The Effect of Low Frequency Non Thermal Ultrasound on Central Weight Reduction in Obese Women Postnatal

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Abstract

Background: Obesity can be an underlying cause of many disorders such as arthritis, lung diseases, diabetes, hypertension, coronary artery disease, heart failure, cataracts, cancer and even early death.

Objective: This study assessed the effect of low frequency non thermal ultrasound on central weight reduction in obese women postnatal.

Methods: Fifty postpartum, multiparous obese women, with a bulged abdomen associated with diastasis recti more than 2.5cm and less than 4cm. Their ages ranged from 25-35 years, their body mass index ranged from 30.0 to 34.9 kg/m² and waist circumference was more than 88cm, they divided randomly into two equal groups (A&B), each of them consisted of 25 women, participants of group (A) received low frequency non thermal ultrasound, Faradic stimulation and abdominal exercise program. While participants of group (B) received faradic stimulation and abdominal exercise program, three times per week for eight weeks.

Results: Showed that group A that received low frequency non thermal ultrasound had statistically higher significant decrease in waist circumference and body mass index than group B.

Conclusion: The finding of the study revealed that there was a significant effect of low frequency non thermal ultrasound on central weight reduction in obese women postnatal.

Key Words: Obesity – Low frequency non thermal ultrasound – Faradic stimulation – Abdominal exercises – Rectus diastasis.

Introduction

OBESITY defined as excess body fat or adipose tissue [1]. Adipose tissue consists of adipocytes, inflammatory cells, and vascular, connective, and neural tissues. Adipose tissue is distributed throughout the body as large homogeneous discrete compartments and as small numbers of cells “marbling” or adjacent to other tissues. Most adipose tissue (85% of total adipose tissue mass) is located under the skin (subcutaneous fat), and a smaller amount (15%) is located within the abdomen (intra-abdominal fat) in lean and obese persons [2].

Obesity may be peripheral, central, or combination of both. Peripheral obesity is deposition of excess fat in the buttock, hips, and thighs, but central obesity is deposition of excess fat in the abdominal area which is a dangerous place for fat to build up because it is closely located to the vital organs and their blood supply [3]. Abdominal obesity means waist circumference more than 102cm in men or more than 88cm in women [4]. Excess abdominal fat also puts pressure against the linea alba and can cause rectus diastasis for men and women [5].

Body mass index (BMI) is an index of weight to height (kg/m²), a BMI between 25 and 29.9 places individuals at increased risk of developing health problems compared with those in the normal range of 18.5-24.9. As the BMI increases from 30 to 40, or above [6]. Women have more body fat than men. Although waist circumference (WC) and BMI are interrelated, waist circumference provides an independent prediction of risk over and above body mass index. The waist circumference at which there is an increased relative risk is defined as follow: Men >102cm and women >88cm [7]. Women with waist measurement of more than 35 inches and men with waist measurement of more than 40 inches may have more health risks than people with lower waist measurement because their body fat distribution [8].
The relation between waist circumference, weight, and BMI can be conceptualized by using simple geometric relations that consider the body as a cylinder; WC is the cylinder’s circumference, height is its length, and weight is a measure of mass. Therefore, BMI provides information about body volume and mass, and WC provides information about body shape [9]. BMI and WC are strongly correlated with total-body adipose tissue mass, WC values provide a measure of both subcutaneous abdominal adipose tissues and intra-abdominal adipose tissues masses. Assessment of WC provides a measure of fat distribution that cannot be obtained by measuring BMI [10].

Faradic is a form of electrical stimulation that uses a higher intensity current than microcurrent stimulation and so is ideally suited for firming and toning body muscles. Faradic therapy is traditionally used for body contouring, slimming and toning. Each treatment session provides a form of passive muscle exercise [11]. It was proved that physical exercises affect physical fitness, subcutaneous fat reduction of different parts of body and reduce whole body weight [12]. It was reported that abdominal exercise program produces a statistically highly significant decrease in rectus diastasis, body weight, BMI, and waist circumference [13]. Low-frequency non-thermal ultrasound used for body contouring. It causes cavitation effect where bubbles are created inside the cell, which swell and rupture, creating mechanical stress that disrupts the adipose cell membrane and releases the stored triglyceride contents [14].

Patients and Methods

Fifty postpartum, multiparous obese women selected from outpatient clinic of Obstetrics and Gynecology, El-Matarya Teaching Hospital after two months of normal vaginal delivery, they involved in the study from March 2014 to March 2015. All participants were divided randomly into two equal groups. Group (A) received low frequency non-thermal ultrasound, faradic stimulation and abdominal exercise program three times per week for eight weeks. Group (B) received faradic stimulation and abdominal exercise program, three times per week for eight weeks. All women signed a written consent forms approved by the Ethical Committee of the Faculty of Physical Therapy, Cairo University.

Inclusion criteria:
• All women had a bulged abdomen associated with diastasis recti more than 2.5cm and less than 4cm.

• Age ranged from 25 to 35 years.
• All women had given birth two to three times.
• BMI ranged from 30.0 to 34.9kg/m².
• Waist circumference >88cm.
• All women were not be engaged in any organized sport activity.

Exclusion criteria:
• Woman less than 25 years and more than 35 years.
• Primipara and woman had given birth more than three times.
• BMI less than 30.0 and more than 34.9kg/m².
• Waist circumference less than 88cm.
• Women had previous cesarean section, abdominal and/or back operations, abdominal skin diseases, spinal disorders.

Instrumentation:
• Weight height scale for measuring the weight and height in two groups before and after treatment program.
• A one centimeter wide measuring tape: To measure waist circumference in two groups before and after treatment program.
• Ultrasonographic machine model Volusion 730 PRO, JE used to measure the inter recti distance above umbilicus, at umbilicus and below umbilicus for each woman in both groups before and after the program of treatment.
• Ultrasonic device (Body son 4, include four fixed heads and one movable head, model EME, made in Italy with a frequency of 3MHz) was used for participant of group A.
• Faradic stimulation unit (Computerized multichannel device, two channels, model EME, made in Italy) was used for participant of both groups.

Assessment procedures:
• A full history was taken from each participant before starting the study.
• Weight and height were measured for each participant to calculate the BMI according to the following equation: \[ BMI = \frac{\text{Weight}}{\text{height}^2} \text{ (kg/cm}^2\text{)} \]
• Waist circumference was measured for each participant from the waist, mid-way between palpated iliac crest and palpated lower rib margin at mid axillary line, while the subject in supine position. Measuring at least one hour after meal intake.
• Measurement of the inter recti distance above umbilicus, at umbilicus and below umbilicus for each participant, the woman was instructed to assume crock lying position and a suitable amount of KY gel was placed on the abdomen. The ultrasonographic probe was placed perpendicular above the umbilicus (midway between umbilicus and xiphoid process) and the distance in between the two recti was measured, then the probe was placed at the umbilicus and the distance in between the two recti was measured, then the probe was placed below the umbilicus (midway between umbilicus and symphsis pubis) and the distance in between the two recti was measured.

Therapeutic procedures:
The volunteers of group (A) received a program of:

• Ultrasonic device was used for 20 minutes three times per week for a total period of 8 weeks aiming to remove fat at abdominal region. The woman was asked to assume a comfortable supine lying position, four heads were covered with gel and placed on the main bulged area at the abdominal region and wrapped in their position with straps.

The volunteers of both groups received:

• Faradic stimulation unit was used for 30 minutes three times per week for a total period of 8 weeks. Before starting the treatment session, each woman asked to evacuate her bladder to make sure that she was relaxed. Then the woman was asked to assume a comfortable supine lying position. Stimulation performed bilaterally for the rectus abdominis muscles, four electrodes were covered with gel, each two electrodes formed a channel for stimulation and placed one on the origin of the muscle (at the anterior surface of pubic crest & front of symphsis pubis), while the other electrode placed on the insertion of the same muscle (along horizontal line into the anterior surface of xiphoid process & outer surface of 5,6 and 7 costal cartilages) the electrodes wrapped in their position with straps.

• Traditional abdominal exercises which included sit up exercises, reverse sit-up exercise, reverse trunk twist exercise, and U-seat exercise was performed for 30 minutes three times per week for a total period of 8 weeks.

Results

In this study 50 postpartum, multiparous obese women were assigned randomly into equal two groups; group A (n=25) their mean age was 29.12, mean waist circumference was 102.52 ±6.482 cm, and mean BMI was 32.408 ±1.059kg/cm². Group B (n=25) their mean age was, 29.33, mean waist circumference was 101cm±6.238cm, and mean BMI was 32.508±1.356kg/cm².

Waist circumferences of group A which evaluated before treatment was ranged between 92cm and 116cm with a mean value of 102.52 ±6.482cm, and after treatment was ranged between 91cm and 108cm with a mean value of 96.38 ±6.182cm. It was found that waist circumferences of group B which evaluated before treatment was ranged between 90.5cm and 114cm with a mean value of 101cm±6.238cm and after treatment was ranged between 87cm and 110cm with a mean value of 97.6±6.315cm. There was highly significant difference (p=0.0013) in group A before treatment when compared to after treatment values and There was no statistically significant (p=0.0614) difference in group B before treatment when compared to After treatment values as shown in Table (1) and Fig. (1).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Waist circumference (cm)</th>
<th>t-value</th>
<th>p-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before treatment</td>
<td>After treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>102.52±6.482</td>
<td>96.38±6.182</td>
<td>3.428</td>
<td>0.0013</td>
</tr>
<tr>
<td>Group B</td>
<td>101±6.238</td>
<td>97.6±6.315</td>
<td>1.915</td>
<td>0.0614</td>
</tr>
</tbody>
</table>

**HS:** Highly Significant. **NS:** Non Significant.

![Fig. (1): Mean value and SD of waist circumference of both groups (A and B) before and after treatment.](image)
BMI of group A which evaluated before treatment was ranged between 30.7kg/cm$^2$ and 34.4kg/cm$^2$ with a mean value of 32.408 ± 1.059kg/cm$^2$ and after treatment was ranged between 29.9kg/cm$^2$ and 33.2kg/cm$^2$ with a mean value of 31.328 ± 1.093kg/cm$^2$. It was found that BMI of group B which evaluated before treatment was ranged between 30.6kg/cm$^2$ and 34.9kg/cm$^2$ with a mean value of 32.508 ± 1.356kg/cm$^2$. And after treatment was ranged between 29.5kg/cm$^2$ and 34kg/cm$^2$ with a mean value of 31.716±1.350kg/cm$^2$. There was highly significant difference ($p<0.0009$) in group A before treatment when compared to after treatment values and there was significant ($p=0.0439$) difference in group B before treatment when compared to after treatment values as shown in Table (2) and Fig. (2).

Table (2): Mean value and SD of BMI of both groups (A and B) before and after treatment.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Before treatment</th>
<th>After treatment</th>
<th>t-value</th>
<th>p-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>32.408±1.059</td>
<td>31.328±1.093</td>
<td>3.549</td>
<td>0.0009</td>
<td>HS</td>
</tr>
<tr>
<td>Group B</td>
<td>32.508±1.356</td>
<td>31.716±1.350</td>
<td>2.069</td>
<td>0.0439</td>
<td>S</td>
</tr>
</tbody>
</table>


It was found that rectus diastasis of group A above umbilicus which evaluated before treatment was ranged between 25.1mm and 35.6mm with a mean value of 27.968±2.974mm and after treatment was ranged between 21.5mm and 25.8mm with a mean value of 20.244±2.825mm. There was highly significant difference ($p<0.0001$) in both groups (A and B) before treatment when compared to after treatment values as shown in Table (3) and Fig. (3).

Table (3): Mean value and SD of rectus diastasis of both groups (A and B) before and after treatment.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Before treatment</th>
<th>After treatment</th>
<th>t-value</th>
<th>p-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>28.016±2.809</td>
<td>13.708±3.301</td>
<td>16.504</td>
<td>0.0001</td>
<td>HS</td>
</tr>
<tr>
<td>Group B</td>
<td>27.968±2.974</td>
<td>19.244±2.825</td>
<td>9.415</td>
<td>0.0001</td>
<td>HS</td>
</tr>
</tbody>
</table>

HS: Highly Significant.

Discussion

The effect of low frequency non thermal ultrasound on central weight reduction was studied in obese women postnatal. There was highly significant decrease ($p=0.0013$) in waist circumference of group A before treatment when compared to after treatment values and there was statistically non significant ($p=0.0614$) difference in waist circumference of group B before treatment when compared to after treatment values. Also there was highly significant ($p=0.0009$) decrease in BMI of group A before treatment when compared to after treatment values, and there was significant ($p=0.0439$) difference in BMI of group B before treatment when compared to after treatment values.
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Vispute Sachin considered the effects of the subcutaneous sit-up exercises (alternated exercises, 7 sets, 10 repeats in each set and 10 seconds of rest between each two repeats) on the size of fat cells in different parts of the body by biopsy of the abdomen, %fat, sub-scapula and glutes. He showed a significant reduction in the thickness of the cells in the area under experiment [15].

Moreno-Moraga et al., reported that with non-thermal ultrasound, a low frequency increase the likelihood of cavitation while generating little heat through absorption mechanisms. Ultrasound at Cavitation (USFC) is the method in handling obesity, especially in destroying fat and shaping a particular part of the body [16].

The results of this study are in agree with those of Ferraro et al., who observed the effects of ultrasound waves at different frequencies on abdominal fat tissue, then they demonstrated that ultrasound at 1MHz does not induce cellular alterations. In contrast, both 2- and 3-MHz frequencies are capable of causing complete fat tissue disruption, including destruction of adipose cells and collagen fibers [17].

The results of the current study were supported by Livia et al., who reported that the effectiveness of low frequency ultrasound in reducing localized fat deposits was represented by a reduction in the body contour in the treated areas and there was a significant reduction in the thickness of the cells in the area under experiment [18].

The results of the current study were also supported by Mark et al., who reported that In clinical trials, a single treatment of low frequency ultrasound reduced mean waist circumference by 1.3-2.5cm. and three treatments reduced waist circumference by 2.3-3.5cm [19].

In contradiction Maha Saber et al., reported that, either sham ultrasound cavitation or low frequency ultrasound cavitation had non significant differences regarding weight loss at the end of sessions and diet program of the study [20].

Ascher reported that, non thermal ultrasound may be appropriate for nonobese patients (body mass index B 30) with focal adiposity [21].

So, it could be concluded that there was a significant effect of low frequency non thermal ultrasound on central weight reduction in obese women postnatal.

References

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