International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 3, No. 1, p. 164-169, 2013

RESEARCH PAPER OPEN ACCESS

Acylated ghrelin in response to short time exercise in middle-aged men

Eizadi M*, Dooaly H, Kiani F, Khorshidi F

Department of Physical Education and Sport Science, Saveh Branch, Islamic Azad University, Saveh, Iran

Key words: Acylated ghrelin, exercise, obesity, insulin action.

Article published on January 25, 2013

Abstract

Ghrelin, a 28-amino-acid peptide, reduces fat oxidation and increases adiposity and its dysregulation may be important in obesity. This study aims to clarify the effects of a single bout exercise on levels of Acylated ghrelin and insulin resistance in Seventeen healthy sedentary obese men (39 ± 5 years mean ± standard deviation of mean, BMI ≥ 30 kg/m2). For this purpose, pre and post-exercise blood samples were collected to measuring ghrelin, insulin and glucose concentration. Insulin resistance was assessed using the homeostasis model assessment for insulin resistance formula derived from insulin and glucose levels. Student's t-tests for paired samples used to determine whether there were significant changes in each of variables in response to exercise test. Compared to pre-exercise, serum ghrelin increased significantly after exercise ($p = 0.009$). Serum insulin and insulin resistance did not change after exercise test when compared to pre-test. Based on these data, we conclude on session short-time exercise can be increase serum Ghrelin even in obese subjects.

* Corresponding Author: Eizadi M ✉ izadimojtaba2006@yahoo.com

Introduction

There is considerable evidence that Sedentary, overweight, and obese individuals are generally insulin resistant. On the other hand, they are able to maintain normal glucose tolerance through compensatory increases in pancreatic insulin secretion (Cris *et al.,* 2009). Obesity, which has become a global public health problem, is caused by the interplay between environmental and genetic factors. Among the factors, ghrelin is one of the circulating peptides, which stimulates appetite and regulates energy balance, and thus is one of the candidate genes for obesity and its related diseases such as type II diabetic (Julia *et al.,* 2010).

Epidemiologic studies clearly show that ghrelin is involved in the development of metabolic syndrome, type 2 diabetes (T2DM) and cardiovascular system (Pulkkinen et al., 2010). This polipeptide hormone has two different forms with different performance: unacylated ghrelin (UAG) and Acylated ghrelin (AG), in which Ser 3 is octanoylated (Kojima *et al.,* 1999). It was reported that a relative excess of AG compared to UAG has been reported in insulin resistance and related conditions (Barazzoni *et al.,* 2007). Previous investigations have shown lower plasma ghrelin concentration in obese when compared with lean subjects (Barazzoni *et al.,* 2007; Tsch¨op *et al.,* 2001; Vivenza *et al.,* 2004). It has been also demonstrated that in type 2 diabetes patients the fasting ghrelin concentrations are lower in obese than in lean persons (Shiiya *et al.,* 2002). It has been hypothesized that ghrelin may also participate in the regulation of glucose and insulin metabolism. On the other hand, some previous studies suggested a positive relation between ghrelin and insulin resistance (Barazzoni *et al.,* 2007).

It has been demonstrated that aerobic exercise is effective in improving insulin sensitivity or insulin resistance in patients with obesity, prediabetes and type 2 diabetes (Houmard *et al.,* 2004; Hughes *et al.,* 1999. Eizadi *et al.,* 2011). Also, it was reported that aerobic exercise for long time increases serum ghrelin in obese subjects (Kelishadi *et al.,* 2008). But, the role of short-time exercise or one session exercise on serum ghrelin on insulin resistance in obese subjects and related diseases are still not completely elucidated. Therefore, the objective of this study is to investigation the effects of a single bout cycling test on serum ghrelin and insulin resistance in middle-aged obese men.

Material and methods

Subjects:

Seventeen healthy sedentary obese men (39 ± 5 years mean ± standard deviation of mean, BMI ≥ 30 kg/m2,) participated in the study by voluntarily. This study aimed to evaluate serum ghrelin and insulin resistance in response to a single bout cycling exercise. After the nature of the study was explained in detail, informed consent was obtained from all participants.

Inclusion and exclusion criteria:

Participants were included if they had not been involved in regular physical activity or diet in the previous 6 months. Subjects included individuals with no cardiovascular diseases, gastrointestinal diseases, kidney and liver disorders or diabetes. All subjects were non-smokers. In addition, exclusion criteria included inability to exercise and supplementations that alter carbohydrate-fat metabolism. The subjects were advised to avoid any physical activity or exercise 48 hours before the exercise test.

Anthropometrical measurements:

Anthropometric measurements of participants were performed while they stood in light clothing without shoes. The weight and height of the participants were measured by the same person when the participant had thin clothes on and was wearing no shoes. Body Mass index (BMI) was calculated using the formula body weight/height in terms of kg/m^2. Waist and hip circumferences were measured and a waist-to-hip ratio (WHR) was calculated. Percentage body fat was measured using body composition monitor (OMRON, Finland).

Blood samples and exercise test

Blood samples were collected before and after a single bout cycling test in order to measuring serum Acylated Ghrelin, insulin and glucose concentration. Exercise test was performed according to YMCA standard protocol on leg ergometery cycle (Tunturi, made in Finland). This protocol was performed in 5 continues stage without rest between stages. Each stage lasted 3 minute (Mullis *et al.,* 1999). Insulin resistance was calculated from the measurements by means of a formula devised for use in epidemiologic studies: fasting glucose (mmol/liter) 3 fasting insulin (lU/ml)/25 (Duncan *et al.,* 1995). Glucose was determined by the oxidase method (Pars Azmoun, Tehran, Iran). Serum ghrelin was determined by ELISA method (Human Acylated Ghrelin Kit, Biovendor, Austria). The Intra- assay coefficient of variation and sensitivity of the method were 10.3% and 4 pg/mL, respectively.

Table 1. Mean and standard deviation of anthropometric and metabolic characteristics of studied subjects.

Variables	Obese group	None-obese group
Age (year)	39 ± 5	-------
Weight (kg)	99 ± 11	-------
Height (cm)	174 ± 6.6	-------
Body Fat (%)	31.9 ± 4.28	-------
Body mass index (kg/m²)	32.69 ± 3.23	-------
Abdominal circumference (cm)	105 ± 13	-------
Glucose (mg/dL)	103 ± 9.8	99 ± 11.9
Insulin (µIU/ml)	8.64 ± 2.11	9.45 ± 1.6
Insulin resistance	2.21 ± 0.36	2.24 ± 0.42
Ghrelin (pg/ml)	53.8 ± 14.3	87 ± 21.3

Statistical analysis

Data were analyzed by computer using SPSS software version 15.0. The Kolmogorov-Smirnov test was applied to determine the variables with normal distribution. Student's t-tests for paired samples used to determine whether there were significant changes in each of variables in response to exercise test. All statistical tests were performed and considered significant at a $P \leq 0.05$.

Results

In this study the effect of a single bout cycling exercise on serum levels ghrelin and insulin resistance was assessed in middle-aged obese males. Mean and standard deviation of anthropometrical and biochemical indexes characteristics of studied subjects are shown in Table 1. Findings from Kolmogorov-Smirnov test were showed normal distribution in all variable values at baseline. The data of paired T test method showed that single bout cycling test resulted a significant increase in serum ghrelin when compared to pre-test values ($p = 0.009$, Fig 1). No significant differences were found in insulin resistance by cycling exercise with compared to baseline ($p = 0.311$). Also, there were no significant differences for serum insulin concentration after exercise test when compared to pre-test ($p = 0.223$). 461.

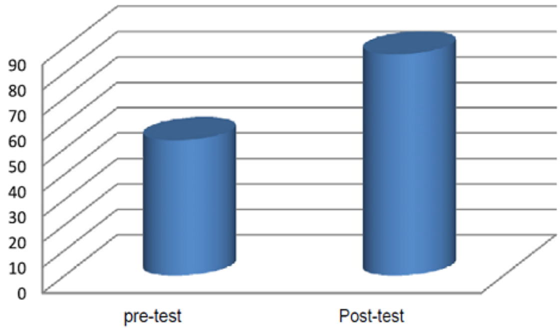

Fig. 1. The changes pattern of serum Ghrelin at baseline in baseline and after cycling test in studied patients. This figure shows that single bout cycling test resulted a significant increase in serum ghrelin when compared to pre-test values.

Discussion

The major finding of this investigation was increased serum ghrelin in response to cycling test in studied obese subjects. On the other hand, on session cycling exercise with short-time can be increase serum ghrelin in middle-aged healthy obese men. In present study, we observed increases in serum ghrelin, while insulin levels and insulin resistance did not change in response to exercise test in these subjects.

In the present study, short-term biking exercise led to a significant increase in serum ghrelin levels. In this context, although scientific resources support significant changes in serum ghrelin levels in response to long-term exercise programs in healthy populations and patients (Kelishadi *et al.,* 2008; Kim *et al.,* 2008), still there is no overall and comprehensive consensus on this subject. However, scientific findings regarding serum ghrelin response to exercise are limited to single exercise sessions in healthy subjects or patients. Despite this, some studies on the effect of a single exercise session have reported no change (Malkova *et al.,* 2008; Schmidt *et al.,* 2004) or significant increase (Erdmann *et al.,* 2007) in serum or plasma ghrelin, but some other studies, confirming our study, have reported significant increases in ghrelin levels after exercise (Ghanbari-Niaki, 2006). A review of the said findings in this context implies the absence of a general conclusion. It is possible that in the said studies, other effective factors besides exercise have been involved ghrelin in changes. It also appears that the type of exercise, its intensity, duration and type of laboratory equipment and gauges are also influential in the final result. Significantly increased ghrelin levels in the present study may be attributed to moderate intensity exercise.

Extensive studies have mentioned that ghrelin has a role in the development of metabolic syndrome and type 2 diabetes (Ukkola *et al.,* 2009), although the direct or indirect role of glucose and insulin in ghrelin regulation is not completely understood. According to previous studies, it has been indicated that the acute ghrelin consumption increases plasma glucose levels by down regulation of insulin, which somehow notes the interaction of ghrelin, with blood insulin or glucose (Pulkkinen *et al.,* 2010).

Reviewing the research findings advocate some sort of a close correlation between circulating ghrelin and glucose or insulin levels (Yada *et al.,* 2008). These studies somehow suggest that any change in the levels is associated with changes in insulin secretion from the pancreas and changes in blood glucose levels. So according to some previous findings, an increase in blood ghrelin levels is associated with reduced insulin secretion which in turn leads to an increase in blood glucose concentration (Broglio *et al.,* 2003; Dezaki *et al.,* 2004). Hence, it is expected that changes in serum ghrelin levels lead to a change in blood insulin or glucose due to external stimuli.

Unlike the information, despite no change in insulin and glucose and insulin resistance, cycling test in present study led to an increase in serum ghrelin levels in studied obese subjects. Since some previous studies have been reported lower serum ghrelin in obese peoples when compared to lean subjects (Barazzoni *et al.,* 2007; Tsch¨op *et al.,* 2001; Vivenza *et al.,* 2004). This is likely exercise tends to increase this peptide hormone even in the absence of changes in insulin or insulin resistance in obese subjects.

Confirming these findings in a recent study, despite no change in insulin, glucose, lipid profile, and leptin in response to a long-term exercise, plasma ghrelin levels significantly increased (Kelishadi *et al.,* 2008). Furthermore in another study it was found that the effect of exercise on insulin and leptin is dependent on the energy balance but the ghrelin response to exercise is to some extent independent of energy balance (Hagobian *et al.,* 2008).

References

Barazzoni R, Zanetti M, Ferreira C. 2007. Relationships between desacylated and acylated ghrelin and insulin sensitivity in the metabolic syndrome," Journal of Clinical Endocrinology and Metabolism **92,** 3935–3940.

Broglio F, Benso A, Castiglioni C. 2003. The endocrine response to ghrelin as a function of gender in humans in young and elderly subjects. J Clin Endocrinol Metab **88,** 1537-42.

Cris A. Charles J, Lori A, Michael T, Kim M, Joseph A. 2009. Effects of Exercise Training Intensity on Pancreatic B-Cell Function. Diabetes care **32(10),** 1807-1811.

Dezaki K, Hosoda H, Kakei M. 2004. Endogenous ghrelin in pancreatic islets restricts insulin release by attenuating Ca2+ signaling in ß-cells: implication in the glycemic control in rodents. Diabetes **53,** 3142-51.

Duncan M, Singh B, Wise P. 1995. A simple measure of insulin resistance. Lancet **346,** 120–1.

Eizadi M, Khorshidi D, Seyedhoseini MA, Daraei Shokrabad F. 2011. Aerobic Exercise-Induced Weight Reduction Decrease Serum Leptin in Patients with Diabetic Mellitus. Advance in bioresearch **2(2),** 143-150.

Erdmann J, Tahbaz R, Lippl F, Wagenpfeil S, Schusdziarra V. 2007. Plasma ghrelin levels during exercise - effects of intensity and duration. Regul Pept **143(1-3),** 127-35.

Ghanbari-Niaki A. 2006. Ghrelin and glucoregulatory hormone responses to a single circuit resistance exercise in male college students. Clin Biochem **39(10),** 966-70.

Hagobian TA, Sharoff CG, Braun B. 2008. Effects of short-term exercise and energy surplus on hormones related to regulation of energy balance. Metabolism **57(3),** 393-8.

Houmard JA, Tanner CJ, Slentz CA. 2004. Effect of the volume and intensity of exercise training on insulin sensitivity. J Appl Physiol **96,** 101–106.

Hughes VA, Fiatarone MA, Fielding RA. 1993. Exercise increases muscle GLUT-4 levels and insulin action in subjects with impaired glucose tolerance. Am J Physiol **264,** 855–862.

Julia W, Karen C, Javier R, Ascension M. 2010. Role of physical activity on immune function Physical activity, exercise and low-grade systemic inflammation. Proceedings of the Nutrition Society **69,** 400–406.

Kelishadi R, Hashemipour M, Mohammadifard N, Alikhassy H, Adeli K. 2008. Short- and long-term relationships of serum ghrelin with changes in body composition and the metabolic syndrome in prepubescent obese children following two different weight loss programs. Clin Endocrinol (Oxf). [Epub ahead of print].

Kim HJ, Lee S, Kim TW, Kim HH, Jeon TY, Yoon YS, Oh SW, Kwak H, Lee JG. 2008. Effects of exercise-induced weight loss on acylated and unacylated ghrelin in overweight children**.** Clin Endocrinol (Oxf) **68(3),** 416-22.

Kojima M, Hosoda H, Date Y, Nakazato M, Matsuo H, Kangawa K. 1999. Ghrelin is a growth-hormone-releasing acylated peptide from stomach," Nature 402**(6762),** 656–660.

Malkova D, McLaughlin R, Manthou E, Wallace AM, Nimmo MA. 2008. Effect of Moderate-intensity Exercise Session on Preprandial and Postprandial Responses of Circulating Ghrelin and Appetite. Horm Metab Res [Epub ahead of print].

Mullis R, Campbell IT, Wearden AJ, Morriss RK, Pearson DJ. 1999. Prediction of peak oxygen uptake in chronic fatigue syndrome. British Journal of Sports Medicine **33(5)**, 352-6.

Pulkkinen L, Ukkola O, Kolehmainen M, Uusitupa M. 2010. Ghrelin in Diabetes and Metabolic Syndrome. Int J Pept. **3,** 1-11.

Schmidt A, Maier C, Schaller G, Nowotny P, Bayerle-Eder M, Buranyi B, Luger A, Wolzt M. 2004. Acute exercise has no effect on ghrelin plasma concentrations. Horm Metab Res **36(3),** 174-7.

Shiiya T, Nakazato M, Mizuta M. 2002. Plasma ghrelin levels in lean and obese humans and the effect of glucose on ghrelin secretion," Journal of Clinical Endocrinology and Metabolism **87(1),** 240–244.

Tsch¨op M, Weyer C, Tataranni PA, Devanarayan V, Ravussin E, HeimanML. 2001. Circulating ghrelin levels are decreased in human obesity," Diabetes **50(4),** 707–709.

Ukkola O, Kunnari A, Jokela M, Päivänsalo M, Kesäniemi YA. 2009. Ghrelin and metabolic disorders. Current Protein and Peptide Science **10 (1),** 2–7.

Vivenza D, Rapa A, Castellino N. 2004. Ghrelin gene polymorphisms and ghrelin, insulin, IGF-I, leptin and anthropometric data in children and adolescents," European Journal of Endocrinology **151(1),** 127–133.

Yada T, Dezaki K, Sone H, Koizumi M, Damdindorj B, Nakata M, Kakei M. 2008. Ghrelin regulates insulin release and glycemia: physiological role and therapeutic potential. Curr Diabetes Rev **4(1),** 18-23.