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**Original Article**

# The Comparison of Active and Passive Recovery after one Session of Exhaustive Exercise Lactate Serum and Heart Rate Level among Runners

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## Abstract

**Background:** Considering the need of athletes to reach normal conditions and prepare for the next activities, the methods of removing lactic acid and reducing the heart rate are very important. The need of athletes to recover and to prepare for the next activities, methods of disposal lactic acid are important.

**Method**: 26 healthy elite men were selected and then randomly divided in two groups of 12 men in active and 14 men in passive group. Before exercise, lactate acid and heart rate were measured, then each runner performed Bruce test so that he became exhausted completely then immediately and after 10 minutes lactate acid and heart rate measured again and analyzed by repeated measures test (p>. /05).

**Results**: Results show that lactate acid and heart rate increase significantly immediately after exercise ($p$<.05). Changes 10 minutes after active and passive recovery decrease than after exercise but still increased significantly than before exercise (p<.05)..

**Conclusion**: Finding of this study showed that active recovery after an exhaustive training session causes significant According to the results of the research, it is suggested to perform active recovery after the exercises in order to eliminate more lactate.

**Keywords**: Athletes, Exercise, Heart Rate, Lactates

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## Introduction

One of the significant challenges that athletes have always been dealt with, especially during training and competition, is the return period to the initial state after training or competition. Return period is defined as the time it takes to reach the initial metabolic activity limit after an activity has ended. According to experts, the followings are the primary factors which contribute to fatigue and the places where it occurs: energy-generating mechanisms (such as phosphagen, glycolysis, and aerobic respiration), an accumulation of metabolic waste products, the nervous system, and the problems with the mechanism that cause muscle fibers to contract (15).

Lactic acid is a chemical that is created as a result of excessive muscular activity and is a byproduct of the inefficient Krebs cycle and respiratory chain as well as the anaerobic metabolism of glucose that takes place in the absence of oxygen. Fatigue results from lactic acid accumulation, which hinders muscular contraction. Since the turn of the 20th century, Lactic acid has been proposed as one of the most significant factors in fatigue and the failure to sustain the efficient process of power generation during highly strenuous sports activities (3). The length of the exercise appears to have an impact on how much lactic acid is reduced after active recovery, making the program helpful.

It seems that the duration of the exercise influences the effect of active recovery on the amount of lactic acid reduction; therefore, an active recovery program is beneficial for more than 5 minutes, but longer than 20 minutes can be detrimental (1). Additionally, this impact is dependent on the individual's sports background in such a way that the amount of lactic acid reduction after returning is faster and more in athletes than in non-athletes (1).

The simplest approach to measure workout intensity is to monitor heart rate. It goes without saying that when exercise intensity increases, so does the heart rate, which peaks shortly after the maximum activity. Exercise becomes less effective and more challenging to sustain as your heart rate rises (14, 2). Due to the requirement for athletes to return to normal circumstances and be ready for the next exercise, researchers and trainers have focused on techniques of lactic acid removal and heart rate reduction in the body.

Finding a program that can assist quickly removing lactic acid from the circulation and lowering the athlete's heart rate can be considered in light of the importance of these issues after an intense activity and preparing the athlete for the next activity. Researchers have used several techniques to monitor the lactate changes and the heart rate after an exercise. (Zafari

(2000), Monidero et al. (2000), Love et al. (2001), Dahl et al. (2006), Weil et al. (2008), Nemati (2004), Kohandel (2006), and Baldari (2005)) (17, 11, 9, 4, 16, 12, 8, 1). Most studies indicate that further research is required since the results of various techniques for returning to the initial state are inconsistent. Consequently, The Comparison of Active and Passive Recovery after one Session of Exhaustive Exercise Lactate Serum and Heart Rate Level among Runners.

## Materials And Methods

Twenty-six runners who had competed in a provincial championship and had at least two years of training experience were invited to take part in a semi-experimental study. In addition, smokers and people with endocrine diseases, diabetes, heart and chronic ailments were excluded from the study. The subjects were asked to follow normal sleep patterns (at least 8 hours), daily activity patterns, and diet during the study. They were also asked not to do any vigorous physical activities or use nutritional supplements. They were also told not to take any medications, drink coffee, smoke, or eat cocoa for 48 hours before the test and until the blood sample is taken because these things affect how the immune system works. The lack of control over the subjects' motivation and hidden diseases was one of the study's limitations. The subjects were randomly divided into active recovery group (12 people) and passive recovery group (14 people). Due to the withdrawal of 2 subjects, the groups became heterogeneous.

Exercise programs included a body warm-up, the Bruce test, 10 minutes of active or passive recovery. The active recovery group exercised immediately after the exercise for ten minutes on a different treadmill at 60% of maximum heart rate, while the passive recovery group did not do any activities immediately after the exercise and lay on the bed for 10 minutes. The lactate level was measured by taking a few drops of blood from the subjects' fingertips with a lactometer half an hour before the training began. The heart rate was measured by a Polar heart rate monitor, and then the subjects ran until exhaustion on the Cosmed (Germany) electronic treadmill using Bruce's instructions. At the beginning of the test, the treadmill was moving at a speed of 1.6 kilometers per hour and had a slope of 10%. Every three minutes, the speed and slope of the machine changed. The Borg pressure perception test was utilized in order to evaluate the training pressure and determine the onset of helplessness. All subjects' blood was taken with a lactometer to measure the amount of lactate and their heart rate was measured at each stage immediately after the Bruce test and after ten minutes of recovery. The Polar heart rate monitor was used once more to determine Bruce's test, as well as the ten minutes of active and passive recovery following training.

Using a lactometer, the density of lactic acid in the blood was measured. This hand-held device shows the blood lactate density in millimoles per liter through enzymatic spectrophotometry. In order to use it, a special kit was first inserted into the device's hole. Next, a drop of blood from the patient's index finger was placed to the kit, covering the pad completely. After a few seconds, the device displayed the level of density. It showed blood lactate on the screen. The subjects' heart rates were displayed by this small device, which was wrapped around their wrists and turned on after a few seconds. Ethical considerations: 1- The researcher took the consent form each athlete and explained his goals to them. 2- In the case of lactate sampling, two experienced doctors and assistants were employed, and all health and research conditions were implemented within the framework of the laws.

Due to the normality of the data, the student's t-test was used to analyze the data and compare the averages at various stages. Data analysis was carried out with SPSS software version 21. Additionally, 95 percent was considered as the confidence level for each test.

**Results**

The study's findings indicated that the average age, weight, height, and body mass index (BMI) of the study's participants were 21.5+26.2 years, 76+43.7 kg, 180+3.28 cm, and 16.1+81.19 kg/m2 respectively. As it is illustrated, the active recovery group's lactate levels were 0.383.1, 269.1 and 7.1, respectively, before exercise, immediately after exercise, and after ten minutes of active recovery and they were .29, and 21.9, 8.4.17, and 9.7.14 in the passive recovery group (Chart 1). As it is shown, the active recovery group saw a significant decrease in the amount of lactic acid after recovery ($p \geq .05$), whereas the passive recovery group saw no such decrease ($p \geq .05$).

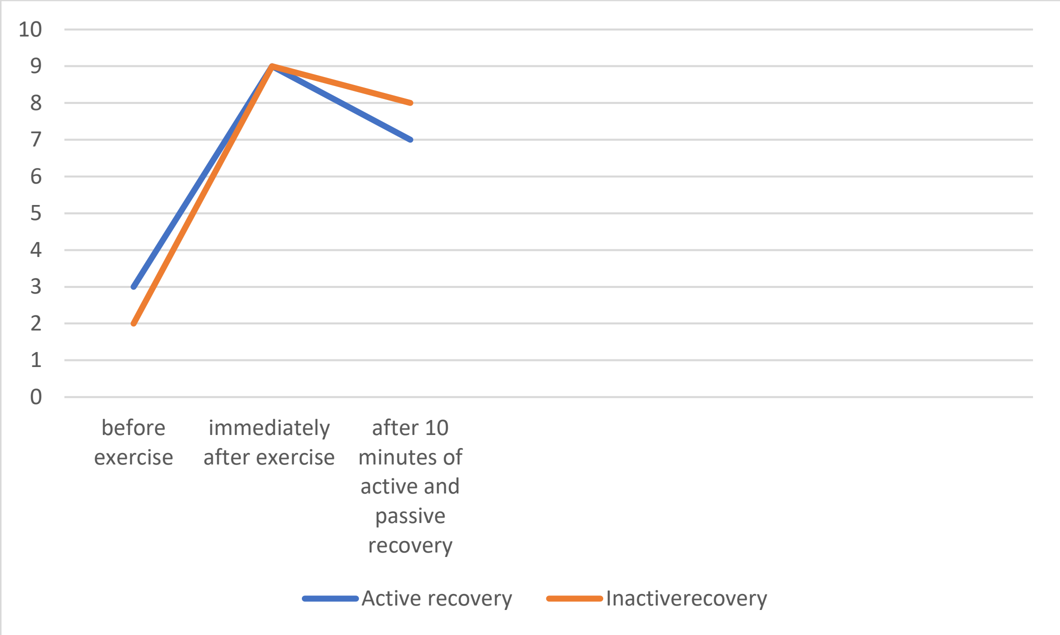


**Figure 1. Mean lactate levels before exercise, immediately after exercise and after 10 minutes of active and passive recovery.**

As the results of Table 1 show, there is no significant difference between the average heart rate of the two groups at the desired time points (p≥0.05) and active recovery compared to passive recovery causes a greater reduction in heart rate immediately after exercise, but these changes are not significant (p≥0.05).

**Table 1. Mean, standard deviation, and Student's t-test statistics to compare the average number of heart beats of passive and active recovery groups in different phases of the test.**

| Levels | Recovery Type | Number | Mean | SD | T | df | *P* |
|---|---|---|---|---|---|---|---|
| Pre-exercise increasingly frustrating HR | Inactive | 14 | 96.64 | 22.92 | 1.51 | 24 | 0.14 |
| | Active | 12 | 83.00 | 22.90 | | | |
| End of the 1st stage HR | Inactive | 14 | 122.43 | 20.13 | 1.45 | 24 | 0.16 |
| | Active | 12 | 111.25 | 18.83 | | | |
| End of the 2nd stage HR | Inactive | 14 | 141.00 | 16.17 | 1.09 | 24 | 0.29 |
| | Active | 12 | 131.75 | 26.50 | | | |
| End of the 3rd stage HR | Inactive | 14 | 169.00 | 10.76 | 1.82 | 24 | 0.08 |
| | Active | 12 | 154.92 | 26.55 | | | |
| End of the 4th stage HR | Inactive | 14 | 187.21 | 7.32 | 1.29 | 24 | 0.21 |
| | Active | 12 | 183.08 | 8.97 | | | |
| End of the 5th stage HR | Inactive | 14 | 193.71 | 7.68 | 1.94 | 24 | 0.07 |
| | Active | 12 | 187.17 | 9.56 | | | |
| After 10 minutes of recovery .HR | Inactive | 14 | 108.86 | 16.09 | 0.12 | 24 | 0.90 |
| | Active | 12 | 107.92 | 23.20 | | | |

**Explanation**: HR =heart rate; Mean =average; SD =standard deviation; t =t statistic; df =degrees of freedom; p =significance level.

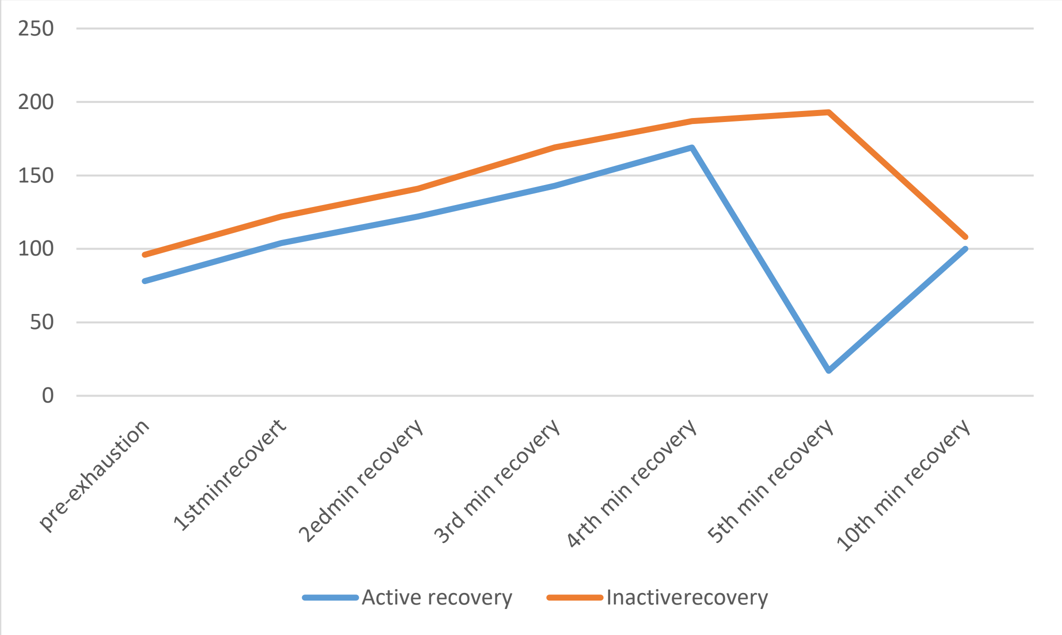


**Figure 2, Comparing the average number of heart beats of passive and active recovery groups, in different stages of the test.**

End of the 1st stage, end of the 2nd , end of the 3rd, end of the 4th, Immediately after training, 10 min after recovery

## Discussion

The results of this study showed that passive recovery compared to active recovery caused a greater decrease in heart rate, but it was not significant. In contrast, active recovery caused a significant decrease in blood lactic acid. In 2008, Weil and his colleagues investigated the effects of cold-water immersion (10, 15 and 20 degrees Celsius) and active cooling on performance, the reduction of blood lactate levels and heart rate in repetitive activities.

The findings demonstrated that active cooling has a greater effect on blood lactate levels than any cold-water immersion protocols. In comparison, immersion cold water resulted in a further decrease in heart rate and heat stress, as well as superior subsequent performances.

In 2005, Baldari and his colleagues carried out a study to learn more about the effect of active cooling on blood lactate excretion. They concluded that the cooling time should be longer than 5 minutes to have a beneficial effect but shorter than 20 minutes to avoid harms.

In another study, the effects of active and passive cooling (with a duration of 15 minutes) on improving subsequent performances and reducing blood lactate and heart rate in multiple competitions were investigated (Lao et al, 2001). Contrary to the findings of the current study, the results showed that active cooling could not further reduce blood lactate and improve subsequent performances. On the other hand, the reduction in heart rate among active cooling programs was not significantly different which is line with the present study. In 1998, Bera et al. had an investigation on 20 men and women who were placed in one of these two positions—resting on a chair or lying on their backs on the floor—and given mental relaxation training after their heart rates increased due to physiological tensions and pressures. Before and after the mental relaxation exercise, their heart rates were measured. The results showed that the heart rate decreased significantly. The findings of this research regarding the removal of lactic acid from the blood in the period of returning to the initial active and passive state agree with the results of Peterson (1988), Bampo (2009), Powers (2009), Monidero et al. (2000), Baldari (2005),Nemati (2004), Kohandel (2006) and in terms of the reduction of the heart rate in the phase of returning to the initial active and passive state, results are in consistent with the results of Bampo et al. (2009), Kerins (2006), Monidoro et al. (2000), Love et al. (2001), Dahl et al. (2006), Weil et al. (2008), and it is in disagreement with the research results of Zafari (2009), Nemati (2004), Kohandal (2006).

The volume of blood that flows through the muscle vascular network in a given amount of time determines the rate at which oxygen and lactic acid are absorbed and released from the muscle. As a result, during the recovery phase, individuals who are active remove more lactic acid from their bloodstream than those who are passive (7). Returning to the initial active state increases the rate of blood lactate removal by increasing the rate of metabolism and regular blood flow, and increases blood lactate metabolism by oxidation and gluconeogenesis. More lactic acid is removed from muscle tissue than in people at rest during the phases of light work and increased isotonic contraction. As cardiac efficiency and venous blood flow increase, the rate of lactic acid entering the liver tissue increases and the plasma concentration of this acid decreases earlier than in resting individuals (16). The contractions of the muscles support the veins' efforts to move the blood toward the heart by contracting during the activity. The work of the veins is disrupted, reducing the amount of blood that reaches the heart when the athlete abruptly stops during an activity. Because there is less blood returning to the heart, blood builds up in the legs (blood stays in the same places), leading to faint and dizziness. In addition, the hormone norepinephrine lowers blood pressure and has the potential to cause fatal heart arrhythmia when the state is restored (13). Walking slowly and taking a few minutes of rest after exercise stop blood from flowing to the hands and legs.

## Conclusion

The results of this research showed that the program to return to the initial active state was more effective for the disposal of lactic acid accumulated in the athletes' blood, but there was no significant difference observed between the heart rate of the groups after 10 minutes of active and passive recovery. Therefore, it is recommended for athletes to return to the initial active state after training and competitions in order to reach homeostasis.

## Competing interests

There is no competing of interest to disclose.

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