Serum leptin and ghrelin changes-induced aerobic training in healthy young females

Masoumeh Azizi

Department of Sport Science. Islamic Azad University, Abadan Branch. Abadan. Iran
Email: science.sport@yahoo.com

ABSTRACT

Background: Ghrelin is a peptide hormone secreted from the endocrine cells of stomach, affecting feeding behavior, appetite, energy consumption, weight, and body composition which may thus be an essential hormone for maintaining energy hemostasis. Leptin, an antagonist to ghrelin, is another hormone which also plays a key role in metabolism. Much evidence indicates that aerobic exercise training is a key component of exercise recommendations for weight control. Yet, results on the impact of this exercise on ghrelin and Leptin levels are controversial, and are from studies performed among athletes.

Purpose: The aim of this study was to examine of the effect of 8 weeks aerobic training on Serum leptin and ghrelin changes-induced aerobic training in healthy young females.

Material and Method: 24 inactive female students, with a mean age of 27.56±0.48 yrs, height 162.66± 5.05 cm, and a body mass index of 32.68±0.84 kg/m^2 participated in the study in two trials [control-(n=12) and exercise-(n=12)] in a counterbalanced, randomized design. Serum levels of leptin and ghrelin via Blood samples were taken 48 h before starting the aerobic training program. Then, experimental group performed the aerobic training program included aerobic training with 65-85% of individual maximum heart rate for 3 session per week, 60 minute per session and 8 consecutive weeks. Differences between post test and pre test were evaluated using a Student's t -test for paired samples. A P-value < 0.05 was considered to be statistically significant.

Results: Student′s t-test revealed a significant differences in levels of plasma total ghrelin (P=0.08) and a significant decrease also in plasma levels of leptin in the experimental group when compared to the control group.

Conclusion: Our study showed that regular and light aerobic exercise could decrease leptin levels and increase ghrelin concentration of healthy females. But further studies should be done to evaluate the effect of different modes, intensities and durations of exercise training on ghrelin and leptin and their association with post-exercise hunger, meal initiation and food intake.

Keywords: Ghrelin, Leptin, Aerobic exercise, Healthy women.

INTRODUCTION

Discovery of several new gut peptides involved in appetite regulation and energy homeostasis have recently made investigators to seek the probably alterations associated with exercise. Among them ghrelin and leptin, the two particular gut peptides, are of interest because they appear to regulate hunger and food intake and are not specifically controlled by body fat stores[5].
Ghrelin hormone is mainly secreted from the cells of the stomach which stimulates Growth Hormone (GH) release. Also there is evidence of limited ghrelin production by other tissues including the brain [19]. According to a number of reports, its level is fluctuated under food intake, starvation and energy homeostasis. Moreover, plasma ghrelin is negatively associated with Body Mass Index (BMI). Indeed, plasma level is increased in anorexia nervosa and cachexia and decreased in obesity [7]. Ghrelin level as well plays in a compensatory manner to body weight variations. It decrease with weight gain resulting from overfeeding or high-fat diet and vice versa weight loss induces an increase of ghrelin level. This effect is concerned with weight loss due to food restriction and long-term chronic exercise, but not acute exercise [4].
Leptin, the other endocrine hormone-the product of the *ob* gene, that is thought to play a key role in the regulation of body weight. Further studies report a major role of leptin is to relay information to signal transducing receptors in the hypothalamus reducing appetite, increasing energy expenditure, promoting adipose oxidation and thus aid in reducing body weight [2]. Undubtedly, exercise training is a potent stimulus for secretion of many hormones [16]. Among them, many investigations have examined the effects of exercise on plasma leptin and ghrelin levels. Although exercise training has reduced serum leptin levels and increase ghrelin levels [9], the effects of exercise, independently of loss of fat mass, have not been clearly established. In the limited number of studies where acute exercise was examined [20], short-term exercise had no effect on serum leptin and ghrelin levels. In contrast, recent data suggest that prolonged exercise (marathon run, ultra-marathon, 3-h cycling) may result in a fall in serum leptin levels and a rise in ghrelin levels (8,9). These results with exercise may be related in part to the time of exercise and whether subjects are fed or fasted [13].
Vestergaard et al.[19] reported a decline in ghrelin levels significantly after exercise in elite athletes and healthy subjects (age 18–37 yr). They also reported high-dose GH suppresses ghrelin levels and support that GH feedback inhibits ghrelin secretion. Other reports on ghrelin knockout adult mice demonstrate that lack of ghrelin protects from rapid weight gain induced by early exposure to a high-fat diet, decreases adiposity, and increases energy expenditure and locomotor activity [17], and adult mice lacking the ghrelin receptor, when fed a high-fat diet, eat less food, and accumulate less weight. Unal et al measured leptin concentrations in trained young male athletes (from different sports) and in healthy sedentary subjects. They noted a significant lower leptin after exercise and concluded that regular exercise, by reducing fat percentage, suppresses serum leptin levels [18]. Hickey et al reported a diminution of the concentration of leptin after 12 weeks of an aerobic training among young women. This decrease appeared despite the absence of significant changes in fat mass [11].
However, the most recent studies revealed depending on the exercise program (eg, duration, intensity, or frequency) and characteristics of subjects at baseline results can be varied. Hence, we decided to examine the effect of 8 weeks resistance training on serum leptin and ghrelin changes-induced resistance training among healthy young females.

METHODS

1. Subjects

The study subjects were 24 inactive-healthy female students 24 inactive female students, with a mean age of 27.56±0.48 yrs, height 162.66± 5.05 cm, and a body mass index of 32.68±0.84 kg/m^2 participated in the study in two trials [control-(n=12) and exercise-(n=12)] in a counterbalanced, randomized design. They were informed about the aims and procedures of the investigation protocol, as well as the possible risks and benefits before they gave their written consent. Serum levels of leptin and ghrelin via blood samples were taken 48 h before starting the aerobic training program. Then, experimental group performed the aerobic training program included aerobic training with 65-85% of individual maximum heart rate for 3 session per week, 60 minute per session and 8 consecutive weeks.

2. Statistical Analysis

All values are reported as Means ±SE. Differences between exercise-induced changes in serum leptin and ghrelin levels before and after exercise protocol were analyzed using a Student`s t-test for paired samples. A P-value < 0.05 was considered to be statistically significant. Analysis was performed using SPSS version 18.0.

Results

Mean ± standard deviation(SD) of variables including BMI, Leptin and Ghrelin for each subject of CG group (Post-test and Pre-test) are shown in table.1.and for each subject of AG group (Post-test and Pre-test) in table.2. and table.3. reveals the comparison of measurements between two groups after 8 weeks training. The BMI of the AG after 8 weeks of aerobic exercise training was significantly decreased from 32.94 kg/m2 to 31.65 kg/m2 (P = 0.037)(Table 1). Such changes were not detected in the CG. The Mean of Leptin concentration of AG decreased from 25.68 ± 18.4 ng/ml to 13.95 ± 5.3 ng/ml, and that in the CG increased from 17.54 ± 6.3 ng/ml to 19.65± 2.16 ng/ml. The P value of leptin in Control group and Aerobic group after 8 weeks were (*P* = 0.155 and *P* = 0.001, respectively). There was also a significant difference between the groups (*P* = 0.001) after 8weeks (Figure.2). The ghrelin levels increased dramatically in AG group after 8 weeks aerobic exercise training *P* = 0.000(Table.2). Moreover, these changes were seen while two groups were compared (P= 0.000)(Table.3).

Discussion and Conclusion

The aim of the present study was to investigate the effects of aerobic training on leptin and ghrelin levels and their association with BMI. Our results indicate that 8 weeks of aerobic

training reduced leptin and ghrelin levels (Fig.1 & 2). Some studies have attributed these changes after endurance training [15].

Ishii *et al.* proved that plasma leptin level decreased after 6 weeks of aerobic exercise in type II diabetics subjects and this decrease was independent of the changes in fat mass [12]. Hickey, *et al.* expressed that distance swimming exercises for 12 weeks could decrease leptin level accompanied by a decrease in insulin [13]. However, the decrease in leptin may be due to the increase in the accessible energy, some studies evaluating the effect of short-term exercise on leptin level have shown that an absence of any change in the plasma leptin level [3]. In untrained or less trained subjects, short exercise training periods have shown the same effect on leptin secretion. For example, resting leptin levels decreased after 1) 3-weeks of military training preceded by a 5-day aerobic military walk of 25-35 km (during the five days) [6]. after 2) 12-weeks of an aerobic cycling exercise program e.g. 5 $d.wk^{-1}$ at 50% of maximal oxygen uptake during 45 min, performed by 25 obese sedentary women (Polak et al., 2006) and after 3) a 6-month anaerobic training program (3 $d.wk^{-1}$, 10 strength exercises/three sets per session) in 50 inactive men (Fatouros et al., 2005). These decreases were associated with a parallel decline in body fat (Fatouros et al., 2005; Polak et al., 2006). Nevertheless, the decrease in resting leptin concentration may also occur without any decrease in fat mass [6].

The present study presents ghrelin levels after 8 weeks aerobic exercise training increased significantly. Several studies have confirmed the results of the present study [2,9,17]. Leidy et. al. (2004) conducted a study in which healthy females took part in a chronic exercise program while fed a diet designed to maintain body weight. Some remained weight stable whereas others lost weight. Overtime, ghrelin concentration raised only in the weight loss group [14]. Foster-Scubert et. al. (2005) also confirmed these results with sedentary postmenopausal female were randomized to either a chronic aerobic exercise group or a passive stretching control group for one year and were asked to maintain their typical diet [8]. At the end of the intervention, the chronic exercise group had lost a small but substantial amount of weight compared with the control group and ghrelin levels increased in relation to the amount of weight loss. Some seemingly discrepant results concerning ghrelin's response to exercise may be related to the intensity, duration or mode of the exercise [2]. For example, Bouassida et. al (2009) found increased ghrelin tested its effect after exercise lasting at least 2 hours.

Data have revealed that serum leptin levels were significantly and highly correlated with body weight [8,14] and insulin levels [1]. They have attributed changes in leptin levels after endurance training as well. It is thought factors which were resulted in changes in fat mass may be responsible for the decreased leptin levels in subjects.

In agreement with these studies, our results demonstrated that Ghrelin increased, Leptin decreased and BMI loss obtained through aerobic training. Taken together, our finding suggests that an 8-week period of aerobic training is sufficient to reduce body weight and leptin, raise

ghrelin and probably, at least in part obesity. Based on these results, it could be suggested that subjects need to participate in aerobic training programs that lead to loss of body weight and fat reduction to improve ghrelin and leptin level.

Finally, an 8-week aerobic training program decreased insulin leptin and BMI and increase ghrelin concentration in our subjects. These findings suggest that exercise-induced changes in gut peptides hormones may be associated with the beneficial effects of exercise. Further studies are needed to elucidate the mechanisms by which exercise affects gut peptides.

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Table.1. *CG Groups' Pre- and Post-Experiment Measurements, BMI, Leptin and Ghrelin*

Control group	Pre-Test Mean ± SD	Post-Test Mean ± SD	P-value
Leptin(ng/ml)	17.54	19.65	0.155
Ghrelin(pg/ml)	318.71	318.06	0.524
BMI(kg/m^2)	31.41	31.28	0.509

Table.2. *AG Groups' Pre- and Post-Experiment Measurements, BMI, Leptin and Ghrelin*

Control group	Pre-Test Mean ± SD	Post-Test Mean ± SD	P-value
Leptin(ng/ml)	25.68	13.95	0.001
Ghrelin(pg/ml)	321.65	417.72	0.000
BMI(kg/m^2)	32.94	31.65	0.037

Table.3. *The comparison between CG and AG Groups' Post-Experiment Measurements, Ghrelin and Leptin*

AG & CG	SD	t	df	sig
ghrelin	5.6271	-17.71	22	0.003
leptin	2.8505	1.853	22	0.054

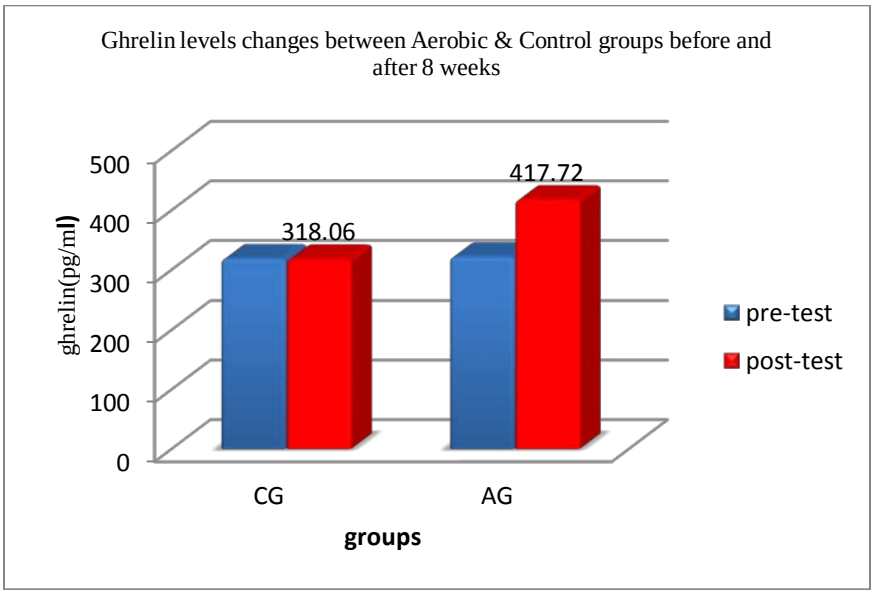

Figure 1. The Mean differences between AG & CG ghrelin changes after and before exercise

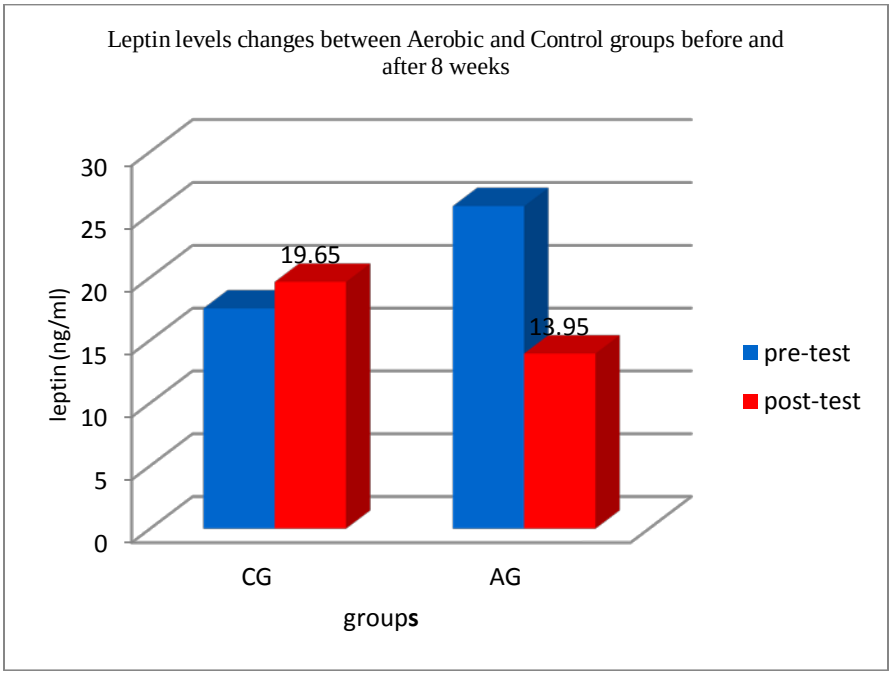

Figure 2. The Mean differences between AG & CG leptin changes after and before exercise