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Preserving Muscle Mass During GLP-1RA Induced Weight Loss Using Combined HIFEM and Synchronized Radiofrequency Technology

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Abstract

Background: Glucagon-like peptide-1 receptor agonists (GLP-1RAs) are now widely prescribed for weight loss. However, rapid weight reduction often leads to unintended muscle mass loss, which may reduce basal metabolic rate, making long-term weight maintenance more challenging.

Study Aim: This chart review examines the effects of combined HIFEM and RF technology on preserving skeletal muscle mass during GLP-1RA weight loss treatment.

Methods: 63 participants were divided into 3 cohorts: group G (n=21, 2 males, 19 females, 48.3±21.0 years, BMI 26.8±3.3 kg/m^2) received only GLP-1RA weight loss treatment, group GHR (n=21, 6 males, 15 females, 46.0±13.1 years, BMI 25.9±3.3 kg/m^2) received GLP-1RA treatment with HIFEM+RF treatment, and group HR (n=21, 7 males, 14 females, 50.8±11.3 years, BMI 24.6±3.4 kg/m^2) received only HIFEM+RF treatment. Body composition was assessed using bioelectrical impedance analysis.

Results: Group G experienced a decrease in muscle mass, averaging -2.9±1.3 lbs. Conversely, group GHR gained +1.0±3.1 lbs of muscle, and group HR gained +1.8±3.1 lbs of muscle. Changes in muscle mass differed significantly between groups G and HR, as well as G and GHR ($p<0.001$).

Conclusion: The results indicate combining HIFEM+RF with GLP-1RA weight loss therapy effectively mitigates muscle mass loss. Participants receiving the combined intervention not only maintained but increased muscle mass by 1.0 lb, resulting in a net difference of 3.9 lbs compared to GLP-1RA treatment alone.

Keywords: GLP-1RA; HIFEM; Muscle; Weight loss

Introduction

Glucagon-like peptide-1 receptor agonists (GLP-1RAs), originally developed to treat type 2 diabetes, are now widely prescribed for weight loss and represent a promising therapeutic option for obesity management [1]. Notable drug examples in this class include exenatide, liraglutide, dulaglutide, and semaglutide [2].

GLP-1RAs mimic the GLP-1 peptide hormone that is produced by intestinal enteroendocrine L-cells and certain neurons in response to food intake. GLP-1RAs contribute to weight loss through several mechanisms [1]. They delay gastric emptying, which enhances satiety, and act on GLP-1 receptors in the hypothalamus, a food intake regulation brain area, to suppress hunger, reduce food cravings, and improve eating behaviors [1,3-6]. Clinical trials consistently show that GLP-1RAs can reduce weight between 5% and 10% of total body weight in obese patients [1,3].

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While weight loss can significantly improve health outcomes in overweight and obese individuals, rapid weight reduction often leads to the unintended loss of lean body mass (LBM), particularly skeletal muscle mass (MM). A review of studies involving 1,641 adults on semaglutide reported that up to 40% of weight loss was from MM [7]. Skeletal muscle is not only essential for movement but also serves as the body's largest insulin-sensitive tissue, accounting for about 80% of postprandial glucose uptake [8]. It also plays a role in lipid metabolism and is a key determinant of basal metabolic rate (BMR) [9,10]. Loss of muscle mass can reduce BMR, therefore make long-term weight maintenance more challenging, and increasing the risk of type 2 diabetes [10,11].

Preserving MM during weight loss may be achievable through strength training and a protein-rich diet [12-14]. However, during substantial weight loss, individuals may experience a decline in energy levels, which is confirmed by prior studies showing reduced amounts of physical activity in participants undergoing a weight loss program [15,16].

In addition, the time and effort required for consistent resistance training may not be feasible for many individuals. Moreover, due to appetite suppression and prolonged satiety caused by GLP-1RA treatment, patients may find it difficult to attain their sufficient daily protein intake of 1.2-2g/kg to preserve their MM [17,18].

To address these challenges, non-invasive technologies have emerged as supportive tools in body contouring. One such method is the concurrent use of HIFEM and synchronized radiofrequency (RF) technology. This combination therapy targets fat reduction and muscle growth simultaneously and has been validated in aesthetic medicine for body sculpting in areas such as the abdomen, buttocks, arms, and thighs [19-22]. HIFEM induces supramaximal muscle contractions that exceed voluntary exercise capacity, stimulating hypertrophy and hyperplasia through satellite cell activation and expression of heat-shock proteins [23-25]. Meanwhile, the RF component selectively heats tissue based on electrical impedance, triggering fat cell apoptosis at temperatures between 107.6°F and 113°F [26,27]. Meanwhile, in the muscle tissue, the RF heating reaches a safe 104°F, and in synergy with the HIFEM procedure, RF recruits myosatellite cells, promoting muscle regeneration and further strengthening [23].

This chart review aims to investigate the effects of combined HIFEM and RF technology on preserving skeletal muscle mass during GLP-1RA weight loss treatment.

Materials and Methods

Participants

This chart review utilized data from the existing clinical database containing records from patients who underwent weight loss interventions between 2022 and 2024. Data on age, sex, height, and change in body weight and composition of participants were obtained from the database. Participants were eligible for inclusion if they met the following criteria: (1) aged 21 years or older, (2) had a baseline body mass index (BMI) of ≥18.5 kg/m², (3) received either glucagon-like peptide-1 receptor agonist (GLP-1RA) therapy, HIFEM combined with synchronized radiofrequency (HIFEM+RF) treatment, or both concurrently, and (4) had at least one follow-up bioelectrical impedance analysis (BIA) beyond the baseline assessment. Patients who met the eligibility criteria were contacted via email or telephone, informed about the study's objectives, and provided written informed consent for the use of their data in this analysis.

Participants were divided into three cohorts: group G received only GLP-1RA treatment for weight loss, group GHR received GLP-1RA treatment concurrently with HIFEM+RF treatment, and group HR received only HIFEM+RF treatment. Group HR served as a control group.

Bioelectrical impedance analysis (BIA)

Body composition was assessed using multi-frequency bioelectrical impedance analysis (BIA) via the InBody system (InBody Co., Ltd., Seoul, Republic of Korea), a widely used tool for non-invasive estimation of body fat (FM) and muscle mass (MM). BIA measures impedance to a low-level electrical current that passes through the body, with the resistance varying based on tissue composition. As muscle tissue contains a higher water content than adipose tissue, it presents lower impedance, enabling estimation of muscle mass, fat mass, and total body water [28].

BIA assessments were conducted under standardized conditions. Participants were instructed to void their bladder and avoid food and exercise for at least three hours prior to measurement. During the scan, subjects stood upright with bare feet and placed their thumbs and heels on the designated electrodes.

Body weight and body composition (fat mass and skeletal muscle mass) were recorded during each BIA session. BMI was calculated using the formula: BMI = weight in pounds / height in inches² × 703. For each participant, the changes in weight, BMI, fat mass, and skeletal muscle mass were computed as the difference between baseline and the most recent follow-up measurement. Group-level means and standard deviations were then calculated to assess average changes within each cohort.

Statistical analysis

Descriptive statistics, including means and standard deviations, were calculated to summarize baseline characteristics and outcome variables. Group comparisons for changes in body weight, BMI, fat mass, and muscle

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mass were conducted using the Kruskal–Wallis test. Where significant overall differences were detected, post hoc pairwise comparisons were performed using Dunn's test. Statistical significance was set at a p-value of < 0.05.

Results

A total of 63 participants were enrolled and evenly distributed across three treatment groups: group HR (n=21, 7 males, 14 females, 50.8±11.3 years); group G (n=21, 2 males, 19 females, 48.3±21.0 years), and group GHR (n=21, 6 males, 15 females, 46.0±13.1 years).

Baseline weight and body composition

At baseline, participants in group G had an average body weight of 161.8±29.9 lbs and a BMI of 26.8±3.3 kg/m². Their mean fat mass was 55.3±17.0 lbs, corresponding to a body fat percentage of 33.9±7.9%. Their muscle mass averaged 58.9±13.5 lbs, or 36.5±4.7% of total body weight.

Group HR showed a similar average weight of 161.5±30.2 lbs, but with a lower BMI of 24.6±3.4 kg/m². Their fat mass was 39.9±14.4 lbs (25.0±8.1% body fat), while muscle mass was higher at 67.9±17.3 lbs, making it 41.8±5.0% of body weight.

In group GHR, the baseline mean weight was 157.0±35.2 lbs with a BMI of 25.9±3.3 kg/m². Fat mass averaged 44.2±15.4 lbs, accounting for 28.8±9.6% body fat, and muscle mass was 68.1±22.7 lbs, or 42.8±10.3% of body weight. Full baseline data are presented in Table 1.

Statistical analysis revealed differences were only in baseline fat mass weight (p = 0.01) between groups G and HR; no other significant differences between groups were in baseline values (p > 0.05).

Weight and BMI Changes

Among the groups, group G lost the most amount of body weight, with an average reduction of 14.7±8.7 lbs. Group GHR experienced a more moderate weight loss of 7.1±11.7 lbs, while group HR showed a slight gain in body weight, averaging 1.2±6.2 lb. Corresponding changes in BMI mirrored this pattern: group G demonstrated a reduction of 2.5±1.5 kg/m², followed by a 1.3±2.0 kg/m² decrease in group GHR, and a reduction of 0.2±0.9 kg/m² in group HR, despite an observed weight gain. Statistical comparisons revealed significant differences in weight and BMI changes between groups G and HR (p < 0.001) and between groups HR and GHR (p = 0.007). The difference between groups G and GHR was not statistically significant (p = 0.176).

Body Composition Changes

Fat loss by weight was on average 10.2±8.3 lbs in group G, 8.1±9.4 lbs in group GHR, and 1.7±5.6 lbs in group HR. In terms of body fat percentage, group G decreased by 3.5±4.3%, group GHR by 3.9±4.3%, and group HR by 1.1±2.6%.

Statistical analysis revealed significant differences in fat weight change between groups G and HR (p < 0.001), and between groups HR and GHR (p = 0.007). No significant difference was observed between groups G and GHR (p = 0.176).

Group G experienced a decrease in muscle mass, averaging 2.9±1.3 lbs (19.4% of total body weight loss). Conversely, group GHR gained 1.0±3.1 lbs, and group HR gained 1.8±3.1 lbs. Despite these differences in absolute muscle mass, body muscle percentage increased across all groups. Group HR showed an average increase of 0.7±1.6%, group G by 1.6±2.3%, and group GHR increased by 3.3±3.1%.

Changes in muscle weight differed significantly between groups G and HR (p<0.001), as well as G and GHR (p< 0.001). No significant difference was observed between groups HR and GHR (p > 0.999). For body muscle percentage, significant differences (p = 0.006) were found as well. Full post-treatment data and change data can be found in Tables 2 and 3, respectively.

Table 1: Age, body weight, BMI and body composition of the study cohorts at baseline, expressed in mean±SD.

Group	Age (years)	Weight (lbs)	BMI (kg/m²)	Fat mass (lbs)	Body fat percentage (%)	Muscle mass (lbs)	Body muscle percentage (%)
G	48.3±21.0	161.8±29.9	26.8±3.3	55.3±17.0	33.9±7.9	58.9±13.5	36.5±4.7
HR	50.8±11.3	161.5±30.2	24.6±3.4	39.9±14.4	25.0±8.1	67.9±17.3	41.8±5.0
GHR	46.0±13.1	157.0±35.2	25.9±3.3	44.2±15.4	28.8±9.6	68.1±22.7	42.8±10.3

Table 2: Post-treatment body weight, BMI and body composition of the study cohorts expressed in mean±SD.

Group	Weight (lbs)	BMI (kg/m²)	Fat weight (lbs)	Body fat percentage (%)	Muscle weight (lbs)	Body muscle percentage (%)
G	147.1±27.4	24.3±2.8	45.0±15.1	30.4±7.8	56.0±13.1	38.1±4.6
HR	162.7±31.3	24.8±3.4	38.2±15.1	23.9±8.6	69.7±18.8	42.5±5.5
GHR	149.9±35.5	24.6±2.9	36.1±15.2	24.9±9.8	69.1±23.5	46.2±12.3

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Table 3: Changes in body weight, BMI and body composition of the study cohorts from baseline to post-treatment, expressed in mean±SD.

Group	Weight change (lbs)	BMI change (kg/m²)	Fat weight change (lbs)	Body fat percentage change (%)	Muscle weight change (lbs)	Body muscle percentage change (%)
G	-14.7±8.7	-2.5±1.5	-10.2±8.3	-3.5±4.3%	-2.9±1.3	1.6±2.3%
HR	1.2±6.2	-0.2±0.9	-1.7±5.6	-1.1±2.6%	1.8±3.1	0.7±1.6%
GHR	-7.1±11.7	-1.3±2.0	-8.1±9.4	-3.9±4.3%	1.0±3.1	3.3±3.1%

Discussion

This chart review investigated the efficacy of combining HIFEM and Radiofrequency treatments (HIFEM+RF) in preserving muscle mass (MM) during pharmacologically induced weight loss using GLP-1 receptor agonists (GLP-1RA). The findings suggest that the HIFEM+RF intervention mitigates the loss of MM associated with rapid weight reduction and may actively promote muscle gain.

Participants who received HIFEM+RF treatments (Group GHR) experienced an average of 1.0 lbs increase in muscle mass, in contrast to the 2.9 lbs decrease in MM observed in the group receiving only GLP-1RA therapy (Group G), corresponding to a difference of 3.9 lbs in muscle mass between the groups. An increase of 1.0 lb of muscle mass is equivalent to approximately eight weeks of regular resistance training in individuals not undergoing a weight loss program [29]. However, as discussed above, maintaining muscle mass during weight loss is highly challenging [12]. In such conditions, exercise generally serves to reduce muscle loss rather than promote muscle gain [30,31], making the observed muscle increase in this study notably distinct. Importantly, both groups lost a comparable amount of fat mass, as measured by body fat percentage, but only group G exhibited a loss in MM. The difference in muscle mass change between these groups was statistically significant ($p < 0.001$).

Although Group G lost more total weight and showed a greater reduction in BMI compared to Group GHR, this additional weight loss is largely attributable to a loss of muscle mass, which accounted for 19.4% of total body weight lost. This finding is in alignment with prior research describing significant amounts of muscle loss during GLP-1RA weight loss programs [7].

When adjusted for body composition, the HIFEM+RF group achieved a more favorable outcome: a simultaneous reduction in fat mass and increase in muscle mass, indicating an overall improvement in body composition rather than simple weight loss. This is evident when comparing post-treatment metrics. Despite group G and GHR reaching similar weight and BMI, group G had higher body fat (group G 30.4% vs. group GHR 24.9%) and lower muscle mass (group G 38.1% vs. group GHR 46.2%) compared to group GHR.

Similarly to group GHR, the control group receiving solely HIFEM+RF treatments (group HR) showed the procedure was effective in improving body composition, demonstrating body fat reductions (-1.7 lbs) and MM increase (1.8 lbs). However, mean weight increase was observed due to MM gain.

These findings suggest the non-invasive HIFEM+RF procedures as a beneficial adjunct therapy to pharmacological weight loss programs for the preservation of muscle mass. Moreover, the procedures offer selective fat reductions and muscle enhancement, which is not possible with weight loss or exercise [32]. Furthermore, the treatment requires minimal effort from patients, making it a practical and accessible option, especially during weight loss, when reduced energy levels often make regular exercise difficult to sustain [15,16]. As discussed above, maintaining or improving MM is crucial not only for daily physical functioning, but also for our metabolic health, longevity and maintaining weight loss [10,11].

Although the study findings are promising, several limitations must be considered. Dosage and the duration of the GLP-1RA treatments, nor the HIFEM+RF treatment numbers and area, or therapy intensity, was assessed, as this information was not obtained. Secondly, the sample size was relatively small, which limits the generalizability of the results. Further research would benefit from including a larger sample size, investigating the role of weight loss duration and speed, as well as GLP-1RA dosage, number, intensity and treatment areas of HIFEM+RF procedures.

Despite limitations, the study had notable strengths. Firstly, body composition was objectively analyzed using the BIA system, a widely used method for assessing body composition. The study compared three groups, which allowed for comparative analysis of changes in body composition among pharmacological, device-based, and combination treatment approaches. Lastly, the study sample included a wide range of age and BMI, allowing for a greater generalizability of the results.

Conclusions

The results of this study indicate that combining HIFEM+RF procedures with GLP-1RA weight loss therapy effectively mitigate muscle mass loss. Patients receiving HIFEM+RF interventions not only maintained but increased their muscle mass by 1.0 lb, resulting in a net difference of 3.9 lbs in muscle mass between the groups.

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Conflict of Interest

Dr. McCoy is an Advisory Board Member, clinical investigator, and speaker for BTL Industries, the manufacturer of the study device. Dr. Schoeff is a clinical investigator and speaker for BTL Industries, and Dr. Goldfarb is a clinical investigator for BTL Industries. However, no funding for the research, authorship, or publication of this article was provided.

References

1. Ard J, Fitch A, Fruh S, et al. Weight Loss and Maintenance Related to the Mechanism of Action of Glucagon-Like Peptide 1 Receptor Agonists. Adv Ther 38 (2021): 2821-2839.
2. Collins L, Costello RA. Glucagon-Like Peptide-1 Receptor Agonists. In: StatPearls. StatPearls Publishing (2025). Accessed May 5, 2025. http://www.ncbi.nlm.nih.gov/books/NBK551568/
3. Vosoughi K, Salman Roghani R, Camilleri M. Effects of GLP-1 agonists on proportion of weight loss in obesity with or without diabetes: Systematic review and meta-analysis. Obes Med 35 (2022): 100456.
4. Hjerpsted JB, Flint A, Brooks A, et al. Semaglutide improves postprandial glucose and lipid metabolism, and delays first-hour gastric emptying in subjects with obesity. Diabetes Obes Metab 20 (2018): 610-619.
5. Coveleskie K, Kilpatrick LA, Gupta A, et al. The effect of the GLP-1 analogue Exenatide on functional connectivity within an NTS-based network in women with and without obesity. Obes Sci Pract 3 (2017): 434-445.
6. Farr OM, Sofopoulos M, Tsoukas MA, et al. GLP-1 receptors exist in the parietal cortex, hypothalamus and medulla of human brains and the GLP-1 analogue liraglutide alters brain activity related to highly desirable food cues in individuals with diabetes: a crossover, randomised, placebo-controlled trial. Diabetologia 59 (2016): 954-965.
7. Bikou A, Dermiki-Gkana F, Penteris M, et al. A systematic review of the effect of semaglutide on lean mass: insights from clinical trials. Expert Opin Pharmacother 25 (2024): 611-619.
8. Merz KE, Thurmond DC. Role of Skeletal Muscle in Insulin Resistance and Glucose Uptake. Compr Physiol 10 (2020): 785-809.
9. Kim G, Kim JH. Impact of Skeletal Muscle Mass on Metabolic Health. Endocrinol Metab 35 (2020): 1-6.
10. Zurlo F, Larson K, Bogardus C, et al. Skeletal muscle metabolism is a major determinant of resting energy expenditure. J Clin Invest 86 (1990): 1423-1427.
11. Al-Ozairi E, Alsaeed D, Alroudhan D, et al. Skeletal Muscle and Metabolic Health: How Do We Increase Muscle Mass and Function in People with Type 2 Diabetes? J Clin Endocrinol Metab 106 (2021): 309-317.
12. McCarthy D, Berg A. Weight Loss Strategies and the Risk of Skeletal Muscle Mass Loss. Nutrients 13 (2021): 2473.
13. Wycherley TP, Moran LJ, Clifton PM, et al. Effects of energy-restricted high-protein, low-fat compared with standard-protein, low-fat diets: a meta-analysis of randomized controlled trials123. Am J Clin Nutr 96 (2012): 1281-1298.
14. Pasiakos SM, Cao JJ, Margolis LM, et al. Effects of high-protein diets on fat-free mass and muscle protein synthesis following weight loss: a randomized controlled trial. FASEB J 27 (2013): 3837-3847.
15. Redman LM, Heilbronn LK, Martin CK, et al. Metabolic and Behavioral Compensations in Response to Caloric Restriction: Implications for the Maintenance of Weight Loss. PLOS ONE 4 (2009): e4377.
16. Martin CK, Heilbronn LK, de Jonge L, et al. Effect of Calorie Restriction on Resting Metabolic Rate and Spontaneous Physical Activity. Obesity 15 (2007): 2964-2973.
17. Volek JS, Kackley ML, Buga A. Nutritional Considerations During Major Weight Loss Therapy: Focus on Optimal Protein and a Low-Carbohydrate Dietary Pattern. Curr Nutr Rep 13 (2024): 422-443.
18. Johnson B, Milstead M, Thomas O, et al. Investigating nutrient intake during use of glucagon-like peptide-1 receptor agonist: a cross-sectional study. Front Nutr 12 (2025): 1566498.
19. Kent DE, Jacob CI. Simultaneous Changes in Abdominal Adipose and Muscle Tissues Following Treatments by High-Intensity Focused Electromagnetic (HIFEM) Technology-Based Device: Computed Tomography Evaluation. J Drugs Dermatol JDD 18 (2019): 1098-1102.
20. Duncan D. Safety and Efficacy of Simultaneous Application of High-intensity Focused Electromagnetic Field and Synchronized Radiofrequency for Non-invasive Fat Reduction and Muscle Toning in Inner Thighs: Magnetic Resonance Imaging Evaluation. J Clin Aesthetic Dermatol 15 (2022): 28-32.

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DOI:10.26502/acbr.50170468

21. Jacob C, Weiss R. Upper Arm Toning and Strengthening with Simultaneous Application of HIFEM and Synchronized RF. Presented at: 41st Annual Conference of the American Society for Laser Medicine and Surgery. San Diego, CA (2022).

22. Busso M, Denkova R. High-Intensity Focused Electromagnetic (HIFEM) Field Therapy Used for Non-Invasive Buttock Augmentation and Lifting: Feasibility Study. undefined. Published online (2019). Accessed November 1, 2021. https://www.semanticscholar.org/paper/High-Intensity-Focused-Electromagnetic-(HIFEM)-Used-Busso-Denkova/72caa6ec7c4ac1052c31958765ba1015d7cace7e

23. Halaas Y, Duncan D, Bernardy J, et al. Activation of Skeletal Muscle Satellite Cells by a Device Simultaneously Applying High-Intensity Focused Electromagnetic Technology and Novel RF Technology: Fluorescent Microscopy Facilitated Detection of NCAM/CD56. Aesthet Surg J 41 (2021): NP939-NP947.

24. Goto K, Okuyama R, Sugiyama H, et al. Effects of heat stress and mechanical stretch on protein expression in cultured skeletal muscle cells. Pflugers Arch 447 (2003): 247-253.

25. Pomella S, Cassandri M, Antoniani F, et al. Heat Shock Proteins: Important Helpers for the Development, Maintenance and Regeneration of Skeletal Muscles. Muscles 2 (2023): 187-203.

26. Franco W, Kothare A, Ronan SJ, et al. Hyperthermic injury to adipocyte cells by selective heating of subcutaneous fat with a novel radiofrequency device: feasibility studies. Lasers Surg Med 42 (2010): 361-370.

27. Goldberg DJ. Induction of fat apoptosis by a combination of synchronized radiofrequency and HIFEM technology: Human histology study. J Cosmet Dermatol 23 (2024): 812-817.

28. Khalil SF, Mohktar MS, Ibrahim F. The Theory and Fundamentals of Bioimpedance Analysis in Clinical Status Monitoring and Diagnosis of Diseases. Sensors 14 (2014): 10895-10928.

29. Hwang P, Morales Marroquín FE, Gann J, et al. Eight weeks of resistance training in conjunction with glutathione and L-Citrulline supplementation increases lean mass and has no adverse effects on blood clinical safety markers in resistance-trained males. J Int Soc Sports Nutr 15 (2018): 30.

30. Frimel TN, Sinacore DR, Villareal DT. Exercise Attenuates the Weight-Loss-Induced Reduction in Muscle Mass in Frail Obese Older Adults. Med Sci Sports Exerc 40 (2008): 1213-1219.

31. Foster-Schubert K, Alfano C, Duggan C, et al. Effect of diet and exercise, alone or combined, on weight and body composition in overweight-to-obese post-menopausal women. Obes Silver Spring Md 20 (2012): 1628-1638.

32. Vispute SS, Smith JD, LeCheminant JD, et al. The Effect of Abdominal Exercise on Abdominal Fat. J Strength Cond Res 25 (2011): 2559.

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