Ultrasound Cavitation Versus Abdominal Exercises on Post Menopausal Abdominal Fat

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Abstract

Background: Obesity has been linked to development of diabetes mellitus, cardiovascular diseases, dementia, and cancers. Specifically in accumulation of abdominal visceral adipose tissue were related to difference in metabolic profile and indicator of cardiovascular disease risk in postmenopausal women.

Aim of Study: Was to determine the effectiveness of ultrasound cavitation versus abdominal exercises on post-menopausal abdominal fat.

Material and Methods: Sixty obese women with abdominal fat, their age ranged from (50-65) years, their BMI (30-35kg/m^2), WHR ranged between (0.81 to 1.0). They were selected from Outpatient Clinic of physical therapy department in Egyptian Radio and TV Union. They were randomly divided into two equal groups. Group (A) consisted of 30 women who received ultrasound cavitation in addition to low-calorie diet (1200cal) for eight weeks, two sessions per week, Group (B) consisted of 30 women who received abdominal exercises in addition to the same low-calorie diet (1200cal) for eight weeks, two sessions per week. All women in both groups (A&B) were evaluated by measuring (BMI,WHR and Skin fold thickness) before and after the study period.

Results: The results showed high statistical significant decrease in the mean values of BMI, WHR and Skin fold thickness in both groups, However the results were in the favor of abdominal exercises group.

Conclusion: So, it could be concluded that both ultrasound cavitation and abdominal exercises combined with low-calorie diet were effective in reduction of BMI, WHR and skin fold thickness, However the abdominal exercises combined with low-calorie diet cause much more improvement than ultrasound cavitation.

Key Words: *Post menopausal period – Abdominal obesity –*
Ultrasound cavitation – Abdominal exercises.

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Introduction

MENOPAUSE, also known as the climacteric, is the time in most women's lives when menstrual periods stop permanently, and they are no longer able to bear children, Menopause typically occurs between 49 and 52 years of age, Medical professionals often define menopause as having occurred when a woman has not had any vaginal bleeding for a year. It may also be defined by a decrease in hormone production by the ovaries. In those who had surgery to remove their uterus but still have ovaries, menopause may be viewed to have occurred at the time of the surgery or when their hormone levels fell, Following the removal of the uterus, symptoms typically occur earlier, at an average of 45 years of age [1].

The word "menopause" literally means the "end of monthly cycles" from the greek word pausis (cessation) and the root men- (month), because the word "menopause" was created to describe this change in human females where the end of fertilities traditionally indicated by the permanent stopping of monthly menstruation or menses [2].

Focused Ultrasound can be focused at specific depths in subcutaneous adipose tissue, preventing exposed and damage to tissues outside of the focal zone. The intensity is brought to a sharp focus in the subcutaneous fat to destroy adipocytes. Lesion healing and lipid desorption follow normal healing processes with the gradual metabolism of free lipids [3].

Aim of the work:

This study was performed to compare between the effects of ultrasound cavitation and abdominal exercise on abdominal fat in postmenopausal women.

Subjects, Material and Methods

I- *Subjects:*

Sixty post menopausal women complaining from abdominal obesity, participated in this study. Women were selected randomly from Outpatient Clinic of physical therapy department in Egyptian Radio and TV Union.

Inclusive criteria:

The women were selected according to the following criteria:

• Initially suffer from abdominal obesity post menopause.

• The age ranged from 50-65 years old.

• Body mass index (BMI) ranged from 30-35kg/m^2.

• Waist-to-hip ratio between 0.81 to 1.0.

Exclusive criteria:

Patients were excluded from this study for any of the following cases:

• Smokers.

• Anemic.

• Body mass index more than 35kg/m^2 or less than 30kg/m^2.

• Athletic women.

• Diabetic and hypertensive women.

• Women have scar, hernia, skin diseases in abdominal area.

• Women receive anti-depressant, any hormonal replacement therapy or any medication to reduce their body weight.

Design of the study:

Two groups pre-test post-test design. The patients were divided randomly into two equal groups (A&B).

• *Group A:*

This group composed of 30 women who received low-calorie diet (1200 Kcal/day) and ultrasound cavitation sessions for 2 sessions per week, 30 minutes for each session for eight weeks.

• *Group B:*

This group composed of 30 women who received low-calorie diet (1200 Kcal/day) and abdominal exercise sessions for 2 sessions per week, 30 minutes for each session for eight weeks.

II- *Procedures:*

• Measurement taken pre-test assessment and post-test assessment (eight weeks later after the intervention program) as follow.

• Body Mass Index (BMI): Was calculated by taking a woman's weight (kg) and dividing by their height squared (m^2) by using standard height and weight scale. As weight (kg)/height^2 (m) =BMI [4].

• Waist Hip Ratio (WHR): Waist to hip ratio was calculated by taking a women's waist girth and dividing by their hip girth. The waist is measured at its smallest point (above the umbilicus) and the hips at the widest point (gluteal (buttock) muscles) by using Plastic tape measure with Caution: Do not pull the measuring tape tight around subject waist or hips [5].

• Formula: Waist (inches) divided by hips (inches) =ratio.

• Skin fold thickness: The most prominent point in the abdomen is marked, skin and subcutaneous tissues at that point was pinched between the thumb and the forefinger and gently pulled away from the underlying muscles. Then, while the grasp was maintained, the caliper was placed over the skin fold and left in its place for 3 seconds, and then the value was recorded [6].

Therapeutic procedures:

Group (A): They received low-calorie diet (1200 Kcal/day) as follow (50% carbohydrate, 30%fat, 20% protiens) and ultrasound cavitation sessions.

• Mode: Pulsed.

• Frequency: 40 KHZ [7].

• Duration: 30min.

• Rate of sessions: Twice times per week for eight weeks.

Group (B): They received low-calorie diet (1200 Kcal/day) as follow (50% carbohydrate, 30% fat, 20% protiens) and abdominal exercise sessions.

• Duration: 30min.

• Rate of session: Twice times per week for eight weeks.

• Static abdominal exercise [8].

Female was asked to contract abdominal muscles firmly and press lumbar region down, hold for 10 seconds then relax for 5 seconds and repeated for 10 times.

Dynamic abdominal exercise [9].

A- *Lateral flexion of the trunk:*

She was asked to contact her abdominal muscles, try to touch with the tips of the fingers farthest point on her leg with the head follow the movement and eyes look behind the shoulder, hold for 10 seconds relax 5 seconds and repeated for 10 times.

B- Abdominal muscles as pelvic rotators:

This exercise was very effective to strengthen the external oblique muscles as the following:

Female was asked to contract her abdominal muscles, try to touch the plinth with flexed knees, hold for 10 seconds then relax for 5 seconds and repeated for 10 times.

C- Abdominal muscles as trunk rotators:

This exercise was very effective to strengthen the oblique muscles:

Female was asked to contract abdominal muscles, turn upper trunk to the right side as far as she can and let her head and eyes follow the movement, hold for 10 seconds then relax for 5 seconds and repeat for 10 times, then she repeated the same exercise to the left side.

Results

Data collection:

The current study evaluated the effect of ultrasound cavitation versus abdominal exercises on post-menopausal abdominal fat Prior for final analysis, data were screened, for normality assumption test and homogeneity of variance. Normality test of data using Shapiro-Wilk test was used, that reflect the data was normally distributed after removal outliers that detected by box and whiskers plots. All these findings allowed the researchers to conducted parametric and non-parametric analysis. Additionally, testing for the homogeneity of variance revealed that there was no significant difference ($p>0.05$).

Statistical analysis:

The statistical analysis was conducted by using statistical SPSS Package program version 25 for Windows (SPSS, Inc., Chicago, IL). The following statistical procedures were conducted:

- Descriptive statistics including the mean and standard deviation for demographic data (age, weight and height), waist hip ratio, and skin fold variables.

- Paired *t*-test to compare within group A and group B for BMI, waist hip ratio, and skin fold variables.

- Unpaired (Independent) *t*-test to compare between mean values of group A versus group B for demographic data (age, weight, height and), BMI, waist hip ratio, and skin fold variables.

- Significant level: All statistical analyses were significant at 0.05 level of probability ($p\leq0.05$).

1- Demographic data:

Table (1) represented the comparative of demographic data values between group A and group B. Mean values of age were 54.20±2.47 year in group A and 55.40±2.86 year in group B. Mean values of weight were 84.64±4.83kg in group A and 86.30±4.85kg in group B. Mean values of height were 158.63±3.95cm in group A and 160.62±2.63cm in group B. The statistical analysis by independent *t*-test revealed that no significant differences ($p>0.05$) in values of demographic data (age, weight, height) between group A and group B.

Table (1): Comparison of demographic data mean values between group A and group B.

Items	Group A (Mean±SD)	Group B (Mean±SD)	*t*-value	*p*-value	Significance
Age (year)	54.20±2.47	55.40±2.86	1.659	0.102	NS
Weight (kg)	84.64±4.83	86.30±4.85	1.320	0.192	NS
Height (cm)	158.63±3.95	160.62±2.63	1.297	0.092	NS

SD : Standard deviation.
p-value : Probability value.
NS: : Non-significant.

2- Body mass index (BMI):

Within groups:

Table (2) represent the comparative mean values between pre- and post-BMI within each group. In group A, the mean values of pre- and post-BMI were 33.45±1.86kg and 29.09±2.12kg, respectively, with improvement percentage 13.03%. In group B, the mean values of pre- and post-BMI were 33.65±1.76kg and 26.61±2.45kg, respectively, with improvement percentage 20.92%. The statistical analysis by paired *t*-test revealed that there were significant differences between pre- and post-BMI within group A ($p=0.0001$; $p<0.05$) and group B ($p=0.0001$; $p<0.05$).

Table (2): Comparison between mean values of pre- and post-body mass index within each group.

Items	Body massindex (kg/m^2)			
	Group A		Group B	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Mean±SD	33.45±1.86	29.09±2.12	33.65±1.76	26.61±2.45
Mean difference	4.36		7.04	
Improvement %	13.03%		20.92%	
t-value	12.048		17.606	
P-value (*P*<0.05)	0.0001		0.0001	
Significance	S		S	

SD : Standard deviation.
% : Percentage.
p-value : Probability .
S: : Significant.

Between groups:

The statistical analysis by independent *t*-test revealed that there were no significant difference in pre-BMI ($p=0.683$; $p>0.05$) while, a significant difference in post-BMI ($p=0.0001$; $p<0.05$) between both groups.

3- Waist hip ratio:

Within groups:

Table (3) represent the comparative mean values between pre- and post-waist hip ratio within each group. In group A, the mean values of pre- and post-waist hip ratio were 0.91 ±0.05cm and 0.82±0.02cm, respectively, with improvement percentage 9.89%. In group B, the mean values of pre- and post-waist hip ratio were 0.90 ±0.07cm and 0.73±0.03cm, respectively, with improvement percentage 18.89%. The statistical analysis by paired *t*-test revealed that there were significant differences between pre- and post-waist hip ratio within group A ($p=0.0001$; $p<0.05$) and group B ($p=0.0001$; $p<0.05$).

Table (3): Comparison between mean values of pre- and post-waist hip ratio within each group.

Items	Waist hip ratio (cm)			
	Group A		Group B	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Mean±SD	0.91 ±0.05	0.82±0.02	0.90±0.07	0.73±0.03
Mean difference	0.09		0.17	
Improvement %	9.89%		18.89%	
t-value	9.908		14.886	
P-value (*P*<0.05)	0.0001		0.0001	
Significance	S		S	

SD : Standard deviation.   *p*-value : Probability .
%   : Percentage.   S: : Significant.

Between groups:

The statistical analysis by independent *t*-test revealed that there were no significant difference in pre-waist hip ratio ($p=0.946$; $p>0.05$) while, a significant difference in post-waist hip ratio ($p=0.0001$; $p<0.05$) between both groups.

4- Skin fold:

Within groups

Table (4) represent the comparative mean values between pre- and post-skin fold within each group. In group A, the mean values of pre- and post-skin fold were 51.70±1.57mm and 44.22±2.16mm, respectively, with improvement percentage 14.47%. In group B, the mean values of pre- and post- skin fold were 50.37±1.57mm and 36.13±1.78mm, respectively, with improvement percentage 28.27%.

The statistical analysis by paired *t*-test revealed that there were significant differences between pre- and post-skin fold within group A ($p=0.0001$; $p<0.05$) and group B ($p=0.0001$; $p<0.05$).

Table (4): Comparison between mean values of pre- and post-skin fold within each group.

Items	Skin fold (mm)			
	Group A		Group B	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Mean±SD	51.70± 1.57	44.22±2.16	50.37±1.57	36.13±1.78
Mean difference	7.48		14.24	
Improvement %	14.47%		28.27%	
t-value	17.239		26.809	
P-value (*P*<0.05)	0.0001		0.0001	
Significance	S		S	

SD : Standard deviation.   *p*-value : Probability .
%   : Percentage.   S: : Significant.

Between groups:

The statistical analysis by independent *t*-test revealed that there were no significant difference in pre-skin fold ($p=0.187$; $p>0.05$) while, a significant difference in post-skin fold ($p=0.0001$; $p<0.05$) between both groups.

Discussion

Aim of this study was performed to compare between the effects of ultrasound cavitation and abdominal exercise on abdominal fat on postmenopausal women.

This study was carried out on sixty women who were selected from Outpatient Clinic of Egyptian Radio and TV Union. Their age ranged between 50-65 years old, BMI (30-35kg/m^2) and WHR in between (0.81 to 0.1 cm). They were randomly divided into two equal groups, 30 women in each group.

The first group was the group (A): Who received low-calorie diet (1200Kcal/day) and ultrasound cavitation sessions for eight weeks, two sessions per week for total treatment period of eight weeks.

The second group was the group (B): Who received low-calorie diet (1200Kcal/day) and abdominal exercises sessions for eight weeks, two sessions per week for total treatment period of eight weeks.

Data obtained from both groups regarding (WHR, BMI, Abdominal skin fold) were measured before and at end of the program.

The result of this study showed that the ultrasound cavitation in addition to diet regimen in group (A) produces a statistically significant decrease in the mean values of BMI, WHR and abdominal skin fold post treatment compared with pretreatment (p=0.0001).

The mean difference in group (A) between pre and post treatment for WHR, BMI and abdominal skin fold was 0.09cm, 0.20kg and 7.48mm respectively and the percent of improvement was 9.89%, 13.03% and 14.47% respectively.

Studies supported the results of group (A):

The results of the study agreed with that of Sabbour et al., [10] the combination of UC and low-calorie diet characterized have more effect than a low-calorie diet alone in lowering anthropometric, total body weight and plasma lipoprotein variables, that supported the findings of my study which showed the effect of ultrasound cavitation on lowering abdominal obesity.

The result of the study agreed with that of Mohammed et al., [11] in which 60 years old females, received ultrasound cavitation for 4 week, with one session per week, 40 minutes. The results showed significant improvement in decreased weight, BMI, SFT, WC and lipid profile, and more dramatic response if combination between UC, electrolipolysis and diet regimen.

The result of the study agreed with those of Fatemi [12] who said that ultrasound cavitation reduce abdominal fat by ablating subcutaneous adipose tissue and causing molecular vibrations that increase the temperature of local tissue and induce rapid cell necrosis resulting in coagulative necrosis of the adipocytes and subsequent reduction of the fat layer.

The results of this study agreed with Samantha et al., [13] who said that focused ultrasound effectively decreases waist circumference in Chinese. The higher the total fluence delivered, the large the decrease in waist circumference was observed.

Also, it comes in agreement with Nazanin et al., [14] who reported that high intensity focused ultrasound is a new promising method for fat reduction. HIFU works by ablating subcutaneous adipose tissue and causing molecular vibration that increase the temperature of local tissue and induce rapid cell necrosis. Several studies reveal the safety and efficacy of HIFU for reduction in the abdomen and the flanks. These studies indicate consistent reduction in abdominal circumference >2cm after

a single treatment. The adverse events are limited to transient tenderness, bruising and edema. As a result, the likelihood of using HIFU for fat reduction will increase over time.

Also, the results of Shek [15] come in contrast with the results of the present study as they found that here were no significant changes in any of the measurements before and after treatment for Fifty-three patients had up to three treatments one month apart and patient satisfaction was also poor, because results were suboptimal.

Regarding group (B), the present study reveals that abdominal exercises in addition to low caloric diet in group (B) produces a statically highly significant decrease in the mean values of BMI, WHR, skin fold thickness post-treatment compared with pre-treatment (p= 0.0001).

The mean difference in group (B) between pre and post treatment for WHR, BMI and abdominal skin fold was 0.17cm, 7.04kg and 14.24mm respectively and the percent of improvement was 18,89%, 20.92 and 28.27% respectively.

Studies supported the results of group (B):

These results agreed with Nikpour et al., [16] who reported that resistance, endurance and concurrent abdominal exercises have positive effect on decreased abdominal obesity indices (waist to hip ratio, waist circumference and BMI) in middle-aged women with abdominal obesity following 8 weeks exercise training.

Parvin et al., [17] reported that resistance and abdominal training has a favorable effect on total cholesterol, body fat percentage, waist and abdomen circumference. This study was done on forty women who received abdominal exercises in a supervised 45 to 50 minutes training sessions, 3 times per week on non-consecutive days for 10 weeks without any diet restriction. In current study subjects received diet regimen, so they showed highly improvement in decreased abdominal obesity indices.

The result of this study agreed with the study of Arslan et al., [18] who found that after six weeks of abdominal exercise program, significant different were founding the subject's BMI, waist to hip ratio and waist circumference.

The result of the present study supported with Parvin et al., [17] who reported that Program of regular abdominal exercises and healthy eating pattern can produce considerable improvement in anthropometric measurements (body weight, body

mass index, waist circumference and waist hip ratio).

On the other hand, Stephen [19] showed a decrease in body mass index and abdominal fat by doing exercises for 3days/week for6 weeks because there was decrease in total amount of stored calories. This decrease in energy stores is obviously the results of a negative energy balance so that exercise produces decrease in energy intake leading to a reduction in weight.

Finally, according to pervious discussion and results of the present study, application of abdominal exercise combined with low calorie diet is highly significant method for treating abdominal obesity and reduction of abdominal fat on postmenopausal women more than ultrasound cavitation combined with low calorie diet.

Conclusion:

Accordingly, it could be concluded that both ultrasound cavitation and abdominal exercises combined with low caloric diet showed significant effect in decreasing (BMI, WHR and Skin fold thickness). But using abdominal exercises with low caloric diet is more beneficial method to decrease abdominal fat in postmenopausal women than ultrasound cavitation with low caloric diet.

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الموجات الصوتية بالتجويف مقابل
تمرينات البطن على سمنة البطن
فترة ما بعد انقطاع الطمث

تهدف هذه الدراسة الى المقارنة بين تأثير الموجات الصوتية بالتجويف مقابل تمرينات البطن على سمنه البطن فترة ما بعد انقطاع الطمث اجريت هذه الدراسة على ستين سيده لديهن سمنه فى منطقة البطن واعمارهن تتراوح بين ٦٥-٥٠ عاما ومؤشر كتله الجسم يتراوح بين ٣٥- ٣٠ ونسبه الخصر الى الحوض تتراوح بين ٠.٨١-٠.١، وتم اختيارهن من العيادة الخارجية بقسم العلاج الطبيعى بمبنى الإذاعة والتليفزيون وقد تم تقسيمهن الى مجموعتين متساويين فى العدد. المجوعة الاولى تتكون من ثلاثين سيده تلقين موجات صوتية بالتجويف بالإضافة الى نظام غذائى منخفض السعرات الحرارية ١٢٠٠ سعر حرارى والمجموعة الثانية تتكون من ثلاثين سيده تلقين للبطن بالإضافة الى نظام غذائى منخفض السعرات الحرارية ١٢٠٠ سعر حرارى لمدة ثمانية اسابيع بمعدل جلستين بالأسبوع. تم تقييم جميع المرضى عن طريق قياس مؤشر كتله الجسم ونسبه محيط الحضراليا لحوض وطيات الدهون قبل بدء الدراسة وبعد نهاية الفترة الكلية للدراسة. اظهرت النتائج تحسن ذو دلاله إحصائية فى موشر كتله الجسم ونسبه الخصر للحوض وطيات الدهون فى كلتا المجموعتين ولكن مجموعه تمرينات البطن بالإضافة الى النظام الغذائى من خفض السعرات الحرارية كانت أكثر تحسنا من مجموعه الموجات الصوتية بالإضافة الى النظام الغذائى منخفض السعرات الحرارى فى الحد من السمنة فى منطقة البطن.