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# The effect of Resistance Training on level of Ghrelin Hormone in Overweight Females

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**ABSTRACT: Obesity is associated with adverse changes in metabolic and cardiovascular risk factors, including high blood pressure, dyslipidemia, and insulin resistance, thereby leading to an increased risk of morbidity and mortality from cardiovascular disease and type 2 diabetes. Ghrelin had been noted to food intake, glucose, and lipid metabolism, as well as influencing cardiovascular functions. The present study is to determine the effect of resistance training on Ghrelin in overweight females. Twenty overweight females subject (BMI$\geq$25) were randomly assigned to two groups (resistance training and control). The experimental training programs were performed three days a week for 12 weeks at a definite intensity and distance. Before and after 12 weeks intervention, Ghrelin, weight and body composition was measured for all subjects. Using independent T-test, the results showed that resistance training had significant effect on Ghrelin, body weight and fat percentage ($p\leq0.05$). Our study finding demonstrated that resistance training leads to significant increase of Ghrelin levels.**

**Keywords:** Resistance Training, Ghrelin, Overweight Women

## INTRODUCTION

World Health Organization (WHO) reports that overweight and obesity is the fifth leading cause for death globally, and third in the high-income countries (WHO (2004). Body weight is regulated by long term and short term energy balance signals. Energy homeostasis is controlled by peripheral signals from adipose tissue, the pancreas and the gastrointestinal tract. These signals influence circuits in the hypothalamus and brain stem to produce positive and negative effects on the energy balance (Mager, 2008). Researchers have recently discovered hormones that regulate energy homeostasis and are involved in the regulation of body weight. Some of these hormones are ghrelin, adiponectin, leptin, obestatin, and resistin (Kojima and Kangawa 2005).

Ghrelin is a growth hormone-releasing peptide secreted by the stomach with multiple biological functions, including food intake, glucose, and lipid metabolism, as well as influencing cardiovascular function (Hosoda *et al.,* 2002, Kola *et al.* 2005, Takaya *et al.,* 2000). Ghrelin has the ability to improve cardiac function in chronic heart failure and endothelial function in patients with the metabolic syndrome (Nagaya *et al.* 2004, Tesauro *et al.,* 2005). In addition, Ghrelin has a vasodilator effect in humans (Okumura et al., 2002) showing a decrease in blood pressure without an increase in heart rate (Nagaya *et al.* 2001a) and additional hemodynamic effects by increasing cardiac output (Nagaya *et al.* 2001b). Against this subject, circulating plasma levels of ghrelin are decreased in obesity (Tschop *et al.,* 2001) suggests that low ghrelin levels might play a role in the etiology of obesity and the associated cardiovascular risk that accompanies obesity. Indeed, ghrelin levels have been shown to be lower in obese individuals and to rise after weight loss (Hanusch-Enserer *et al.* 2004)

Due to the effect of ghrelin on weight control and appetite, the levels of this peptide is affected by exercise and results in a change in appetite and weight. Different studies have reported different findings on the effect of exercise on plasma ghrelin levels and various tissues. Some studies have shown that exercise-induced weight loss and the subsequent reduction in body mass index can change the plasma levels of ghrelin (Kraemer and Castracane 2007, Van der Lely *et al.,* 2004, Leidy *et al.* 2004, Erdmann *et al.,* 2007).

In fact, exercise may lead to negative energy balance and the subsequent change in plasma and tissue levels of ghrelin. Therefore, some studies have examined the effect of exercise on plasmatic levels and body weight changes. Karen and colleagues reported that plasma ghrelin levels increased in response to a training program for one year. This training program led to weight loss without reducing caloric intake. Hence, they suggested that a reduction in body weight results in an increase of plasma ghrelin levels which is known as a part of the adaptations to the energy shortage (Karen *et al.* 2003). Leidy *et al,* also measured the effect of exercise training with diet restriction on plasma total ghrelin levels in normal weight women. The results showed that ghrelin levels in the exercise-induced weight loss group compared with those who had a stable weight, was significantly increased. Therefore it seems that ghrelin is sensitive to weight changes. Kraemer et al, also examined the effect of exercise on ghrelin and the results showed an increase in ghrelin levels in people who have had lost weight. But the results of Mirzaei et al, study showed an increase in des-acyl ghrelin while the subjects' weight loss was not significant (Mirzaei *et al.,* 2009). While Ghanbari-Niaki *et al,* investigated the effect of 6 weeks of aerobic exercise on plasma ghrelin levels in mice and the results showed a decrease in plasma ghrelin in mice (Ghanbari-Niaki *et al.,* 2009). In recent years, resistance training or weight training has become a very popular form of exercise to improve physical fitness, enhance performance, and prevent injuries and increase muscle size (Kraemer *et al.,* 2002b). The physiological and biochemical responses to resistance exercise are different from those exhibited in response to endurance exercise (Kraemer *et al.,* 2002a). Therefore, considering the conflicting results of these studies, further research in this area is needed to identify the influencing of resistance training on ghrelin.

## MATERIALS AND METHODS

First of all call notices were posted in Azad University Qods City Campus in which the researcher invited to identify overweight and obese individuals who were willing to run exercise for weight adjustment and improvement of their physiological conditions. In the next stage the candidates were invited for the purpose of the Initial assessments and from among them, at least 20 individuals with BMI≥25 whose being overweight or obese was not associated with thyroid under-activity and did not have a history of exercise or calorie restriction diet were selected. After obtaining consent letters from the participants, they were asked to avoid rigorous physical activity 48 hours before the test and attend the pathobiology laboratory for blood sampling after 12 hours of fasting. The anthropometric measurements of the subjects were done in the gym. The subjects were then divided randomly into two exercise and control groups. The height was measured using a medical height meter; weight and body composition were measured using a body composition monitor (OMRON, Finland). The amount of calories intake of the subjects was determined by data collection method using a three-day questionnaire, at the beginning, at the end and every fortnight during the exercise period. The subjects were advised to keep up their usual diet during the research period. Resistance training consisted of 50-60 min of circuit weight training per day, 3 days a week, for 12 weeks. This training was circularly performed in 11 stations and included four sets with 12 maximal repetitions at 50-60% of 1-RM in each station. The resting time between two stations was 30 second and the related time between the sets was 90 second. In order to determine the overload after a four - week training program, a test with one maximum repetition for each subject in each station will be carried out and the rat load will be determined based on it. General and specific warm-up was performed prior to each training session and each training session was followed by cool-down. Five milliliter of blood was taken from each subject after 12 hours of fasting from the brachial vein and was reserved degrees by test time. Blood sampling in both phases was done between 8 and 9 AM in the follicular phase of every subject. Biovendor kit was used accordingly to measure plasma ghrelin using ELISA method.

### *A. Statistical analysis*

All values are represented as mean ± SD. As to the inferential statistics, first the Kolmogorov-Smirnov test was used for normal distribution and Leuven test was used for data homogeneity. Then independent t test was used for testing significance between groups. All the statistical operations were performed by spss software version 18 and significance level of tests was considered $p \leq 0.05$.

## RESULTS

The descriptive profile of the groups in variables of age, height, weight, body mass index, body fat percentage, ghrelin plasma as well as the independent t-test are presented in the Table 1. After 12 weeks of Resistance training ghrelin level ($p= 0.000$) (Fig. 1) showed a significant increases. Also the difference of measurements of variables of the two groups including Body weight ($p = 0.023$) and Body fat percentage ($p = 0.000$), was significant ($P \leq 0.05$) but, Body mass index ($p = 0.476$) was not significant (Table 1).

**Table 1: Pre-and post-test physical, physiological and biochemical variables and t test in the two groups.**

| Index / Groups | Resistance | | Control | | P |
|---|---|---|---|---|---|
| | **Pre test** | **Pos test** | **Pre test** | **Pos test** | - |
| Age (year) | 22.30 ± 2.41 | - | 22.77 ± 2.06 | - | - |
| Height (cm) | 160.3 ± 3.02 | - | 159.6 ± 3.99 | - | - |
| Weight (kg) | 75.48 ± 1.63 | 73.75 ± 1.58 | 75.08 ± 1.40 | 75.37 ± 1.32 | 0.023 |
| Body mass index (kg/m$^2$) | 29.46 ± 2.04 | 28.78 ± 1.96 | 29.55 ± 1.92 | 29.66 ± 1.93 | 0.476 |
| Fat percentage (%) | 31.58 ± 1.94 | 29.25 ± 1.29 | 31.80 ± 1.57 | 31.96 ± 1.57 | 0.000 |
| Ghrelin (pg/ml) | 4.62 ± 0.22 | 6.30 ± 0.84 | 4.57 ± 0.21 | 4.74 ± 0.27 | 0.000 |

Data are expressed as mean and standard deviation

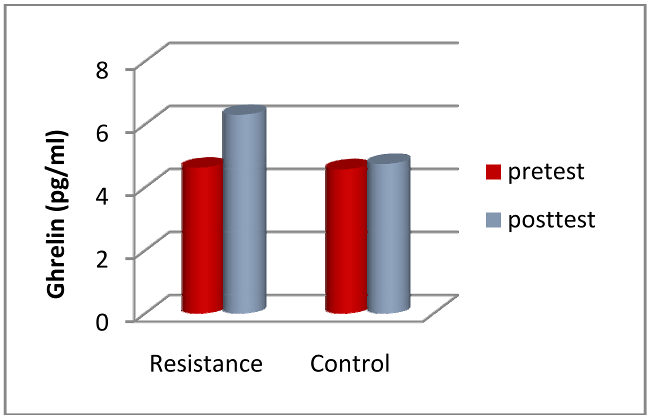


**Fig. 1.** The pattern of changes in Ghrelin levels before and after 12 weeks of exercise in resistance training and control groups.

## DISCUSSION

In this study the effect of 12 weeks of resistance training on plasma Ghrelin in overweight female was studied. The results of this study show that plasma Ghrelin levels in the experimental group increased significantly after 12 weeks of resistance training. Examining the result of studies on the role of physical activity on plasma ghrelin levels showed conflicting results, which some agree and some disagree with the results of this study. The results of previous studies have often evaluated the ghrelin response in one exercise session (Ghanbari-Niaki 2006, Schmidt *et al.*, 2004). Also there is little information on the effect of a period of exercise (short or long) on the response of plasma ghrelin levels (Foster- Schubert *et al.*, 2005). Leidy *et al,* studied the plasma ghrelin levels over a period of weight loss with diet and exercise. The results indicated a significant increase in plasma ghrelin in subjects who have lost weight and in subjects who have not lost weight, ghrelin levels remained constant. Also, Foster-Schubert and colleagues found that ghrelin levels increases as a result of exercise-induced weight loss without reducing food intake.

This important finding indicates the role of ghrelin in the adaptive response associated with weight loss, and thus its role in the regulation of body weight in the long term. It has been observed that plasma ghrelin levels also change with an increase or decrease in BMI. Karen *et al,* in their study have proposed the hypothesis that ghrelin is involved in the regulation of a negative feedback loop, which regulates the body weight.

This hypothesis states that a reduction in body weight is a reason for increasing the plasma ghrelin levels, which in fact the increase is recognized as part of the adaptations to energy shortage. Also in the study of Foster and Schubert upon completion of a one-year exercise protocol ghrelin showed an 18% increase in subjects who had lost weight more than 3 kgs (Foster-Schubert *et al.* 2005). Therefore, the present study also showed a significant decrease in body weight and body fat percentage which, in line with the above studies, may be the reason for the rise in plasma ghrelin. On the other side the results of some studies are contrary to the present study. In a study Robert and colleagues showed that a 93-day period of regular exercise in identical twins did not cause significant changes in ghrelin levels.

In a study Mirzaei *et al*, found that 8 weeks of aerobic exercise in obese women, leads to an increase in des-acyl ghrelin levels, whereas no significant change was observed in the levels of acyl ghrelin. In another study Kim et al, found that after 12 weeks of combined training in 11-year-old boys, des-acyl ghrelin concentrations were increased, whereas acyl ghrelin concentrations did not change (Kim *et al.* 2008). Also the results of few studies indicate a decrease in plasma ghrelin after sports activity. In this regard we can refer to the study conducted by Maslow et al. In their study, these researchers showed that the states of negative energy balance, such as physical activity can reduce food intake in obese individuals by reducing the levels of ghrelin and its activity (Marzullo *et al.,* 2004). In line with this, Wang and colleagues also found that upon 8 weeks of aerobic exercise, changes in plasma ghrelin levels and the hypothalamus are different. Their findings showed that the appetite and body weight of obese mice reduces by exercise through reducing the level of ghrelin in hypothalamus (Wang *et al.,* 2008). Therefore, this study shows that any resistance training increases the acyl ghrelin plasma concentrations in women who are overweight. A comprehensive review of the findings of previous studies and this study indicates that factors such as gender of the subjects, whether they are obese or thin, duration and type of the exercise protocol may affect the changes in ghrelin levels upon a period of exercise. On the other hand, the majority of these studies have examined total ghrelin, whereas acyl ghrelin has a role in energy balance, which in this study acyl ghrelin was assessed. Therefore, the findings of previous studies on the effects of exercise training on total ghrelin levels cannot be generalized to acyl ghrelin.

## CONCLUSION

The findings of this research show that resistance training leads to weight loss reduced body fat and increased Ghrelin at the same time. The results of the present study showed that exercise may cause a negative energy balance in the body of overweight women and in response to energy shortage, ghrelin is secreted to stimulate food intake behavior, supply lost sources of energy and restore the energy balance. This increase of ghrelin can stop the catabolic processes after exercise and probably cause an overcompensation of glycogen. The result of this information in total confirms the depletion of energy reserves and increased ghrelin theory.

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