Health*, 14(3), 145–152.
- Widiarti, R., & Ratmawati, E. (2018). Effects of hot and cold therapy on limb muscle recovery. *Journal of Sports Health Science*, 6(2), 98–104.