The Effect of 4 Weeks of Continuous Exercises with Abdominal Fat Tissue Massage on Body Composition Changes in Overweight People: A Pilot Study

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Abstract

Objective: This study aimed to investigate the effect of 4 weeks of continuous exercise combined with abdominal fat tissue massage on body composition in overweight individuals.
Materials and Methods: Twenty-two participants (mean (±SD) age 28(±3) years; BMI 27.5 (±1.7)) were randomly divided into three groups: continuous training (CT, N= 7), continuous training with massage (CT+MA, N= 8), and massage only (MA, N= 7). The massage groups received 15-minute abdominal massages three times a week. The CT+MA group performed moderate continuous training at 50-60% VO2peak for 45 minutes after the massage. The CT group followed the same training protocol without massage. Body composition was assessed before and after the intervention, measuring fat percentage, waist to hip ratio (WHR), abdominal hip circumference, weight, and abdominal skinfold thickness.
Results: The PBF, WHR, and skinfold thickness values in the abdominal area of the CT+MA group had a significant decrease compared to MA and CT groups.
Conclusion: The results suggest that abdominal massage before exercise enhances lipolysis and spot fat reduction in the massage area, probably by increasing blood supply to subcutaneous fat tissue. This intervention could be a practical approach to boost lipolysis in future research.
Keywords: Massage, Obesity, Lipolysis, Exercise, Abdominal subcutaneous adipose tissue

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Introduction

Inactivity and high-calorie food consumption are known as the main factors that increase the rate of worldwide obesity, and subsequently the increase in the rate of obesity, many metabolic diseases such as diabetes, high blood pressure, and cardiovascular problems have increased significantly (1). In recent years, numerous researchers have undertaken investigations into diverse interventions aimed at mitigating obesity. Among these interventions, physical activity has emerged as particularly efficacious (2).

Recent study has elucidated that physiologically, hormonal shifts induced by exercise precipitate alterations in circulation to both engaged muscle and adipose tissue. some of these changes stem from the mechanisms of smooth muscle contractions within the endothelial cell, thus manifesting distinctively (3). Previous studies have reported that blood supply to adipose tissue is greatly reduced during exercise due to the vasoconstriction caused by hormonal changes, and this process reduces the exposure of fat cells to blood. It has been discovered that t

his factor leads to a notable decrease in the activity of enzymes and hormones associated with lipolysis (4).

It seems that according to the physiological effects on contractile changes in vascular smooth muscles if an intervention is used to increase blood supply to fat tissue, the lipolysis process can increase (5). To enhance blood flow to muscles during exercise, angiogenesis is increased in various organs, which subcutaneous fat being the most crucial in obesity and body contouring, typically Studies have shown that by reducing the exposure of adipocytes to the blood stream, the amount of lipolysis decreases drastically (7). One of the important factors that increase the blood flow to the subcutaneous fat is known as mechanical pressure such as massage. In this regard, the use of massage affects the hypothalamus-pituitary-adrenal axis (HPA) and after that nitric oxide, histamine and prostacyclin are released from the vessel wall, which by affecting blood viscosity leads to an increase in blood flow in target tissues (8).

In addition, it has been reported in previous studies that during physical activity due to physiological hormonal changes related to endothelial cells and cell surface receptors, the blood supply to the subcutaneous fat tissue is greatly reduced, and subsequently the process of decomposition of fat tissue in these areas will be limited (9). In this regard, it was reported that following vibration massage in people with cellulite, blood and oxygen supply to fat tissue increased (10).

And also, in a study, the effect of percussive massage was investigated on 90 people, the participants received the intervention of percussive massage on the right leg for 6 weeks, and no intervention was done on the opposite leg, after 6 weeks The results showed that the mitochondrial oxidation was significantly higher than the opposite leg where there was no intervention. Moreover, the amount of subcutaneous fat in the thigh area was significantly reduced compared to the opposite leg. (11).

However, it seems that if the blood flow in the subcutaneous fat tissue is increased by massage before continuous exercises, it causes the exposure of adipocytes to the blood flow to increase and subsequently due to the increase in local heat and increase the function of lipolytic enzymes increases lipolysis in the area under intervention. Therefore, the purpose of this study was to investigate the effect of 4 weeks of continuous exercises with abdominal fat tissue massage on body composition changes in overweight people.

Material and methods

This experimental research was conducted as a pilot study in the Sports and Health Sciences faculty of Shahid Beheshti University, Tehran, Iran. In this study, 22 people voluntarily

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participated in this research project after checking the inclusion and exclusion criteria.

The inclusion criteria included: body mass index in the range of overweight between 25.1-29.9, no history of metabolic and orthopedic diseases, no medication, no following a special diet According to the results of the body composition assessment, the diet was adjusted for all participants with the ratio 55% carbohydrates, 25% fat and 20% protein (12), and not having regular exercises in the last 6 months, Before starting the implementation of the main protocol, the subjects were tested for body composition, peak oxygen consumption, waist & hip circumference and skinfold thickness, and then the participants were randomly divided into 3 groups: continuous training (N=7), continuous training + massage (N=8), and massage (N=7). For 4 weeks, 3 sessions per week of continuous exercises and massage intervention were implemented.

Assessment of body composition and skin fold thickness was performed one day before and after the implementation of the main protocol by the INBODY 770 body analyzer (made in South Korea) and also by the Caliper Slim Guide made in the United States.

Training protocol

The protocol of moderate-intensity continuous training (MICT) included: 5 minutes of warm-up at a speed of 5 km/h, 30 minutes at an intensity of 50-60% of the Vo2peak, and 5 minutes of cooling down at a speed of 5 km/h (5).

Massage protocol

15 minutes of adipose tissue massage with friction, effleurage, rolling, kneading, and cupping methods for boosting circulation and temperature was conducted in the abdominal area (13). In the combined intervention group (massage + continuous exercise), first 15 minutes of massage was performed in the subcutaneous fat tissue and then continuous training was performed.

Skin fold thickness measurement

Skin fold thickness was evaluated by Caliper Slim Guide, according to the hypothesis of the current research regarding local fat burning in abdominal areas, skin fold evaluation was performed in abdominal areas.

Statistical analysis

Data were analyzed using a mixed-design ANOVA (2×3) method with the within-subjects factor Time (pre and post) and the between-subjects factor Group (CT, CT+MA, MA). Descriptive statistics (means and standard deviations) were calculated for each group at both time points. Assumptions of normality were assessed using the Shapiro-Wilk test, and homogeneity of variances was tested using Levene's Test. A significance level of ($P< 0.05$) was considered for all statistical tests.

The main effects of Time and Group, and the Time × Group interaction, were examined. Significant effects were further explored using post-hoc tests (Tukey's HSD) to determine specific group differences. All statistical analyses were conducted using SPSS version 23.

Ethical considerations

The approval of the research ethics committee of Shahid Beheshti University with code: (IR.SBU.REC.1402.131) and clinical trial code: (IRCTID: IRCT20231122060134N1).

Results

Baseline characteristics of the participants have shown in Table 1.

The main effect of Time was significant ($P= 0.018$), indicating changes in the dependent variables from pre- to post-intervention across all groups.

The main effect of Group was also significant ($P= 0.032$), suggesting differences between the three intervention groups.

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Table 1. Baseline characteristics of the participants

Groups	CT+MA	CT	MA	*P*-value
AGE (years)	27.2 (±1.5)	28.3 (±0.8)	28.8 (±1.2)	0.93
Body Mass Index	28.1 (±1.6)	26.9 (±1.7)	28.8 (±1.2)	0.81
Body Fat Percentage (%)	25.5 (±2.5)	26.3 (±2.2)	26.3 (±3.1)	0.87
Skeletal Muscle Mass (kg)	34.7 (±4.2)	36 (±3.7)	35.4 (±2.5)	0.79
VO2peak (ml/kg/min)	32.5 (±2)	30.8 (±3.6)	31.9 (±2.5)	0.74

Importantly, the Time × Group interaction was significant, indicating that the changes over time differed between the groups. Post-hoc tests revealed that the weight changes among the groups were significant in spite of the no significant weight changes in the CT+MA and CT group but the exercise groups have shown the significant decrease in weight compare with MA group (P= 0.042) (Figure 1).

The alterations in body fat percentage revealed significant changes between the groups (P= 0.021). Subsequently, Tukey's post hoc test showed significant decrease in body fat percentage values in CT+MA group compare to MA group (P= 0.018) (Figure 2).

The results of the statistical analysis of variance showed that there was not a significant difference between the groups in the waist-to-

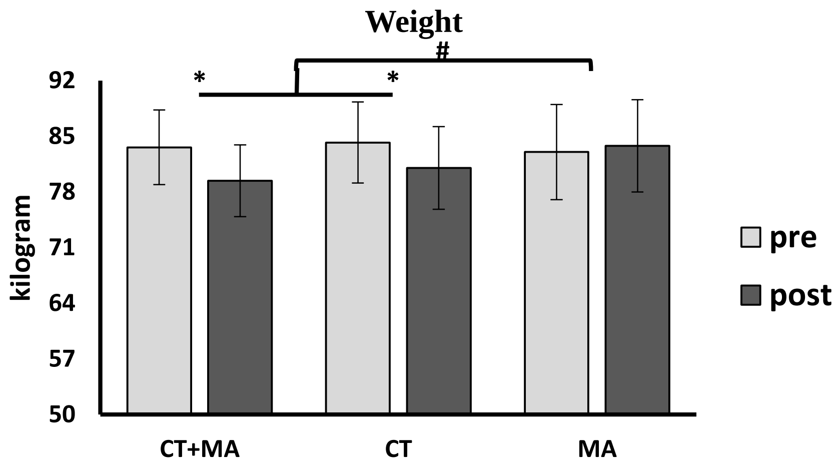

Figure 1. Weight changes before and after 4 weeks of intervention between the research groups. CT (Continuous Training), MA (Massage). * Indicates the changes within groups, and # between groups (*P*< 0.05).

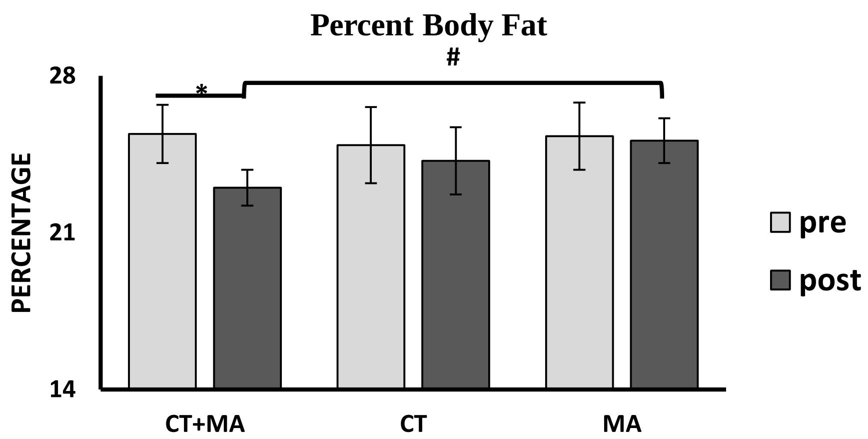

Figure 2. Changes in fat percentage before and after 4 weeks of intervention between the research groups. * Indicates the changes within groups, and # between groups (*P*< 0.05).

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hip ratio (WHR) index values (*P*= 0.089), however the changes between pre and post measurements just in CT+MA group was significant (*P*= 0.021) (Figure 3).

There was a significant difference between the skinfold thickness values before and after the 4-week protocol in the abdominal area between the groups (*P*= 0.038). The post hoc test results showed that the skinfold thickness values in the abdominal area of the CT+MA group had a significant decrease compared to MA group (*P*= 0.032) while there wasn't significant decrease between CT+MA and CT groups (*P*= 0.059) (Figure 4).

Conclusion

In the current investigation, notable reductions in both fat percentage and Waist-to-Hip Ratio (WHR) were observed consequent to exercise participation.

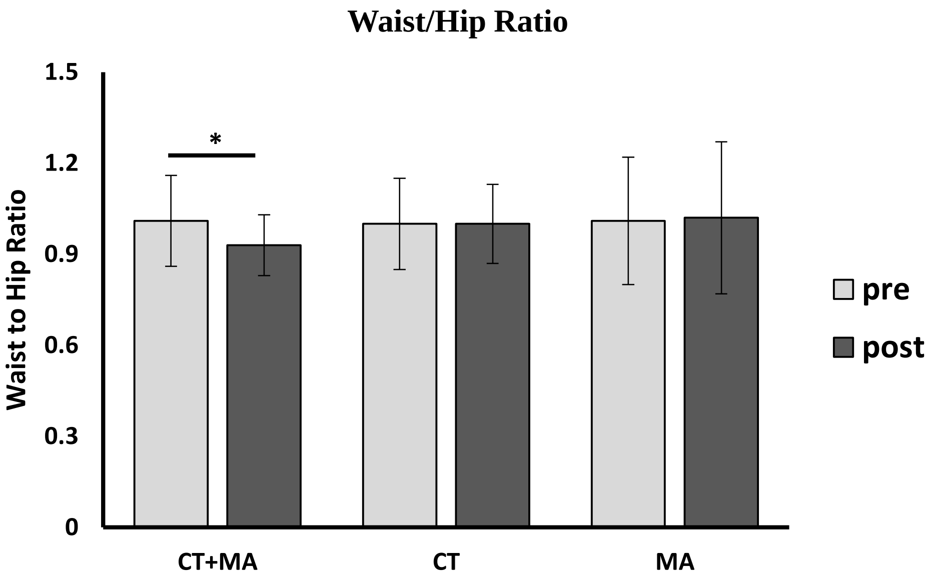

Figure 3. Changes in waist-to-hip ratio before and after 4 weeks of intervention between the research groups * (*P*< 0.05).

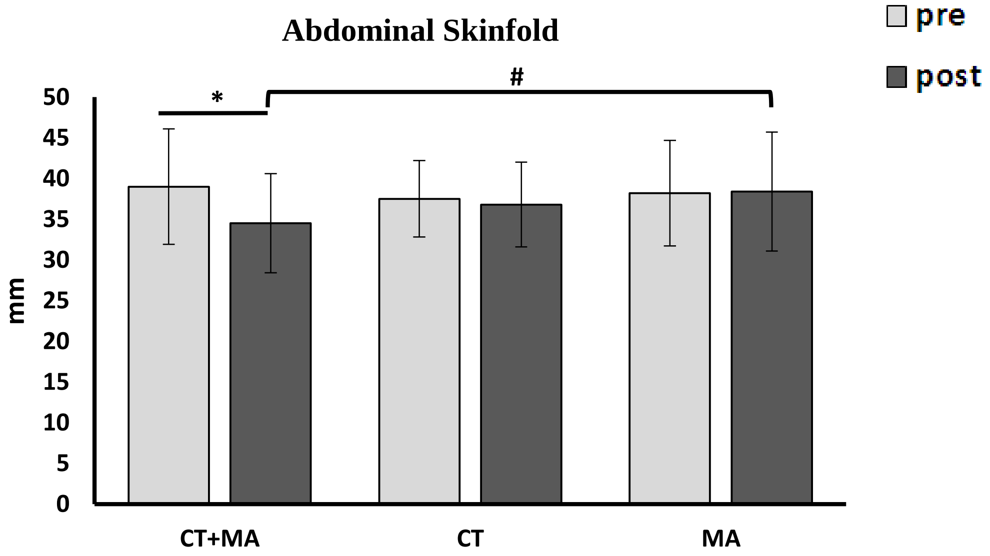

Figure 4. Changes in abdominal skinfold before and after 4 weeks of intervention between the groups. * Indicates the changes within groups, and # between groups (*P*< 0.05).

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Additionally, outcomes underscored the efficacy of combining massage intervention with exercise, aligning with corroborative evidence from prior studies. It was also found that the amount of reduction in body fat percentage and weight following massage before endurance training is also affected (14). In general, many researches have investigated the effect of endurance training on various physiological factors of fat burning. In this regard, researches have been conducted and reported that as a result of exercises with different intensities, the rate of fat metabolism increases through markers that are effective in converting white to brown adipose tissue (15). Also, studies in the field of physiological and biochemical changes of adipocytes have shown that with the increase in the accumulation and hypertrophy of fat cells, changes are created in terms of hypoxia and the reduction of blood flow in the area of accumulation of fats is done in the form of enzymes and regulatory proteins (16). In the current study, the CT+MA group showed an increase in blood supply to subcutaneous fat following massage intervention, leading to a greater reduction in subcutaneous fat compared to other groups. Consequently, research has highlighted angiogenesis as a pivotal factor contributing to enhanced blood supply in various regions. Studies within this domain have indicated that exercise interventions aimed at augmenting blood flow are efficacious in promoting fat metabolism (3).

In a study by Zhang et al., 2023, they reported that performing massage in abdominal area for 5 minutes a day for 5 weeks increased blood supply and fat metabolism in the abdominal area of obese rats (17). While demonstrated, these types of interventions have the potential for side effects and invasiveness (18). However, in the present study, despite the increase in blood supply to adipose tissue in the massage group without exercise, there was no significant change in the direction of increasing fat oxidation and decreasing fat percentage, which seems to be the reason for this physiological changes. That the lack of physical activity and the lack of use of free fatty acids in the blood will not change even when the exposure of adipocytes to the blood flow increases. In a research, Ferreira et al. (2023) reported that massage in resting conditions will not cause changes in the thickness of fat in the abdominal area, the main reason for which is the lack of use of free fatty acids in the blood by the muscles as energy fuel, and subsequently fatty acids Through the re-stratification process in the form of triacylglycerol, they accumulate in the area of stored fats including: subcutaneous fat, visceral fat and intramuscular fat (19).

On the other hand, many studies in adipose tissue metabolism have shown that if calorie intake is restricted and exercise is regular, the amount of free fatty acid metabolism in the blood increases, leading to a decrease in abdominal adipose tissue thickness. In this regard, studies have shown that combining massage with therapeutic interventions like laser therapy can reduce subcutaneous fat diameter in obese subjects. It can be considered a suitable solution to strengthen the effects of fat tissue decomposition with laser intervention (20).

The strengths and weaknesses of this study include: the use of non-invasive intervention available to all people, while due to the limitation of using laboratory facilities such as ultrasound and MRI to accurately assess the thickness of the abdominal fat layer in the abdominal area, it seems that in the future, more detailed investigations can be done using these facilities.

Therefore, according to the obtained results and following the physiological changes in other studies, it seems that the simultaneous combination of subcutaneous fat tissue massage with continuous exercises can be an effective solution for the goals of local fat burning in future research should be further investigated as a type of effective intervention. While it is suggested that this type of intervention be used for longer periods in future research and to accurately evaluate the physiological changes of markers related to

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lipolytic enzymes and hormonal changes, precise laboratory methods should be used.

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Conflict of Interest

There is no conflict of interest between the authors.

Authors' contributions

Conceptualization: MF, MN, and FH; Methodology: MF, TH, AND SN; Software: MF, FH; Validation: MF, and MN; Formal analysis: MF, SN; Investigation: TH, SN; Data curation: MF, AND MN; Writing- original draft: MF, and SN; Writing- review and editing: MN; Supervision: MN, and FH; Project administration: MF.

All authors reviewed and edited the manuscript and approved the final version of the manuscript.

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