

EXPERIMENTAL STUDY

The effect of acute swimming exercise on plasma leptin in rats

Baltaci AK¹, Vurucu N², Uzun A³, Mogulkoc R¹, Kilic M²*Selcuk University, Selcuklu School of Medicine, Department of Physiology, Konya, Turkey.*

rasimmogulkoc@yahoo.com

Abstract: Exercise is known to increase free fatty acid and glucose metabolism. In consideration of such physiological effects of leptin such as reducing food intake and increasing energy consumption, many researchers have studied the relation between leptin and exercise. Despite the inconsistency between results, it is generally accepted that physical activity causes changes in leptin secretion. The present study aims to determine the changes that occur in plasma leptin levels of the rats subjected to acute swimming exercise, immediately after exercise, and in the 24th and 48th hours following exercise.

Forty adult male rats of Sprague Dawley species were equally allocated to 4 groups. Group 1: General Control Group. Group 2: Swimming Group, the group that was decapitated just after 30-minutes of acute swimming exercise. Group 3: Swimming Group, the group that was decapitated 24 hours after 30-minutes of acute swimming exercise. Group 4: Swimming Group, the group that was decapitated 48 hours after 30-minutes of acute swimming exercise. Plasma leptin levels of the experimental animals were determined according to RIA method in the blood samples collected by decapitation method.

Comparison of plasma leptin levels between groups revealed that the Group 3 had the highest plasma leptin levels ($p < 0.01$). Plasma leptin levels in the Group 1 (control) and 4 were not different and the Group 2 had the lowest plasma leptin levels ($p < 0.01$).

Results of the present study show that an acute swimming exercise and/or stress factors associated with an acute exercise inhibit leptin secretion from the adipose tissue (Tab. 1, Ref. 21). Full Text in PDF www.elis.sk.

Key words: acute swimming exercise, leptin, rat.

Leptin hormone is a signal molecule originating from the adipose tissue. Although it is secreted mainly from the white adipose tissue, it is also secreted from the brown adipose tissue in very small amounts (1). It interacts with various systems, ranging from gastrointestinal system to hemopoietic system, and from hypertension to obesity control (2). Leptin is necessary for the regulation of neuroendocrine functions and energy use. Besides, it plays an important role in the onset and advancement of puberty in children and the production of blood (3–5). Its biological effects are inhibiting food intake and increasing energy consumption. Leptin hormone is important in weight control of the body owing to these effects. It affects the satiation center in the ventro-hypothalamus (6, 7). Exercise is known to increase the free fatty acid and glucose metabolism. In consideration of the physiological effects of leptin like reducing food intake and increasing energy consumption (6, 7), many researchers have sought to clarify the relation between leptin and exercise.

Although the results are inconsistent, it is widely accepted that physical activity causes changes in leptin secretion. As opposed to findings to the effect that exercise increased leptin concentration

(8), Hickey and Calsbeek (9) reported that an acute exercise did not change leptin levels, while Hilton and Loucks (10) concluded that exercise did not suppress leptin production. It was noted in another study that leptin levels decreased 9 hours after an acute exercise (11). Besides, there are also reports arguing that leptin levels significantly decreased following an intensive exercise in long-distance swimmers and marathon runners (12, 13). Likewise, Pagano et al (14) stated that 30-minutes of acute swimming exercise reduced leptin levels at about 30 % in rats.

The present study aimed to demonstrate the changes that occur in plasma leptin levels of rats subjected to an acute swimming exercise. The results of our study can contribute to what is already known on this topic.

Materials and methods

Experimental Animals and Groups

The study was conducted in Selçuk University Experimental Medicine Research and Application Center (SUDAM) on the rats provided thereof. The study included 40 adult male rats of Sprague Dawley species, which were grouped as follows:

Group 1 (n = 10) General Control Group: The group which was not subjected to any procedure and fed on a normal diet.

Group 2 (n = 10) Swimming Group: The group fed on a normal diet and decapitated immediately after 30-minutes of an acute swimming exercise.

Group 3 (n = 10) Swimming Group: The group fed on a nor-

¹Selcuk University, Selcuklu School of Medicine, Department of Physiology, Konya, Turkey, ²School of Physical Education and Sports, Selcuk University, Konya, Turkey, and ³School of Physical Education and Sports, Selcuk University, Konya, Turkey

Address for correspondence: R. Mogulkoc, MD, Selcuk University, Selcuklu School of Medicine Department of Physiology, Konya, Turkey, 42080, Konya, Turkey.

mal diet and decapitated 24 hours after 30-minutes of an acute swimming exercise.

Group 4 (n = 10) Swimming Group: The group fed on a normal diet and decapitated 48 hours after 30-minutes of an acute swimming exercise.

Swimming Exercise

Swimming exercise was performed in a 50cm-deep and 50cm-wide pool made of heat-resistant glass and having a thermostat that kept the heat of the water fixed at 37 °C. The exercise was a one (lasting 30 minutes) acute swimming exercise (15). Experimental animals were made to swim at the end of the study and before decapitation in groups of two. Rats in the Group 1 (general control group) were not subjected to swimming exercise. Blood samples were collected from the animals after the exercise by decapitation method.

Plasma leptin analysis

Serum leptin analysis was conducted using Rat Leptin RIA kit (Linco trademark catalogue no: RL-83K). Limit sensitivity of rat leptin analysis is 0.5 ng/ml and limit linearity is 50 ng/ml. The results were presented as ng/ml.

Statistical evaluations

Minitab for Windows Release 13.0 computer package software was used for the statistical evaluation of data. Arithmetic means and standard errors of all parameters were calculated. Variance analysis was used to determine the differences between groups. Least Significant Difference (LSD) Test was employed to compare group means obtained from variance analyses, which were found statistically significant.

Results

Plasma leptin levels in the general control group which was not subjected to any procedure (Group 1) were the same as those in the Group 4, higher than those in the Group 2, and lower than in the Group 3 ($p < 0.01$) (Tab. 1). Plasma leptin levels in the Group 2 (the group decapitated immediately after the swimming exercise) were lower than those in the Groups 1, 3 and 4 ($p < 0.01$) (Tab. 1). The Group 3 (the group decapitated 24 hours after the swimming exercise) had plasma leptin levels higher than in the Groups 1, 2 and 4 ($p < 0.01$) (Tab. 1). Plasma leptin levels in the Group 4 (the group decapitated 48 hours after the swimming exercise) were the same as those in the Group 1, higher than those in the Group 2, and lower than those in the Group 3 ($p < 0.01$) (Tab. 1).

Discussion

Exercise is known to increase free fatty acid and glucose metabolism. Considering that leptin has physiological effects like reducing food intake and increasing energy consumption, many researchers have set about exploring the relation between leptin and exercise (8, 9, 13 14, 16).

Leptin reduces fat accumulation in the body by burning free fatty acids through aerobic way in exercises performed at 50–60 %

Tab. 1. Plasma leptin levels of the study groups.

Group	Leptin (ng/ml)
Group 1 (Control)	4.74±0.55b
Group 2 (Swimming A)	1.86±0.15c
Group 3 (Swimming B)	9.17±1.22a
Group 4 (Swimming C)	4.35±0.60b

of the max VO_2 . In a study including 10 professional football players and sedentary people, the exercising group was found to have lower leptin levels in comparison to the sedentary group. Although the increase in serum leptin levels is generally in direct proportion with BMI of the individual, it has been observed that regular exercising inhibits leptin levels (17).

A decrease in serum leptin levels begins after 60-minutes of aerobic exercises performed at 70 % of Max VO_2 and below, and this inhibition becomes fairly marked in the 24th hour after exercise (6, 18).

It has been seen that exercises that can cause so much energy consumption as to change the energy balance can affect leptin levels and that serum leptin levels drop 48 hours after long-time exercises (19).

Elite athletes whose energy consumption per exercise is 1200–1300 kcal were found to have lower serum leptin levels after 24 hours (20).

In the present study, it was observed that plasma leptin levels significantly decreased immediately after an acute swimming exercise, in comparison to the control group. It was argued that exercise did not change leptin levels (10) or that acute exercise did not alter leptin levels independent of body fat mass (9). However, Nindl et al (11) showed that leptin concentration did not change until after 9 hours following an acute intensive exercise and significant changes occurred in leptin levels after 9 hours. Similarly, Van Angel-Leijssen et al.(8) reported that exercise reduced 24-hour leptin peak and mean leptin concentration. The results of the concerned studies are contradictory with the findings we obtained in this study. However, reports noting that there was a significant inhibition in leptin levels after exercise in long-distance swimmers (12) and that leptin levels were similarly inhibited in marathon runners (13) support the low leptin levels we obtained immediately after an acute exercise. Zaccaria et al (13) pointed to a significant increase in free fatty acid levels parallel to reduced leptin levels in marathon runners and attributed the decrease in leptin levels to the increase in free fatty acid levels. The most significant finding supporting the decreased leptin levels we obtained after an acute swimming exercise was reported by Pagona et al (14) who noted that they found an approximately 30 % decline in plasma leptin after a 30-minute, one-time swimming exercise in rats.

Although leptin studies have revealed that it is a molecule that sends signals to the brain about the fat state and energy reserves of the body, the fact that it has been shown to have receptors in many organs suggests that leptin's functions are not limited with restricting food intake and increasing energy consumption (21). There are still points to be clarified about the effects of leptin hormone on physiological mechanisms. The fact that leptin is a topic of interest for many researchers and is studied in various disci-

plines indicates that leptin's mechanism of influence can be fully brought to light in the near future (21).

The results of our study show that plasma leptin levels which decreased immediately after acute swimming exercise significantly increased after 24 hours and were restored to resting levels after 48 hours. The findings put forward in our study can further contribute to what is already known on this topic.

Based on the findings of our study,

1) Acute swimming exercise resulted in a decrease in plasma leptin levels in rats.

2) Plasma leptin levels, which decreased immediately after acute swimming exercise, increased considerably 24 hours following the exercise.

3) Plasma leptin levels were restored to the levels recorded before resting 48 hours following an acute swimming exercise.

It can be concluded parallel to the findings emphasized above that exercise brings about significant changes in plasma leptin levels and there is a significant relation between leptin and exercise.

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