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Effects of Acute and Chronic Exercises on Plasma Nesfatin-1 Levels in Young Adults

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BACKGROUND/AIMS
The aim of this study was to investigate the effects of acute and chronic exercise on plasma nesfatin-1 levels in young adults.

MATERIAL and METHODS
Sixteen young adult male university students were recruited to participate in this study. Blood samples were taken from the subjects at the beginning of the study and after the training program both at rest and immediately after acute exhausting exercise. The subjects performed cycling exercises for 40–60 minutes, 3 days a week for 8 weeks at 60%–80% of maximal heart rate. Body weight, body mass index (BMI), body fat percentage (BFP) and maximal aerobic capacity (VO2max) were determined before and after the 8-week training program. Plasma nesfatin-1 levels were determined by enzyme-linked immunosorbent assay (ELISA) using commercial kits. The effects of chronic and acute exercise before and after the training program were examined by analysis of variance with two-factor repeated measures. In this study, SPSS 16.0 statistical program was used to evaluate the data and the level of significance was accepted as <0.05.

RESULTS
Cycling exercises had no impact on body weight, BMI and VO2max ($p>0.05$), but BFP decreased significantly ($p<0.05$). Acute and chronic exercise had no significant impact on plasma levels of nesfatin-1 ($p>0.05$).

CONCLUSION
We observed no significant differences in plasma nesfatin-1 levels in response to acute or chronic exercise among young adult male students. However, chronic exercise had a significant impact on BFP.

Keywords: Acute exercise, chronic exercise, Nesfatin-1

INTRODUCTION

Although the rapid progress and new effort-reducing technologies have had a profoundly positive impact on life in general, among the downsides is a level of inactivity that can result in chronic physical and psychological stress (1). Exercise, defined as regular physical movement, has significant effects on metabolism and energy homeostasis (2). For this reason, physicians and researchers recommend regular exercise as a means to treat and to prevent psychological disorders including aberrant responses to stress and tension; regular exercise may also avert or at least limit the impact of cardiovascular disease, obesity, diabetes, and high cholesterol (1).

The molecular mechanisms underlying the delicate balance between energy consumption and energy intake are not fully understood. Hormonal factors certainly play a role in maintaining this balance (3) and many energy-regulating hormones are synthesized in skeletal muscle and adipose tissue (4). Nesfatin-1 is a regulatory and anorexigenic hormone; its synthesis and release are influenced by nutritional status, energy metabolism and exercise (5). Nesfatin-1 was first discovered by Oh-I et al. (6) and is produced in the hypothalamic nucleus, which is currently understood to be the control center for appetite. When administered to mice, nesfatin-1 results in significantly reduced food intake and body weight. Nesfatin-1 is a 24 amino acid peptide generated by post-translational processing of nucleobindin 2 (NUCB2). The effects of nesfatin-1 are dependent on signaling via the melanocortin-3/4 receptor and are not dependent on the actions of the adipose-derived hormone, leptin.

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Nesfatin-1 induces a sense of satiety and suppresses food intake and as such may promote substantial improvements in the health and well-being of overweight and obese individuals (7). Nesfatin-1 modulates glucose homeostasis, increases insulin sensitivity, decreases excess body fat and prevents metabolic disorders (8); it may also have profound effects on the cardiovascular system and the release of stress hormones (9, 10).

The results of studies designed the address the impact of exercise on nesfatin-1 levels are thus far contradictory. Results from several published studies suggest that exercise has no impact on nesfatin-1 levels (5, 11, 12). By contrast, other reports suggest that exercise results in either increased (13-17) or reduced (18-20) levels of plasma nesfatin-1. The aim of this study was to determine the effect of acute and chronic exercise on plasma nesfatin-1 levels in healthy young adult males.

MATERIAL and METHODS

Subjects: Sixteen males between the ages of 20-27 years who were healthy non-smokers and moderately active were recruited to participate in the study. Prior to the start of the study, all participants received detailed explanations regarding the purpose of the study and each was asked to complete the voluntary participation form. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Selçuk University Faculty of Sports Science Non-interventional Clinical Research.

Determination of Body Composition: Participant height (m) and body weight (kg) were determined using a Seca mechanical weighing scale. Body mass index (BMI) was calculated by dividing body weight (kg) by the height squared (m^2) (21). For the determination of body fat percentage (BFP), biceps, triceps, subscapularis, suprailiac skinfold thicknesses were measured with a Holtain skinfold caliper which applied 10 g of pressure per mm^2 at each angle while the participants were in anatomical positions. Body densities and BFP were determined with the following mathematical formulas:

Body Density=1.1631-0.0632×Log (biceps+triceps+subscapularis+suprailiac)

BFP=(4.95/Body Density-4.50)×100 (22).

Main Points:

- Nesfatin-1, a hormone that has this regulatory effect, is an anorexigenic peptide that functions in many body functions by being influenced by nutritional status, energy metabolism and exercise.
- In this study, the effects of acute and chronic exercises on body composition and plasma nesfatin-1 were evaluated in moderately active young adults with normal body mass index.
- It was concluded that the exercises performed significantly decreased only BFP values and had no separate or common effects on Nesfatin-1 level.

Acute Exercise test: To determine the maximal aerobic capacities (VO_{2max}), the 20 m shuttle run test was applied according to the protocol described by Leger et al. (23).

Chronic Exercise: Study subjects participated in a cycling exercise program for 8 weeks, 3 days a week, 40-60 minutes a day, at 60%–80% of the maximal heart rate. The maximal heart rate of each subjects was calculated according to the 220-age formula. During the training, a Polar RS800 heart rate monitor watch was used.

Blood Sampling and Biochemical measurements: Blood samples were taken from the participants at the beginning of the study and at the end of the 8 week training program, both at rest and immediately after acute exhausting exercise. Blood samples were drawn into heparinized vacutainer tubes by medical personnel at 8:00 am after overnight fasting. Blood cells were removed by centrifugation at 3000 rpm for 20 minutes at 4°C; the resulting plasma samples were divided into two aliquots which were stored in microcentrifuge tubes at -20°C prior to analysis. Plasma levels of nesfatin-1 were determined with a human nesfatin enzyme-linked immunosorbent assay (ELISA) test kit (Elabscience, Houston, TX, USA). Absorbance was measured at 450 nm in a microplate reader (Biotek ELx800) and interpolated to a standard semi-logarithmic curve.

Statistical Analysis

Arithmetic means and standard deviations of all measured variables were calculated. The effects of acute exhausting exercise and chronic exercise before and after the training program were evaluated by analysis of variance using two-factor (2×2; rest-acute exercise x pre-post chronic exercise) repeated measures. In case of significant effect or interaction of factors, t-test was used in dependent groups. In this study, the Statistical Package for the Social Sciences 16.0 (SPSS Inc.; Chicago, IL, USA) was used to evaluate data; the level of significance was accepted as <0.05.

RESULTS

Body weight (t=2.07; p=0.06), BMI (t=2.07; p=0.051) and maximum oxygen consumption (VO_{2max}; t=-1.24; p=0.23) among the participants did not change significantly from the beginning to completion of the training program. By contrast, BFP decreased significantly (t=3.36; p=0.00). (Table I).

TABLE I. Changes in The Physical and Physiological Properties of the Subjects Before and After the Training Program

Variables	N	Pre-test Mean ± SD	Post-test Mean ± SD	t
Body weight (kg)	16	68.8±9.3	68.0±8.5	2.07
BMI (kg/m^2)	16	21.6±2.6	21.4±2.3	2.12
BFP (%)	16	11.1±3.2	9.8±2.4	3.36*
VO_{2max} (mL/kg/dk)	16	43.9±5.4	45.3±6.0	-1.24

*p<0.05; SD: Standard Deviation; BMI: Body Mass Index; BFP: Body Fat Percentage; VO_{2max}: Maximum Oxygen Consumption

TABLE 2. Effects of Acute and Chronic Exercise on Nesfatin-1 Levels

		Time	Mean	±	SD	Acute	Chronic	A×C
Nesfatin-1 (ng/mL)	Pre- training program	Rest	40.72	±	12.55	0.28	2.08	1.30
		Exhaustion	40.77	±	17.75			
	Post-training program	Rest	41.54	±	14.76			
		Exhaustion	34.80	±	12.68			

*p<0.05; SD: Standard Deviation; A: Acute exercise; C: Chronic exercise; AxC: Common effect of chronic and acute exercise

Neither the separate nor the common effect ($F_{1,13}$=1.30; p=0.27) of acute exercise ($F_{1,13}$=0.28; p=0.61) or chronic exercise ($F_{1,13}$=2.08; p=0.17) had a statistically significant impact on plasma nesfatin-1 levels (Table 2).

DISCUSSION

In this study, the effects of acute and chronic exercise on body composition and plasma nesfatin-1 were evaluated in moderately active young adult males with normal body mass indices. While the exercise program resulted in significant decrease in BFP, it had no impact on plasma nesfatin-1 levels.

The results of several studies suggest that nesfatin-1 levels and BFP are inversely related. Studies carried out with obese individuals have shown that decreases in BFP were associated with increases in nesfatin-1 levels. Furthermore, significantly more carbohydrate, protein and energy intake was observed among obese individuals with low nesfatin-1 levels (24, 25). While some studies have reported a negative relationship between nesfatin-1 levels and BMI (26, 27), others have concluded that no such relationship exists (28).

The results of the present study are consistent with the latter group of findings. For example, Ghanbari-Niaki et al. (5) explored the impact of an anaerobic sprint test and a kickboxing session in 14 young male athletes; while plasma growth hormone, insulin, glucose, and lactate concentrations increased significantly after the exercise, no changes were observed in plasma concentrations of nesfatin-1. In another study conducted on 30 elderly women with hypertension, aerobic exercise performed three days a week for 12 weeks resulted in a decrease in nesfatin-1 levels, although these findings did not reach statistical significance (29). Similarly, Algül and Özçelik (30) reported a decrease in plasma nesfatin-1 levels among individuals participating in acute exercise although again, the results were not statistically significant. These authors emphasized that plasma nesfatin-1 levels may be affected by other non-exercise-related factors, including anxiety, stress, or nutritional status. Similar results were obtained by Ozdenk (12) who reported an increase in nesfatin-1 levels in samples taken before and after 30 min of aerobic running exercise; these findings also did not reach statistical significance.

By contrast, there are several reports that document significant increases in nesfatin-1 levels in obese subjects (13, 17) or in association with intake of food with high fat content (31). Yazici (14) found that nesfatin-1 levels in young athletes were significantly higher before and after anaerobic exercise than levels determined for a comparatively sedentary group. Among the conclusions, the elevated levels of nesfatin-1 may be due to the degree of metabolic starvation that is encountered both during and immediately after exercise, and/or a neuromuscular stimulus reflex that reestablishes energy balance after excessive energy use during exercise. In a study investigating the effect of resistance exercises (10 weeks and 3 days a week) on the serum levels of nesfatin-1 together with the insulin resistance index, 18 women with type 2 diabetes were randomly divided into two groups, one of which performed resistance exercises while the other did not. After the training, a significant increase in nesfatin-1 levels from baseline levels was identified in the group that performed resistance exercises (15). Algül et al. (16) found that moderate aerobic exercise performed both in the morning and at night significantly increased nesfatin-1 levels in 60 male study participants, but that exercise at night was more effective than exercise in the morning. The study concluded that nesfatin-1 level is a reflex secondary to neuromuscular stimuli that serve to suppress the feeling of hunger caused by the need to maintain energy balance. In contrast to these studies, it has been reported that low-intensity motorized treadmills (20 m/min, 0% slope, 60 min, 8 weeks and 5 days) (18) and high intensity intermittent training (20) decreases nesfatin-1 levels compared to control groups in laboratory rodent studies. Taken together, the research results remain contradictory. Presumably, this may be explained by differences in subjects' baseline nutritional status (26) and the composition of their daily diets (31) as well as stress and thermoregulation (32).

This research has some limitations. The participants in our study were all healthy and moderately active individuals. While the participants were asked not to change their eating habits, they were not maintained on a controlled diet; this could certainly be a significant variable with respect to plasma nesfatin-1 levels. In our study with healthy, moderately active young adult male participants, we detected no significant change in plasma nesfatin-1 levels in response to acute and chronic exercise.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Selçuk University Faculty of Sports Science Non-interventional Clinical Research.

Informed Consent: Written informed consent was obtained from students who participated in this study.

Peer-review: Externally peer-reviewed.

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