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Short Article

# A Comparison of Active and Passive Recovery after an Intense Exhaustive Training Session on the Level of Serum Serotonin of Male Runners

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**A B S T R A C T**

**Background and Aims:** The aim of this research was to compare active and passive recovery after a session of intense exhaustive training on the level of serotonin in the serum of the runners.

**Materials and Methods:** In this semi-experimental study, 26 male elite runners were randomly assigned to two groups of active (n=12) and passive (n=14) recovery. Half an hour before the start of the training, 5 ml blood was drawn from the subjects, and then each subject was tested starting training on treadmill for Bruce test until reaching exhaustion. Immediately and then 10 minutes after the Bruce test, 5 ml of blood was drawn again for measuring serotonin.

**Results and Conclusions:** The mean of serotonin in three steps of before, immediately after and 10 minutes after recovery were 360.83±250.05, 459.67±302.13, 514.5±440.48 ng/ml, respectively in the active recovery group, and 141.26 ± 92.41, 241.04 ± 104.78, 214.34 ± 120.03 ng/ml in the passive recovery group. There was a significant difference between the amount of serotonin after recovery and that of before. However, the type of recovery program after exercise had no effect on the serum serotonin level of the runners.

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## Introduction

Central fatigue is the most important factor in a person's inability to better function, especially in short periods of high intensity exercises [1]. Most of the investigations have shown that during intense training, synthesis and metabolism of serotonin begin to increase due to both increase in the activity of serotogeneric system and also decrease and loss of nerve conduction [1, 2, 3]. Serotonin is a neurotransmitter synthesized extensively from tryptophan in the central nervous system and also in the stomach-intestinal mucosal cells. It plays a role in organizing the nervous-hormonal system, mood, appetite, sleep adjustment, physiological and cognitive activities involved in learning and memorizing [2]. The synthesis and metabolism of serotonin in the brain increases in response to exercise. In addition, increase in the concentration of serotonin is followed by symptoms of central exhaustion such as decreased arousal, reluctance, fatigue, and loss of motor coordination in the brain [3].

Impairment of the recovery to the primary state between trainings or in running competitions causes increased fatigue and reduced ability to carry out some activities [4]. Active recovery is popular as a light exercise after training and intense race, and is believed to improve recovery [5]. On the other hand, passive recovery increases cardiac output to a level less than the active recovery, and the less involvement of muscles reduces the received messages from the mechanical receivers and central commands [6].

Several researches have examined the effect of training on serotonin changes after active and passive recovery with different methods [7, 8, 9, 2]. Also many authors have examined the changes of serotonin [3, 10, 11]. Considering the important role of recovery after training, the researchers intended to compare the impact of active and passive recovery after an intensive exhaustive training session on the serum level of serotonin in runners.

## Materials and Methods

In a semi-experimental study, 26 male sprint runners in Isfahan with at least two years experience of training and one championship attended this research, and were divided into two groups of active (n=12) and passive recovery (n=14). This project was approved by Ethics Committee for Research in Islamic Azad University, Khorasgan Branch, Isfahan, Iran.

At first 5 ml of blood was drawn at rest from the testees 30 minutes before starting the training. Then the testees ran on an electronic revolving bar (COSMED, made in Germany) using the Bruce instructions. To assess the pressure of training and to recognize the moment of fatigue, Borg pressure assessment test was used. Immediately after running the Bruce test and also 10 minutes after active and passive recovery (that included lying on bed in passive recovery group, and running on the treadmill with 60% maximum heart beat rate in the active recovery group), once again 5 ml blood was drawn. The serotonin levels were determined using enzyme-linked

immunosorbent assay according to manufacturer instructions (LSD, USA). ANOVA was performed with repeated measurements at the level of $p< 0.05$.

## Results and Discussion

The averages of age, weight, height and body mass index of the samples were 21.5±2.2 years, 74.5±7.85 kg, 181.5±2.89 cm, and 19.81±1.16 kg/m$^2$, respectively. As the table 1 shows, the concentration of serotonin increased immediately after an intensive exhaustive training session in the two groups ($p\leq0.05$). Prior to training, there was no significant difference between serum serotonin levels in the sprint runners who had active recovery and passive recovery ($p=0.37$).

According to a study carried out by Albirghina et al., the amount of serotonin in horses increases immediately after exercise [2], not thus being in line with the results of the present study. In a study coducted by Caperto et al., the effect of resistance training on the concentration and performance of serotonin in hypothalamus of mice was examined, which showed that the concentration of serotonin was increased after the intensive exhaustive training session, being in accordance with the current research [9]. Also Stringberg et al. studied the serotonin of blood in patients with lower body paralysis during a wheelchair basketball, tennis and swimming training program, immediately after each training session. They detected that the blood serotonin level significantly increases, and after 5-minutes of active and passive recovery, no difference can be observed between their serum serotonin, which is thus in agreement with the present research [7]. Based on the investigation of Essam and Manal, serotonin increases in patients with depression over 12 weeks of Pilates training, again compling with our study [3].

**Table 1.** The results of covariance analysis test between 10-minute active and passive recovery

| | | Serotonin (ng/ml) | | |
|---|---|---|---|---|
| | Number | Before training | Immediately after training | 10 minutes after recovery |
| **Active recovery** | 12 | 360.83±250.05* | 459.67±302.13 | 514.5±440.48 |
| **Passive recovery** | 14 | 141.26±92.41 | 241.04±104.78 | 214.34±120.03 |

*Data are presented as Mean±SD

Most sport studies have shown that a change in hormone concentrations, especially serotonin, is a sign of fatigue, which indicates a clear relationship between the serotonin activity and the intensity of training during practice [3,8]. Albumin is a protein that is combined with blood plasma tryptophan [8], and prevents the

transmission of tryptophan to the brain. Also free fatty acids compete with tryptophan for binding to albumin. Extreme training increases plasma free fatty acids, and so more free fatty acids are combined with albumin, replacing tryptophan which increases the concentration of plasma tryptophan. This reduces the cluster plasma amino acids and as a result increases the ratio of free tryptophan amino acid to clustered amino acid, and thus increases the transmission of brain blood tryptophan that influences the synthesis of serotonin [11]. So the reason for increase in the amount of serotonin after training is probably related to this matter. Among the limitations of the current research are the lack of control of the testees' stimulation, and also lack of control of the hidden disease.

## Conclusion

Based on the findings of this study, the type of recovery after intensive exhaustive training does not affect the levels of serotonin for elite runners.

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## Conflict of Interest

The authors declare no conflict of interests.

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