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Effects of high-frequency current therapy on abdominal obesity in young women: a randomized controlled trial

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Abstract. [Purpose] The aim of this study was to determine the effects of high-frequency current therapy on the abdominal obesity levels of young women. [Subjects] Twenty-two women with abdominal obesity were randomly allocated to either an experimental group (n_1 = 10) or a control group (n_2 = 12). [Methods] The experimental group subjects received high-frequency current therapy for the abdominal region 3 times per week for 6 weeks (a total of 18 sessions). Outcome measures were waist circumference, body mass index, and body composition data (abdominal obesity rate, subcutaneous fat mass, and body fat percentage). [Results] Significant main effects of time in the waist circumference, abdominal obesity rate, subcutaneous fat mass, and body fat percentage were found. Significant time-by-group interactions were found for waist circumference, abdominal obesity rate, subcutaneous fat mass, and body fat percentage. [Conclusion] The use of the high-frequency current therapy may be beneficial for reducing the levels of abdominal obesity in young women.

Key words: High-frequency current therapy, Obesity, Women

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INTRODUCTION

Obesity is a medical condition in which excessive amounts of body fat accumulate (≥30% in body fat or ≥80 cm waist circumference), resulting in detrimental health effects[1)]. The high incidence of female obesity, which may be strongly related to increased health problems and decreased life expectancy, should be given great consideration with respect to the promotion of personal general health attitudes and habits[2, 3)]. In women, obesity aggravates physical conditions and contributes to psychological issues[4, 5)], which are influenced by negative perceptions and biased thinking about body shape[6)].

Specific solutions for reducing abdominal obesity include correct dietary habits, regular exercise, behavior modification, and surgery[7, 8)]. Although the effects of diet and exercise have been proven by previous studies, it may be difficult for most people to maintain their regular pattern. For this reason, high-frequency current therapy could be an easily adaptable and accessible therapeutic method for reducing the degree of abdominal obesity. High-frequency current therapy uses an alternating current of ≥100,000 Hz that converts electrical oscillation energy into thermal energy during application[9)]. In high-frequency current therapy, shortened conduction time with a pulse duration of 0.001 milliseconds causes intense heating effects in a local region without stimulating sensory and motor nerves, facilitating the body's consumption of fat[9)].

To our knowledge, the use of high-frequency current therapy has been given little attention in managing obesity, and its efficacy is controversial. Some previous studies have failed to provide evidence for the effectiveness of high-frequency current therapy in women with obesity[10)], whereas more recent studies have indicated that a high-frequency current therapy decreases female abdominal obesity[11, 12)]. Accordingly, the present study aimed to determine whether high-frequency current therapy can be effectively used to reduce female abdominal obesity.

SUBJECTS AND METHODS

Twenty-two female volunteers were enrolled in this study. They were randomly allocated to either the experimental group (EG) (n_1 = 12; age, 21.17 ± 0.72 years; weight, 63.17 ± 7.91 kg; height, 159.63 ± 4.56 cm) or the control group (CG) (n_2 = 10; age, 21.10 ± 0.74 years; weight, 68.79 ± 11.73 kg; height, 161.69 ± 5.25 cm). Inclusion criteria were as follows: (1) a body mass index (BMI) of ≥23 kg/m^2 and a waist-hip circumference ratio of ≥0.80[13)]; (2) no past or present neurological, musculoskeletal, or cardiopulmonary disorders that would have affected health condition; (3) no smoking and drinking habits; and (4) no psychological problems. Pregnant women were excluded. At the early

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stage of the experimental procedure, the total cohort comprised 30 subjects (15 per group); however, 8 subjects (EG, 3; CG, 5) were dropped from the final analysis because of failures with dietary control and a drinking habit. Before the initiation of this study, a detailed description of the experimental procedures and their safety was given to all the subjects, who then provided their written informed consent. This study was approved by the Institutional Review Board of Cheongju University.

Randomized group allocation was determined by blindly drawing a card from an envelope containing 1- or 2-marked cards. Measurements included waist circumference (WC), BMI, and body composition (i.e., abdominal obesity rate [AOR], subcutaneous fat mass [SFM], and body fat percentage [BFP]) and were performed before and after the 6-week intervention. All measurements were taken three times and averaged. WC was measured during full exhalation while the subject stood with her legs shoulder width apart. The tape measure had an accuracy of 0.1 cm and was placed around the waist in a line across the ends of the 12th rib of both sides. The BMI was measured using an anthropometer (Dectro 6437DHR; Scales Galore, Brooklyn, NY, USA) while in a standing position. Bioelectrical impedance analysis equipment with a ground plate, 2 electrode grips, connection cables, and a display monitor (InBody 520; Biospace, Seoul, South Korea) was used to analyze body composition data. Measurements were taken in the standing position while positioning the foot on the footmark of the ground plate and grasping the electrode grips.

The subjects of both groups were asked to keep a regular dietary habit during the experimental process. A nutritionist drew up a diet plan of 2,000 to 2,500 kcal/day across 3 meals (8 a.m., 1 p.m., and 6 p.m.) for the 6-week intervention. In addition, subjects were asked to avoid extra activities and exercises beyond daily routine activities. For EG subjects, high-frequency current therapy, with a frequency of 0.5 Mhz, was performed on the abdominal region while subjects were supine using specific equipment (CWM-9200; Chungwoo Medical, Seoul, South Korea) for 60 minutes, 3 times per week, for 6 weeks (a total of 18 sessions). High-frequency current therapy was performed in 2 phases: 2 sets of 15-minute applications of capacitive electric transfer (CET) and resistive electric transfer (RET) with the pulsed current option (current conduction time, 0.7 seconds; rest interval, 0.3 seconds) for the first 3 weeks, followed by a 30-minute application of the CET and RET modes with continuous current conduction in the final 3 weeks. The intensity was individualized within a range of 6–7 mA to comfortably adjust the heating sensation during the intervention. An insulated electrode and a stainless steel electrode (8 cm in diameter) were used for the CET and RET modes, respectively. Conductive gel (Body Rubbing Cream; SA'COS, Incheon, South Korea) was used to facilitate skin moisture and current conduction, and high-frequency current therapy was delivered by making circular motions of the electrode over the abdominal region at a moving speed of 5 cm/s, avoiding focused pressure on therapeutic areas.

Data were analyzed using SPSS version 12.0 (IBM Corporation, Chicago, IL, USA) statistical software. All values are presented as mean ± standard deviation. A two-by-two analysis of variance with one within-subject factor (pretest versus posttest) and one between-subject factor (EG versus CG) was used to determine the main effects and interaction for each variable. Significance was accepted for values of $p < 0.05$.

RESULTS

Comparisons of the extent of abdominal obesity before and after the high-frequency current therapy are summarized in Table 1. There were significant main effects of time with respect to WC ($F_{1, 20} = 59.109$, p = 0.000), AOR ($F_{1, 20} = 17.578$, p = 0.000), SFM ($F_{1, 20} = 17.704$, p = 0.000), and BFP ($F_{1, 20} = 22.097$, p = 0.000). However, there were no significant main effects of group for any variables (WC: $F_{1, 20} = 0.924$, $p = 0.348$; AOR: $F_{1, 20} = 2.431$, p = 0.135; BFP: $F_{1, 20} = 0.554$, p = 0.465; BMI: $F_{1, 20} = 1.757$, p = 0.200; SFM: $F_{1, 20} = 0.614$, p = 0.439). Significant time-by-group interactions were found for WC ($F_{1, 20} = 72.297$, p = 0.000), AOR ($F_{1, 20} = 6.603$, p = 0.018), SFM ($F_{1, 20} = 10.700$, p = 0.004), and BFP ($F_{1, 20} = 16.973$, p = 0.001). These results indicate that the changing trends of WC, AOR, SFM, and BFP between pretest and posttest differed significantly between the groups, suggesting the effects of high-frequency current therapy in decreasing obesity.

DISCUSSION

This study investigated whether the use of high-frequency current therapy is helpful for lessening the amount of abdominal obesity in young women. Our findings support the use of high-frequency current therapy to diminish abdominal obesity.

Table 1. Comparison of the obesity level before and after high-frequency current therapy

	EG (n_1=12)		CG (n_2=10)	
	pre-test	post-test	pre-test	post-test
WC (cm)	86.3±4.3	80.7±4.4	85.3±5.2	85.6±5.8
AOR (%)	0.8±0.3	0.8±0.0	0.8±0.3	0.8±0.0
SFM (kg)	17.1±2.5	16.2±2.2	17.6±3.0	17.5±3.0
BFP (%)	33.1±4.6	28.2±4.0	32.0±3.6	31.7±3.0
BMI (kg/m^2)	24.8±3.0	24.4±2.9	26.2±3.0	26.2±2.7

EG: experimental group, CG: control group, WC: waist circumference, AOR: abdominal obesity rate, SFM: subcutaneous fat mass, BFP: body fat percentage, BMI: body mass index

In general, most clinicians have used high-frequency current therapy to achieve beneficial changes derived from its heating effects. The basic mechanism underlying high-frequency current therapy relies on the principles of energy conversion. High-frequency current causes the repeated oscillation of molecular structures, and thereby, the molecular friction produces local heating of subcutaneous tissues[12], leading to beneficial effects in surrounding tissues. This mechanism may also be behind the decreases we observed in obesity levels. Increased temperature in local tissues causes the dilatation of subcutaneous vessels, facilitating the lipolytic process[14, 15]. On the basis of these concepts, Manuskiatti et al.[16] and Sadick and Margo[17] suggested that high-frequency current therapy contributes to the removal of cellulite or fine fat particles, which would result in a reduction in waist and thigh circumference. Additionally, An[18] reported that a high-frequency current of 0.5 MHz was effectively used to reduce obesity levels, and Song et al.[15] supported the selective use of high-frequency current therapy to control fat levels in a local region. These studies yielded findings similar to those of the present study.

However, as found in this study, BMI did not show a significant difference between the groups. In general, high-frequency current therapy is easily accessible for subjects. Given that the decomposition of visceral fat can be facilitated when the insulin concentration is lowered by active exercise, the lack of active muscle effort may be disadvantageous for the decrease of visceral fat. For this reason, regular exercise should be among the first choices for controling the obesity level[19]. Taken together, the present findings suggest that high-frequency current therapy may be a beneficial option to be used together with active exercise for reducing the obesity level.

Notwithstanding the positive effects of the high-frequency current therapy for abdominal obesity, this study had several limitations that should be addressed in future studies. First, the small sample size is a major limiting factor in the generalization of the results to the entire population. Second, the study did not include analytic data from blood tests showing the lipolytic components of subcutaneous fat. Finally, we controlled the subjects' dietary habits and activity levels during the experimental process; however, in some cases, it might have been difficult for the subjects to strictly adhere to the diet regime, and this may have influenced the results. Further studies are planned.

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