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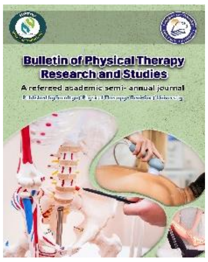

Effect of Cavitation versus Radiofrequency on Abdominal Adiposity Reduction in Overweight Female Students in Deraya University

Tarek H. Mahmoud[1], Mohamed A. Salaam[2], Yasmeen Tarek[3], Nermin Hamdi[4] , Nourhan Sayed[5]

[1] Department of Physical Therapy for Internal Medicine, Chest and Cardiology, Faculty of Physical Therapy, Deraya University, Minia, Egypt.

[2] Department of Physical Therapy for Internal Medicine, Chest and Cardiology, Faculty of Physical Therapy, Deraya University, Minia, Egypt.

[3,4,5] Faculty of Physical Therapy, Deraya University, Minia, Egypt.

Corresponding author:

Tarek H. Mahmoud

P.T., B.Sc., M.Sc., Ph.D., Lecturer of Physical Therapy. Department of Physical Therapy for Internal Medicine, Chest and Cardiology, Faculty of Physical Therapy, Deraya University, Minia, Egypt.

Email: tarek.hanfy@deraya.edu.eg

Tel: 01555543031

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Running Title:

Abstract

Background: Localized adiposity, also known by the name of visceral fat, are adipose accumulations. Abdominal obesity is a subject of extensive investigation due to its classification as a risk factor for cardiovascular illnesses, restrictive lung disease, diabetes, as well as dyslipidemia.

Objectives: The objective of this investigation is to compare the impact of cavitation versus radiofrequency on the reduction of abdominal adiposity in female students in Deraya University.

Methods: Twenty overweight female students in Deraya, they are selected randomly, their age ranged from 18-25 years, Body Mass Index (BMI) (25-29.9) kg/m2, they have waist hip ratio (WHR) > 0.8.

The individuals are randomly allocated into two groups of equal size: Group (A) receive ultrasound cavitation 70 KHz applied for 60 min, one session every week for six weeks plus treadmill exercise. Group B receive radio frequency 60 kHz applied for 30 minutes, one session ever week for six weeks in addition to treadmill exercise. Measurements of waist ratio, circumference ratio, hip ratio, body weight, as well as BMI were taken shortly before the intervention procedures and again six weeks following the study.

Results: Both cavitation and radiofrequency had a significant decrease Abdominal fat thickness and weight (P value<0.05). When the two groups were compared, the waist-to-hip ratio decreased significantly with radiofrequency but not significantly with cavitation (P value>0.05).

Conclusion: Radiofrequency is more effective than Cavitation in the decrease of abdominal fat thickness as well as waist hip ratio.

Keywords: Abdominal Fat, Cavitation, Radio frequency

Introduction

Obesity contributes to or worsens a broad spectrum of health problems, both on its own and in combination with other illnesses[1)]. It is particularly related to the onset of type II diabetes mellitus (DM) as well as coronary heart disease (CHD), an increase in the occurrence of certain types of cancer, complications with the respiratory system (restrictive sleep apnea) and Large and small joint osteoarthritis[2)].

Life-insurance data and epidemiological studies both confirm rising levels of overweight and obesity are significant predictors of reduced longevity, several factors contribute to adult female obesity's high prevalence. A high per capita income, strong purchasing power and the availability of all types of foods on the local market, combined with a lack of nutritional knowledge, resulted in excessive food consumption[3)]. Central obesity is associated with a range of variables, such as environmental as well as nutritional influences [4)]. Dairy products, which are high in calcium, are linked to obesity among diet components. Dairy products as well as calcium have the potential to reduce the likelihood of developing coronary artery disease as well as stroke. High calcium consumption has an inverse relationship with obesity induced by metabolic illnesses including hypertension, DM as well as insulin resistance [5)]. It is important to highlight that the consumption of calcium from dairy products has a significantly stronger impact on the buildup of fat compared to calcium supplements, assuming both are consumed in similar amounts. Another investigation discovered that consuming dairy products following main meal or dinner reduces blood lipids, most likely as a result of reduced fat absorption. Conversely, calcium supplements do not provide a similar outcome. According to Dicker et al., Although dietary calcium has a crucial role in managing obesity, there are additional elements in milk that enhance the process of fat oxidation [6,7)].

Evidence suggests that both overall body fat accumulation and how that fat is distributed in the body play a crucial role in determining the risk associated with obesity[8)]. Obesity classified into four types; Type I is characterized by an excess of fat distributed proportionally all over the body. Type II is characterized by excess fat mainly situated in the trunk and it is subcutaneous. Type III is characterized by excess fat primarily situated in the subcutaneous region of the lower body. Type IV is characterized by excess fat primarily situated in the intra-abdominal region[9)].

Localized abdominal adiposity is the term used to describe the buildup of fat within the abdominal region[10)]. Due to the sluggish metabolism of the fat cells in this particular area, they exhibit more resistance to weight loss[11)]. This fact results in inaccurate measurements in the abdominal region, which can have adverse effects on both the person's overall wellness as well as physical aesthetics. This, combined with the current appreciation for low levels of body fat, induces individuals to have dissatisfaction with their physical appearance and to possess diminished self-worth. [12)].

Obesity can be treated using a variety of methods, including diet therapy, exercise, pharmacotherapy, and surgery. The current surgical treatments require patients to be admitted to the hospital and are linked to postoperative problems including numbness, pain, swelling, as well as prolonged recovery, besides the inherent dangers of surgery. There is some evidence that bariatric surgery raises the risk of colorectal cancer. With that in mind, dietitians are always on search for non-invasive methods to help their patients lose weight[13, 14)].

Currently, physiotherapy offers several therapies to assist in the reduction of body fat, such as manual massage, radiofrequency, carboxytherapy, as well as ultrasound high (ultra cavitation) and low-intensity [15,16)].

Ultrasound Fat Cavitation (USFC) is a method for treating obesity, specifically for getting rid of fat as well as shaping a specific part of the body. As an alternative to surgical weight loss, USFC is better at reducing the risk of obesity-related comorbidities[17,18)]. A change in fat thickness was used to measure the effectiveness of focused therapeutic ultrasound (US) in reducing adipose tissue. The use of US can enhance one's physical appearance[19].

Ultrasonic waves produce alternating cycles of compression and expansion, resulting in both positive and negative pressure. This pushing and pulling can lead to the rupture of fat cells and ultimately the occurrence of cavitation. By focusing the ultrasonic energy on the deeper layers of fat, it is feasible to generate cavities within the fat and diminish the total thickness of the adipose layer[20]. Moreover, it possesses a thermal impact that enhances tissue metabolism, blood circulation, and lymphatic drainage, while simultaneously activating fibroblasts to generate new collagen. This procedure enhances the structural integrity of the fibrous septa within adipose tissue and facilitates the treatment of cellulite[21]. When cavitation therapy is combined with lymphatic drainage, it causes the fat to undergo a transformation into a liquid state, which is then naturally expelled from the body through urine. The procedure is quicker, and then the drainage is efficient[22].

Radio frequency (RF) technology is widely used in several medical disciplines for therapeutic purposes. It is commonly employed for procedures such as acne scar removal, treatment of elevated skin patches, skin tightening, wrinkle reduction, as well as improvement of skin laxity[23]. The RF electrotherapy approach employs high-frequency electromagnetic energy to effectively heat adipose tissue, resulting in enhanced lipolysis and thus raising local cell metabolism. Also, RF facilitates the biochemical process of triglyceride release as well as breakdown in adipocyte lipid droplets, which is reversible. This method yields the production of glycerol as well as nonesterified fatty acids, which can be utilized for energy generation. The release of lipid content leads to adipocyte hypotrophy, which is characterized by a reduction in their volume[24,25].

The RF method can be used in monopolar, bipolar, tripolar, as well as multipolar modes. It enhances the activity of dermal fibroblasts, leading to an improvement in the structure of fibrous septa in adipose tissue. Additionally, it promotes increased blood circulation to the tissues and ultimately stimulates the breakdown of fats (lipolysis). The medical application of RF relies on the generation of an alternating electrical current that induces collisions between charged molecules as well as ions, subsequently transforming them into thermal energy. This process’s primary target is water. RF heating happens independently of chromophore or skin type and does not rely on selective photo thermolysis, but instead relies on heating of water. The biological and clinical impacts of tissue heating induced by RF differ based on the targeted tissue depth, the frequency employed, and the precise cooling of the dermis as well as epidermis. When it comes to RF energy, the depth of penetration is inversely proportional to frequency. Consequently, RF waves with lower frequencies are able to reach deeper levels. RF technology has the ability to heat significant amounts of subcutaneous adipose tissue in a noninvasive and targeted manner. Optimal electric field selection can provide higher heating of fat or water[26,27)].

Methods

Parallel group randomized controlled trial include Twenty overweight female students from all students. The study was conducted at the out clinic of faculty of physical therapy in Deraya University, Minia, Egypt. The study received ethical approval from the ethics committee of the Faculty of Physical Therapy at Deraya University. The patient signed a consent form before enrollment in the study. The study was approved by the Human Research ethics committee of Deraya University, Egypt with the following reference number [PT/REC/230002].

The participants are randomly allocated into two equal groups: Group (A) receive ultra-sound cavitation 70 KHz applied for 60 min, one session every week for six weeks[28,29)] in addition to treadmill exercise. Group(B) receive radio frequency aerobic, 60 kHz applied for 30 minutes, one session every week for six weeks in addition to treadmill exercise. Measurements of waist ratio, circumference ratio, hip ratio, body weight, as well as body mass index were taken prior to intervention approaches and again eight weeks later.

Inclusion criteria Twenty overweight female students in Deraya they were between the ages of 18 and 25, BMI ranged from 25-29.9) kg/m^2 and Waist hip ratio (WHR) > 0.8.

Exclusion Criteria: students with Cardiovascular disease, Musculoskeletal disorders, Neuromuscular disorders, Kidney and liver disease, and other disorders that may affect the result of the study were excluded.

Instrumentation

The Physiotherapeutic Evaluation Protocol for Localized Adiposity (PAFAL), was used as the instrument to gather data for this study. It covered the following topics: identification, anamnesis, smoking, physical examination, and measurements in addition to tests like weight, height, BMI, skinfolds, as well as circumference measurements[30)].

1- Weight and height scale: Burer digital scale and tape will be used to measure weight and height in order to calculate the body Mass Index (BMI). Figure (1)

Body Mass Index formula: BMI equation which is body weight (kg)/ [height (meter^2)] was used to determine the weight category of sample[31)].

2- Tape measurement: Take the circumference of the hips, waist using an ordinary, non-stretching measuring tape. Figure (2)

Figure (1) Burer digital scale

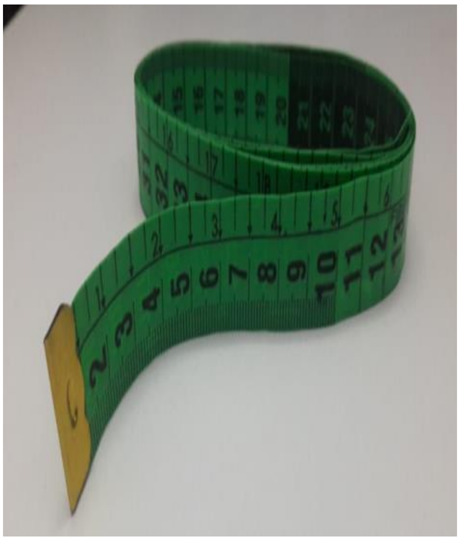

Figure (2) Standard tape measurement

3- The investigation utilized ultrasound cavitation at an intensity of 70kHz. The transducer head has a diameter of 8.0 cm and operates at a power of 45 watts with an output frequency of 40 kHz. The treatment was conducted for a duration of 22.5 minutes in each location.

4- Radio-frequency (RF) at an intensity of 60 kHz. The diameter of each polar head is 5.0 cm, and the output frequencies are 0.5 MHz and 1 MHz The treatment was conducted for a duration of 15 minutes each location.

5- Treadmill: All participants utilized the Kettler treadmill device with a moderate level of exertion, specifically targeting 50-70% of their maximal heart rate.

Procedure

Prior to the study, all participants provided their approval to take part in the research by signing an informed consent form. The medical examination will be conducted at the medical out clinic in faculty of physical therapy. After the volunteers signed the form, by using tape measurement, the same examiner measured all the participants every time pre and post session. Assume an upright posture with a relaxed body and feet positioned closely together. The examiner provided instructions. Avoid providing support to the body or leaning forward, since this can disrupt the accuracy of the measurement. Also, instructed the participants don’t hold breath or suck the stomach, as this will give an inaccurate reading. Participants wore very little or no clothing. The measures were taken at the period between the end of exhalation and the start of inhalation since it is the most precise, according to the examiner. Examiner wrapped a tape measure 5 cm above umbilicus scar, at the umbilicus, and 5 cm below umbilicus[32)]. The tape kept flat against the participant belly, not kinked or twisted. Next, the examiner wrapped the measuring tape over the participant's hips at their widest point—usually the buttocks, right below the hinge point of the thighs. The hip measure will be written as “Hip Circumference.”

The clinical standard involves taking a second measurement of the waist and hips to account for variations caused by breathing. All subjects underwent Kettler treadmill with moderate intensity that should be 50-70% of their maximum heart rate (MHR) for 30 minutes. The MHR is based on the person’s age. The MHR an individual can be determined by subtracting their age from 220 beats per minute (bpm). Since this is an estimate, use caution[33)]. Figure (3)

Figure (3) Kettler Treadmill

Subjects in group (A) were given cavitation sessions in addition 30 minutes of treadmill; subjects in the group (B) were given RF sessions in addition 30 minutes of treadmill.

study group (A) were given US (Mabel 6DUO. Cavitation device developed by DAEYANG MEDICAL CO., KOREA.HIFU.”) Figure (4). The US cavitation with intensity of 70khz was utilized in this investigation. The diameter of the transducer head is 8.0 cm, and it has a power of 45 watts. The depth of penetration of the frequency used was expected to be from 6 to 8-cm[34)]. The individual received treatment while lying in a relaxed supine position. The skin in the abdomen area, namely 5 cm above, at, and below the umbilicus, was sterilized using alcohol. Then, a conducting gel was applied to the targeted location for treatment. The procedure was carried out for 22 minutes on a 200 cm^2 rectangular region of the left abdomen. Beginning at the umbilical scar, a straight line measuring 5 cm in the caudal direction and 5 cm in the cephalic direction were drawn to obtain the area. Then, from the point where the umbilicus scar is located, another straight line measuring 20 cm in the left lateral direction was drawn to form a rectangle. After that, the right side of the abdomen for another 22 minutes. For six weeks, each side underwent treatment with continuous circular motion once weekly.

group (B) were given RF (Mabel 6DUO. Six polar head RF devices developed by DAEYANG MEDICAL CO., KOREA.HIFU Figure (5). The RF with intensity of 60 kHz. The six polar head diameter is 5 cm with a power of 0.5 MHz & 1MHz - the depth of penetration of the frequency used was expected to be 2 to 4mm[34)]. Utilize RF treatment on specific localized fat areas, targeting the same predetermined cavitation site in group (A), apply the applicator with gentle pressure, moving it continuously in a sweeping motion over the skin. The RF therapy was applied to the abdomen for roughly 15 minutes on each side, each treatment session lasted for 30 minutes, and there was a total of 6 treatments over a period of six weeks.

Figure (4) Cavitation Head

Figure (5) Radio Frequency Device

Some advice pre and post sessions:

A. Pre Session (24 Hours)

The participant will be advised about the following

- Decrease the consumption of carbohydrates, fats, and salt in your diet.
- For optimal outcomes, refrain from consuming caffeine.
- Consume predominantly light, fresh, and unprocessed foods whenever feasible.
- Consume a minimum of 2-3 liters of water daily.

B. Post Treatment (24 Hours)

- Consume a minimum of 2-3 liters of water following a cavitation session to effectively eliminate toxins from the body.

- Reduce Carbs, Fats & Salts from diet.

Statistic Evaluation

The paired-samples t-test compares the means of variables within the same group before and after a study, while the independent-samples t-test examines the means of variables before as well as after studies done by different groups. The significance threshold (p-value) in SPSS version 19 was established as 0.05.

Results

Subject characteristics:

Table (1): present the statistical analysis of age, height, weight, as well as BMI of the group (A) as well as group (B): mean value, standard deviation, as well as the level of significance among the two groups. The data suggests that there was no significant difference among the two groups, with a p-value greater than 0.05.

Table 1. Basic characteristics of participants.

	Group A	Group B	MD	t- value	p-value	Sig
	Mean ± SD	Mean ± SD				
Age (years)	22.31 ± 3.17	22.45 ± 3.29	0.72	.062	0.21	NS
Weight (kg)	68.14± 2.61	71.51± 2.43	-3,37	2.45	0.46	NS
Height (cm)	161.74 ± 2.28	161.23 ± 2.37	0.51	.81	0.57	NS
BMI (kg/m²)	27.79± 2.54	27.72± 2.93	0.05	0.45	0.11	NS

SD, standard deviation; MD, mean difference; p-value, level of significance, NS: Non-significant

Table 3. Weight & BMI in (Group A)

Table (3) present the mean, and standard deviation of Weight, as well as BMI pre-study and poststudy of the group (A). The findings revealed a crystal-clear variance (a clear decline) among the two measurements ($p < 0.05$).

Group A	Mean	Std. Deviation	T	P-Value	Decision
Weight(pre)	**69.140**	**77.15767.1**	3.783	0,006	**Sign At 5%**
Weight (post)	**67.520**	**7.1347**	1.620	0,004	**Sign At 5%**
BMI (pre)	**27.7990**	**1.79058**	3.608	0,002	**Sign At 5%**
BMI (post)	**27.1490**	**1.68845**	0.650	0.005	**Sign At 5%**

Table 4. Weight & BMI in (Group B)

Table (4) present the mean, and standard deviation of Weight, as well as BMI pre-study and poststudy of the group (B). The findings revealed a crystal-clear variance (a clear decline) among the two measurements ($p < 0.05$).

Group B	Mean	Std. Deviation	T	P-Value	Decision
Weight(pre)	**71.510**	**5.2657**	6.299	0,001	**Sign At 5%**
Weight (post)	**69.560**	**5.3371**	1.620	0,001	**Sign At 5%**
BMI (pre)	**27.7230**	**1.87140**	5.987	0,002	**Sign At 5%**
BMI (post)	**26.9730**	**1.87385**	0.650	0.001	**Sign At 5%**

Table 5. Round measurement of Abdomen & WHR in (Group A)

Table (5) present the mean, as well as standard deviation of Abdominal adipose fat tissues measured from this site by round measurements above umbilicus 5, at umbilicus, under umbilicus 5 as well as Waist hip ratio (WHR) pre-study as well as poststudy of the group (A). The findings revealed a significance decline among the all measurements ($p < 0.05$).

Group A	Mean	Std. Deviation	T	P-Value	Decision
Pre above umbilicus 5	87.90	3.2810	6.749	0,001	**Sign At 5%**
Post above umbilicus 5	83.750	3.9246			
Pre at umbilicus	95.800	6.7132	3.874	0,002	**Sign At 5%**
Post at umbilicus	91.350	4.7437			
Pre below umbilicus 5	101.60	6.433	4.333	0,001	**Sign At 5%**
Post below umbilicus 5	98.350	6.2095			
WHR (pre)	0.8220	0.01814	6.584	0.001	**Sign At 5%**
WHR (post)	0.78100	0.016633			

Table 6. Round measurement of Abdomen & WHR in (Group B)

Table (6) show the mean, and standard deviation of Abdominal adipose fat tissues measured from this site by round measurements above umbilicus 5, at umbilicus, below umbilicus 5 and Waist hip ratio (WHR) pre-study as well as poststudy of the group (B). The findings revealed a significance decrease between the all measurements ($p < 0.05$).

Group B	Mean	Std. Deviation	T	P-Value	Decision
Pre above umbilicus 5	90.50	4.905	16.883	0,001	**Sign At 5%**
Post above umbilicus 5	81.100	5.0376			
Pre at umbilicus	96.000	5.2122	7.832	0,001	**Sign At 5%**
Post at umbilicus	88.050	5.0577			
Pre below umbilicus 5	103.00	4.876	10.695	0,001	**Sign At 5%**
Post below umbilicus 5	95.050	5.6640			
WHR (pre)	27.7230	1. 87140	5.987	0.001	**Sign At 5%**
WHR (post)	26.9730	1.87385			

Table 7. Differences Between both group

The Mann-Whitney test was employed to determine whether there was a significant difference in the categories based on the decrease in abdominal fat thickness measured at specific locations (above umbilicus 5, at umbilicus, below umbilicus 5) as well as WHR pre and post the study for both groups.

The results indicated a significant difference ($p < .05$), favoring group B in the post-study. as shown in table (7).

Umbilical level	Groups	Mean	Std. Deviation	T	P-Value	Decision
Difference above umbilicus 5	A	4.150	1.9444	-6.329	0.001	Sign At 5%
	B	9.400	1.7607			
Difference at umbilicus	A	4.450	3.6320	-2.283	0.003	Sign At 5%
	B	7.950	3.2098			
Difference below umbilicus 5	A	3.250	2.3717	-4.451	0.001	Sign At 5%
	B	7.950	2.3505			

Table 8. Differences Between both group

The Mann-Whitney test was employed to determine whether there was a significant difference among the two groups in terms of weight, BMI, as well as WHR post-study. The results showed a significant difference in weight and BMI between both groups, while group B exhibited a significant decline in WHR post study. These findings indicate a noticeable variance ($p < .05$). as shown in table (8).

Umbilical level	Groups	Mean	Std. Deviation	T	P-Value	Decision
Difference between WEIGHT	A	1.620	1.3632	-0.622	0.541	Non- Sign At 5%
	B	1.950	0.9789			
Difference between BMI	A	0.650	0.5698	-0.456	0.654	Non- Sign At 5%
	B	0.750	0.3961			
Difference between WHR	A	0.041	0.0197	-5.990	0.001	Sign At 5%
	B	0.087	0.0138			

Discussion

Central obesity has a substantial impact on human health and overall quality of life. Cavitation and radiofrequency treatments have the advantages of being efficient, non-painful, and devoid of the potential hazards associated with surgical procedures. Our study specifically examined the utilization of non-thermal lipocavitation as well as thermolipolysis (RF) for body contouring, with a primary focus on reducing subcutaneous fat in the abdominal area[35)].

Ultrasound's nonthermal effects can lead to the destruction of fat tissue. Mechanical stress caused by cavitation and mechanical vibrations disrupts the process. It also raises tissue temperature, enhances circulation and metabolism in the subcutaneous tissue, and increases cell membrane permeability in adipocytes. This approach causes the destruction of adipocytes, leading to the release of fat into the extracellular compartment. Triglycerides released in this way are believed to be transferred through lymphatic channels to the liver and undergo additional metabolism[19].

In contrast, the radiofrequency employed in this investigation had a more potent impact on adipose tissue in comparison to the effect induced by ultrasound. The generation of endogenous heat within tissues leads to a localized elevation in skin temperature, which subsequently causes the breakdown of certain cross-links among collagen fibers. Collagen fibers undergo contraction, leading to enhanced skin firmness, followed by a subsequent remodeling phase that generates new collagen fibers. The heat produced during the therapy also stimulates tissue metabolism in the treated area, resulting in a decrease in adipose tissue content[24].

Our experiment was done to contrast the impact of cavitation vs radiofrequency on the reduction of abdominal adiposity in female students in Deraya University. Twenty overweight female students in Deraya, they are selected randomly, their age ranged from 18-25 years, Body Mass Index (25-29.9) kg/m2, they have WHR > 0.8. The individuals are randomly allocated into two groups of equal size: Group (A) were given ultrasound cavitation 70 K Hz applied for 60 min, one session every week for six weeks plus treadmill exercise. Group B were given radio frequency 60 kHz applied for 30 minutes, one session ever week for six weeks in addition to treadmill exercise. Waist ratio, circumference ratio, hip ratio, body weight, as well as BMI were taken prior to the implementation of intervention strategies and again six weeks after the study. The statistical analysis of the study's results indicated that both groups (A and B) exhibited a substantial reduction in body weight as well as abdominal fat thickness after the treatment. However, group B demonstrated a more substantial reduction in WHR as well as BMI following the administration of RF compared to group A. Comparing the post-treatment values of body weight, WHR, as well as abdominal fat thickness at different levels (above and below the umbilicus) showed a substantial difference between both groups. Group B had more positive results. Regarding the outcomes of body weight, there was statistically substantial decline regarding the body weight in group A (1. 620.Kg) group B (1.950 Kg) Concerning the outcomes WHR, there was statistically substantial decline of WHR and the percentage of improvement in group A (0.041) group B (0.087) Concerning the outcomes of the fat thickness at the umbilicus level, there was statistically substantial decline of fat thickness at the umbilicus level also, the percentage of improvement in group A (4.450 cm) group B (7.950 cm). Concerning the outcomes of the fat thickness above umbilicus, there was statistically substantial decline of the fat thickness above the umbilicus also, the percentage of improvement in group A (4.150 cm) group B (9.400 cm).

Concerning the outcomes of fat thickness under the umbilicus, there was statistically substantial reduction of fat thickness under the umbilicus also, the percentage of improvement in group A (3.250 cm) group B (7.950 cm) Concerning the outcome of BMI, there was statistically substantial reduction of BMI in group A (0.650) Group B (0.750).

Our study supports the findings of **Kiedrowicz et al (2020)**[36)], who conducted research on the efficacy of US, RF or a combination of both procedures in reducing abdominal adipose tissue and achieving the desired cosmetic outcome. Due to its long-lasting cosmetic effect (which lasted for at least 6 months), RF treatment was considered the most efficient modality. This effect was seen in a reduction in body weight, BMI, as well as waist circumference. Additionally, our findings are in agreement with those of **Mohamed et al. (2015)**[28], who discovered that compared to mesotherapy, U.S. cavitation with RF effectively reduces waist circumference, WHR, as well as skin folds at the suprailiac level. In contrast, our study corroborated the findings of **Savoia et al. (2011)**[37)], who conducted a study on 50 healthy individuals (37 women and 13 men) aged 21 to 62 years. They discovered that after undergoing US cavitation treatment for a period of 2 months, with one session every 15 days and an average total of 3.73 sessions, the duration of each session ranging from fifteen minutes to one hour according to the size of the treated area, there was a significant reduction in waist circumference by an average of 6.2 cm. This indicates that US cavitation effectively contours the body. The findings are corroborated by **Mohammadzadeh et al. (2016)**[38)], who conducted a study examining the impact of a combination of US cavitation, a low-calorie diet, as well as RF on the anterior abdomen and flank areas. The devices were utilized twice weekly, with each instrument being used once weekly, and each session lasting 40 minutes. The study demonstrated a significant reduction in obesity among female participants aged 18 to 65 years. This study contradicted the findings of **Assim et al. (2020)**[39)], who found that "US cavitation as well as multipolar RF can be used to manage abdominal obesity, but US cavitation is more efficient than RF Lipolysis in reducing WHR as well as subcutaneous fat thickness in the management of abdominal obesity".[36]

Limitations

This study investigated a small sample size; so, future investigations will necessitate a larger sample size. In this study, the researchers examined the intermediate effects of combining cavitation with RF after a duration of 6 weeks. Therefore, further investigation is required to evaluate their long-term effects. In addition, while skinfold thickness and waist circumference are accurate, consistent, and economical methods for measuring adipose thickness, ultrasound, computed tomography, as well as magnetic resonance imaging are objective techniques that could provide significant additional insights in future research.

Conclusion

The study's findings revealed that both groups (A and B) experienced a substantial reduction in abdominal fat thickness following the treatment program, whereas group (B) revealed a greater reduction in waist-hip ratio following the administration of RF when compared to group (A).

Comparing the post-treatment values of body weight, waist-to-hip ratio, as well as abdominal fat thickness at different levels (above and below the umbilicus) showed a significant difference among the two groups. Group B had more positive results. Based on this finding we can concluded that Radiofrequency is more effective than Cavitation in decreasing waist hip ratio as well as abdominal fat thickness.

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