The effects of water aerobic exercises on the levels of plasma β-estradiol, Ghrelin and body composition in obese non-athlete women

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Abstract

Ghrelin is an appetizing peptide hormone in the stomach and affects energy balances, weight, and body composition. Weight gain and increase in serum estrogens, especially β-Estradiol, on the other hand, raises the risk of breast cancer in obese women. Therefore, the present study attempts to investigate the effects of water aerobic exercises on the levels of β-Estradiol and ghrelin in blood plasma and body composition of obese non-athlete women. Through a public call, 40 obese women were selected via the convenient sampling. The subjects were put into two experimental and control groups via simple random sampling. 24 hours before the exercise program began, the first stage of 10 cc blood sampling was conducted from the left arm venous while the subjects were fasting. The experimental group went through a 12-week water aerobics exercising program with three sessions per week while the control group went on living without any specific change in their lifestyle and physical activities. The data collected from the blood sample analysis were analyzed through dependent 't' and covariance analysis tests using SPSS 21 computer application. The results revealed that water aerobic exercises significantly affect the level of ghrelin in obese non-athlete women. Yet, the study failed to see a significant change in the level of β-Estradiol, BMI, the net mass and fat percentage. The study demonstrated that, in case water aerobic exercises are obligatory in order to change and influence the severity of the exercises should be over 70% (VO2 max) with sessions longer than one hour.

Keywords : Water aerobic exercises, β-Estradiol, plasma ghrelin, obese women and non-athlete

Introduction

Ghrelin is a peptide secreted in the stomach. Ghrelin plays an important role in the secretion of growth hormone, energy balance, obesity, food intake behavior and some cardiovascular functions (Rashidlamir et al., 2011). Since the discovery of ghrelin, human knowledge of weight balance, appetite, and energy balance has improved significantly and the effect of ghrelin on appetite, metabolism, weight and body composition all resulting in the adjustment of body energy balance (Broom et al., 2007). Several studies have shown that stomach ghrelin increases while fasting and decreases after eating. In fact, plasma ghrelin decreases in positive energy balance condition and increases when the energy balance is negative (Klok et al., 2007). The level of ghrelin and energy balance could be affected by various factors like exercise and physical activity. Numerous scholars have investigated the mechanism of this hormone and its compatibility with physical activities as well.
Ghanbari Niaki et al. (2009) studied the effects of 6 weeks of aerobic exercises on the level of ghrelin in the soleus muscle of the mice and found that endurance exercises decrease the level of ghrelin in plasma and the muscles of the mice.

The effects of changes in the density of ghrelin and β-Estradiol are not yet fully known on physical and health functions of the body. Several studies have been conducted on the role of these two hormones in long term aerobic exercise; yet. The knowledge of water aerobic exercises is far from complete. Very few studies have focused on the effects of water aerobic exercises on the hormone system (Maher et al., 2010). Water is an excellent tool for empowering muscles in handicapped and obese people, but no specific study has investigated the needs of those who have problems with bearing the weight of their lower body parts and waist along with problems with moving due to small distances of the lower vertebrae, Osteoarthritis of the knee, rheumatoid arthritis of the muscles, etc. Therefore, the present study aims to investigate the effects of water aerobic exercises on the levels of serum plasma ghrelin and β-Estradiol in obese non-athlete women.

Materials and Methods

The statistical population of the study included 57 obese and non-athlete women in the city of Miandoab who were asked to participate in the study through a public call. All these women filled up consent forms and finally 40 of them with an average weight of (80±2 Kg), age of (33± 3 years), BMI of (31± 3), height of (160± 5 cm), fat, percentage of (33 ±5) and net weight of (53± 0.6) were selected through convenient sampling as the statistical sample. Then they were randomly put into two control and experimental groups. The subjects’ general health and nutrition were controlled via two questionnaires. The general health questionnaire and the personal information form using screening and self-reporting were used to find the healthy subjects without any health problems. The questionnaires had 10 questions about diseases and 10 questions on personal information. The questionnaire of frequency of food and food recalls with the reliability of p<0.05 or 95% (Hussaini Esfahani et al., 2010) was filled in 24 hr for three days for all subjects and according to that, a diet of low calorie (1500 - 1900 kilo calorie) was given for 12 complete weeks.

Nutrition program

Breakfast: Banana, fat free milk, bread and yogurt with 300 to 350 kilo calories; a snack between breakfast and lunch: natural fruit juice with 100 to 150 kilocalorie.

Lunch: meat, rice, bread, salad without mayonnaise with 550 to 700 kilo calorie; afternoon snack: fruit with 100 - 150 kilo calories.

Dinner: grilled chicken, green pepper or greens and yogurt with 450 to 550 kilo calories. Later on, the physical activity program was set according to table - 1.

Exercise program

The subjects in both control (resting) and experimental (12 weeks of exercise) groups were investigated. The primary severity of exercises in the experimental group was gauged through Adams, (2010) formula using the range of maximum heart rate (180-185 pulse in a minute).

\[ \text{Age - 220 = HR}_{\text{max}} \]

(%) reserve heart rate= \( \text{HR}_{\text{max}} - \text{HR}_{\text{resting}} \)

Target heart rate (THR) = resting HR + 0.60 (HR\text{max}-HR_{\text{resting}})

The subjects were then gathered in the laboratory while fasting for 12 to 14 hr after the nutrition and exercise programs were set. 10 cc blood samples were taken 24 hr before the exercise program began.
while fasting and 24 hr after the final exercise session under equal conditions and from left arm vein at 8 - 9 am and at 23 ± 2 degrees centigrade. The blood samples were kept at -70 degrees centigrade for separation until the end of the exercise program in Danesh pathology laboratory and were centrifuged at 400 RPM. The results were recorded for a 7 hr duration. 5CC of the serum was separated for measuring active acylated ghrelin and measured using the Acylated Ghrelin ELISA kit. The estrogen was measured using an Estradiol ELISA kit. In order to analyze the data and the hypotheses, the dependent ‘t’ test with a significance level of $\alpha = 0.05$ and the covariance test using the SPSS 21 computer application.

**Result**

The data collected were analyzed through dependent ‘t’ and covariance tests and the results and represented in tables 2, 3 and 4 along with Fig. - 1 and 2.

Considering the calculated amount for ‘t’ ($t= -2.366$) and the level of significance of ($p=0.01$), 12 weeks of water aerobic exercises have a significant impact on the level of ghrelin in obese non-athlete women. Moreover, the difference of the means from pretest ($5.73 \pm 0.75$) and posttest ($5.94 \pm 2.94$) in the acylated ghrelin of the experimental group proves the increase in the level of ghrelin after water aerobic exercises. These changes are seen in both control and experimental groups (Fig.- 1).

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**Table - 1. Physical Exercise program**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Stretches</th>
<th>Warm up with push ups</th>
<th>Water exercises</th>
<th>Stretches</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>5 min</td>
<td>5 min</td>
<td>4 min</td>
<td>5 min</td>
<td>5 min</td>
</tr>
<tr>
<td>Severity HR$_{\text{max}}$</td>
<td>pain threshold</td>
<td>THR 50%</td>
<td>THR 75%</td>
<td>pain threshold</td>
<td>THR 40%</td>
</tr>
</tbody>
</table>

**Table - 2. Comparison of the means in pre and posttests of control and experimental groups**

<table>
<thead>
<tr>
<th>Mean of the differences</th>
<th>Comparison of Pre and Post Tests</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acylated ghrelin in experimental group</td>
<td>$5.94 \pm 2.94$</td>
<td>-2.366</td>
<td>0.01</td>
</tr>
<tr>
<td>Acylated ghrelin in experimental group</td>
<td>$0.75 \pm 5.73$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table - 3. Results from covariance test on the effects of water aerobic exercises on β-Estradiol**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sum of squares</th>
<th>Mean of squares</th>
<th>Degree of freedom</th>
<th>F</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>β-Estradiol 17</td>
<td>4.801</td>
<td>4.801</td>
<td>1</td>
<td>0.105</td>
<td>0.750</td>
</tr>
</tbody>
</table>

**Table - 4. Results from covariance analysis to study the effects of water aerobic exercises on anthropometric indices**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sum of squares</th>
<th>Mean of squares</th>
<th>Degree of freedom</th>
<th>F</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>0.718</td>
<td>0.718</td>
<td>1</td>
<td>1.236</td>
<td>0.283</td>
</tr>
<tr>
<td>Fat %</td>
<td>0.984</td>
<td>0.984</td>
<td>1</td>
<td>0.532</td>
<td>0.476</td>
</tr>
<tr>
<td>weight without fat</td>
<td>6.107</td>
<td>6.107</td>
<td>1</td>
<td>1.502</td>
<td>0.320</td>
</tr>
</tbody>
</table>
Considering the calculated amount for F (F=0.105) and the level of significance (p = 0.750) in covariance test, 12 weeks of water aerobic exercises have no significant impact on the level of β-Estradiol in obese non-athlete women. Besides, a comparison between changes in β-Estradiol level in the experimental group shows that its level increases after water aerobic exercises. This was seen in the control group as well; yet the change was more significant in the experimental group (Fig.- 2).

The calculated amount for F, each of the anthropometric indices and their levels of significance in the covariance test reveals that there is no significant difference in water aerobic exercises and anthropometric indices of obese non-athlete women. As it can be seen, this lack of difference is more visible in case of BMI (F = 1.236, p = 0.283), fat percentage (F = 0.532, p = 0.476) and body weight without fat (F = 0.052, p = 0.320).

Discussion

Findings from this study demonstrated that 12 weeks of water aerobic exercises have significant impact on the levels of acylated ghrelin in plasma (p = 0.01, t = -2.366). This concords with findings of Markofski et al. (2013); Holliday, (2013) and Mason et al. (2014).

However, scientific evidences prove the effects of long-term aerobic exercises with an emphasis on their volume on the increase in the level of ghrelin molecule and losing 3 kg weight (Broom et al., 2007). Other studies have shown that a year of regular aerobic exercises with an average severity ends in an 18% increase in the level of base ghrelin in women (Markofski et al., 2013). It is believed that total fasting ghrelin in the group using both exercises and diet receive more effects and their weight loss comes with an increase in the density of ghrelin (Mason et al., 2014).

Furthermore, findings from this study comply with the findings of Foster-Schubert et al. (2008); Kawano et al. (2013) and King et al. (2013). It seems that obese people face more decrease in ghrelin compared to their normal weight counterparts and the effects of severe exercises and appetite related hormones on ghrelin is average and below average (Foster-Schubert et al., 2013). Some studies have revealed that any type of exercise with weight loss effects decrease acylated ghrelin as well and there seems to be no difference in their types (Kawano et al.,
A delicate revision on the relationship between ghrelin and exercising revealed that severe and swift exercising interferes with discharging acylated ghrelin. Therefore, a consensus of these study states that physical exercises do not affect the ghrelin not relevant to weight loss (King et al., 2013).

It seems as if similar severity of exercises decrease acylated ghrelin levels in a similar rate. Thus, when the level of leptin decreases after an average-severity exercise program, its effect on repressing ghrelin will probably go away. These exercises could be proposed as a model of removing fat from the body (Timothy et al., 2013). Researchers have demonstrated that increase in ghrelin level in response to weight loss after exercising occurs regardless of food consumption. This observation about the ghrelin’s role is limited to an adaptive response to weight loss and therefore, body weight could be adjusted (Thivel and Jean-Philippe, 2013).

Moreover, the findings of the present study revealed that 12 weeks of water aerobic exercises have no significant effect on the level of β-Estradiol in obese athlete women (p = 0.750, F = 0.105). In some cases, studies refer to different functions of two hormones that could end in their individual function. This concords with the findings of Rashid Lamir et al. (2011) and Markofski et al. (2013). They believe that aerobic exercises have no significant impact on the level of β-Estradiol in obese non-athlete women. They have also shown that attending a long-term (one-year) exercising program reduces weight and induces hormonal changes. On the other hand, short-term, physical exercises have no significant effect on reducing levels of β-Estradiol.

However, other scholars like Williams, (2004); Kelley (2009) and Zarneshan and Salehzadeh (2012) do not approve of the results from this study. They believe that the effect of an exercise program on the level of β-Estradiol 17 could not be unchanged. They think aerobic exercises with an average severity along with specific diets (Eating soy) not only reduce BMI and obesity, but also decrease the level of serum β-Estradiol in obese women. This means that there is a significant relationship between obesity and β-Estradiol so that body fat percentage and BMI are among determining factors affecting levels of ghrelin and β-Estradiol (Homaee et al., 2011).

The findings from this study failed to find a significant relationship between water aerobic exercises and body composition of obese non-athlete women. This concords with findings from the studies conducted by Khalizadeh et al. (2011) and Hagobin and Evero (2012). They believe that there is no significant relationship between water exercises and body composition and conclude that the severity of aerobic exercise and/or women's thinness or obesity are not the only factors affecting their body composition and aerobic exercises in obese people significantly decrease serum leptin, increase plasma acylated ghrelin density and finally improve appetite. This reduces the level of significance in the difference between aerobic exercises and reduce body mass. On the contrary, results from Abbas Daloooyi et al. (2011); Hady et al. (2012); and Mason et al. (2014) are not in concordance with the present study. They think sports activities reduce body fat mass significantly and the daily energy intake, daily energy consumption are related to energy usage by the exercise and the changes in body fat percentage and energy balance. In general, it seems that poor measurement of energy intake and low severity of exercises along with specific characteristics of water exercises induce little changes in body composition of women and these changes are statistically insignificant.
Conclusion

The findings of the present study demonstrated that the short-term water aerobic exercises presented in this study failed to influence the level of β-Estradiol 17 and body composition of obese women significantly. Yet, the amount of ghrelin measured in the experimental group was significantly different from the amounts measured in the control group. It seems as if obese women need longer time to lose their fat content (Hagobin and Evero, 2012). In this regard, an exercise program with a high severity along with longer and more exercises is necessary in order to make significant changes in the body composition of obese women. In any case, as obese women turn into physical activities aiming at losing weight, they must obtain the power to tolerate the pressure of long term and severe exercise and prevent any muscular, skeletal and cardiovascular damages and this will help reach precise results from studies in the field.

References


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