Effect of Abdominal Resistance Exercise on Abdominal Subcutaneous Fat of Obese Women: A Randomized Controlled Trial Using Ultrasound Imaging Assessments

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Abstract

Objectives: The aim of this study was to compare the effect of diet and an abdominal resistance training program to diet alone on abdominal subcutaneous fat thickness and waist circumference of overweight and obese women.

Methods: This randomized clinical trial included 40 overweight and obese women randomly divided into 2 groups: diet only and diet combined with 12 weeks of abdominal resistance training. Waist and hip circumferences and abdominal skin folds of the subjects were measured at the beginning and 12 weeks after the interventions. In addition, abdominal subcutaneous fat thickness of the subjects was measured using ultrasonography. Percentage body fat and lean body mass of all the subjects were also measured using a bioelectric impedance device.

Results: After 12 weeks of intervention, the weight of participants in both groups decreased; but the difference between the 2 groups was not significant ($P = .45$). Similarly, other variables including abdominal subcutaneous fat, waist circumference, hip circumference, body mass index, body fat percentage, and skin fold thickness were reduced in both groups; but there were no significant differences between the groups.

Conclusions: This study found that abdominal resistance training besides diet did not reduce abdominal subcutaneous fat thickness compared to diet alone in overweight or obese women. (J Manipulative Physiol Ther 2014;xx:1-7)

Key Indexing Terms: *Obesity; Ultrasonography; Resistance Training; Subcutaneous Fat; Abdomen*

Obesity is a risk factor for numerous chronic diseases, such as coronary artery disease, diabetes mellitus, some cancers, and musculoskeletal problems.[1,2] Recent studies have reported an association between body fat distribution and metabolic and circulatory diseases in obesity.[3,4] Studies on this topic showed that people with high waist-to-hip ratio had higher blood pressure, reduced carbohydrate tolerance, higher plasma insulin concentration, and higher risk for stroke and ischemic heart disease.[4–8]

Diet and physical activity are suggested as the major tools for the prevention and treatment of obesity.[9] Aerobic activities have been widely studied and recommended for the prevention and treatment of obesity and its comorbidities.[9] In parallel, some authors have investigated the effects of both general and local resistance trainings on obesity. According to these findings, it is reported that general resistance training might increase the lean body mass (LBM) and muscle strength and also could decrease the percentage of body fat (PBF), waist circumference, and visceral and subcutaneous abdominal fat and thigh fat thicknesses.[10–13] However, our finding regarding the effect of local resistance training on the fat reduction of the subjects is limited to a few studies. Kostek et al[14] reported a significant spot fat reduction in arms of male subjects who were asked to perform an upper-body resistance training program. However, analyzing the results of all the subjects (male and female), they found no significant relation. Therefore, they

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concluded that resistance training could not lead to spot fat reduction in the subjects.

Some have suggested that the minimum thickness of the abdominal subcutaneous fat layer is significantly related to the femoral artery atherosclerosis.[15] This finding suggests that fat reduction in local areas of the body, particularly in the abdomen, might have importance. According to anecdotal findings, local abdominal resistance training might affect the abdominal subcutaneous fat and therefore could be a part of the management of abdominal obesity. However, to our knowledge, no study has tested this hypothesis. Respecting the higher prevalence of overweightness and obesity in women compared to men,[16] the current study was performed to compare the effect of diet alone (DIET) and diet combined with 12 weeks of abdominal resistance training (DIET + EXE) on abdominal subcutaneous fat thickness in overweight and obese women.

Methods

The design of the study was single-blind randomized controlled trial.

Participants

The inclusion criteria were as follows: (1) adult women with age of 18 years or more; (2) overweight or obese subjects (body mass index [BMI] > 25 kg/m^2); (3) no history of regular endurance or resistance training during the last 180 days; (4) not pregnant; (5) no smoking history in the recent 6 months; (6) no systemic diseases that might affect the diet, resistance training, or musculoskeletal functions; and (7) no significant weight loss in the recent 6 months (>10% body weight). In addition, the exclusion criteria were as follows: (1) using products that might affect the body weight or abdominal subcutaneous fat such as laser, vacuum, ultrasound modality, acupuncture, cream products, gel products, massage, and drugs; (2) any sicknesses that could affect the diet or resistance training; (3) getting pregnant during the study.

This study was performed at Sports Medicine Research Center at Tehran University of Medical Sciences.

This study was approved by the ethics committee of Vice Chancellor of Research of Tehran University of Medical Sciences. The study was registered as number "IRCT138812182973N2" at a registry of nationally and privately supported clinical trials (ie, Irct.ir). Participants provided consent to be a part of this study.

Interventions

Subjects were randomly recruited into 2 groups using a computer-generated random number list. Our clinical assessor was not aware of the allocation of the subjects in the study groups.

Subjects were randomly allocated into the 2 following groups: DIET and DIET + EXE.

At the beginning of the study, we estimated subjects' daily energy (caloric) requirements based on their basal metabolic rate (BMR) and physical activity level. We used the Harris-Benedict equation to calculate BMR.[17] Then, we created 10 kcal/kg (41860 J/Kg) of body weight calorie deficit for each subject. This value of calorie deficit was constant during the study. We calculated the number of food units based on 3 major nutrient groups (55%-65% carbohydrate, 12%-20% proteins, and 20%-35% fat) for each subject. Finally, our nutrition specialist taught subjects the food units and the selection methods among them according to the calculations.

In a home-based program, subjects in the DIET + EXE group performed 12 weeks of abdominal resistance training in 3 nonconsecutive days per week. After a light warm-up, subjects performed 2 sets of 8 repetitions of the abdominal crunch, right/left oblique crunch, abdominal drawing-in, and abdominal bracing. Subjects were instructed to hold each contraction for 5 seconds, and a 2-minute rest followed each set.

Outcomes

We measured subject's height, body weight, waist circumference, PBF, abdominal subcutaneous fat, and skin fold thickness in the first visit and 12 weeks later.[18] The subjects were asked to take and hold a deep breath; and while they were barefoot and looking straight ahead, the assessor recorded their height in centimeters. We also measured the body weight of the subjects with an accuracy of 0.1 kg by a digital scale. We measured the waist circumference at the smallest area of the waist between the lower costal border and the iliac crest while the subjects were standing upright and relaxed. In addition, we measured the hip circumference around the largest area of the hips and buttocks. The measured values were recorded at the end of a normal exhalation without pulling the tape tightly.

The PBF was measured for all subjects using the bioelectrical impedance analysis method (AVIS33 body composition analyzer; Jawon Medical Co Ltd, Kyungsang Bukdo, South Korea). Under the standard protocol for use of body composition analyzer, the subjects were asked not to drink or eat anything during the last 4 hours before the test. They were also asked to perform no exercise and receive no diuretics during the 12 hours before the test. In addition, immediately before the tests, the subjects were asked to empty their bladder.[19]

Abdominal subcutaneous fat thickness was measured while the subject was placed in a supine position, keeping her shoulders, buttocks, and heels in touch with the table.[4,12,20]

As ultrasonography has been accepted to be an appropriate noninvasive and reliable device for measuring abdominal subcutaneous fat,[21,22] we used ultrasound assessment of the subjects to measure their subcutaneous fat thickness. A Sonosite MicroMaxx ultrasound machine (Sonosite Inc, Bothell, WA) and a linear transducer (HFL38/6-13 MHz) were used to record the abdominal subcutaneous fat thicknesses in B-mode format. The transducer was positioned in transverse plane, and measurement of subcutaneous fat