



**A COMPARISON OF THE EFFECT OF HIIT WITH AND WITHOUT  
ULTRASONIC CAVITATION ON BODY COMPOSITION**

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**ABSTRACT**

The purpose of this research was to compare the effect of high intensity interval training (HIIT) with and without ultrasonic cavitation (UC) on body composition, including body fat percentage, waist circumference, and skinfold. 24 healthy sedentary women aged 23-33 years were randomly selected and assigned to three groups: HIIT, HIIT+UC, and control. Exercise protocol lasted for 6 weeks. Body fat percentage, total fat mass, trunk fat, skinfold, and waist circumference were measured through body composition analysis before and after the treatment. Subjects' height, weight, heart rate, blood pressure, and maximal oxygen uptake was measured at the beginning of the research. The HIIT protocol started with 5 minutes of walking or slow running at 40% MHR, followed by six repetitions of intense activity at 80-90% MHR for 60 seconds and active resting at 25-30% MHR for 60 seconds (12 minutes total), and finally a 5-minute walking or slow running at 40% MHR for cool down. Overall, the protocol lasted for 22 minutes. Kolmogorov-Smirnov test and covariance analysis were used to analyze the data. The results indicated a significant decrease in body fat percentage, total fat mass, trunk fat, skinfold, and waist circumference as well as a significant increase in HDL following six sessions of HIit. However, HIIT with UC had no significant effect on sedentary women. Future research can investigate the effect of different intensities of HIIT and more exercise sessions.

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**Keywords:** *High intensity interval training, ultrasound cavitation, body composition*

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## INTRODUCTION

Obesity has been a prevalent medical conditions in recent years. A combination of excessive food energy intake and a lack of physical activity is thought to explain most cases of obesity. Obesity affects every segment of the population and continues to increase steadily, especially in children. It increases the risk for many other chronic diseases, including diabetes mellitus, cardiovascular disease, and nonalcoholic fatty liver disease, and decreases overall quality of life [1]. In the US, 34% of adults currently meet the criteria for the metabolic syndrome defined by elevated waist circumference, plasma triglycerides (TG), fasting glucose and/or blood pressure, and decreased high-density lipoprotein cholesterol (HDL-C) [2].

Most researchers agree that exercise is an essential component of any weight loss program. Exercise preserves lean mass and increases total daily energy expenditure [3]. A common reason given for not exercising is time constraints, and long term adherence to exercise programs is often less than 50% at 6 months [3]. Research has shown that high-intensity intermittent training (HIIT) may be more effective at reducing subcutaneous and

abdominal body fat than other types of exercise [5]. Recent studies have suggested that compared with continuous moderate exercise (CME), HIIT may result in better or equal improvement in fitness and cardiovascular health. HIIT consists of brief periods of high-intensity exercise interposed with recovery periods at a lower intensity. The premise of using HIIT in both healthy and clinical populations is that the vigorous activity segments promote greater adaptations via increased cellular stress, yet their short length, and the ensuing recovery intervals, allow even untrained individuals to work harder than would otherwise be possible at steady-state intensity [2].

HIIT programs are not only effective, but also safe. It allows equal or improved outcomes for markedly less time investment and has the potential to be associated with higher rates of adherence due to the varied protocol leading to less boredom [4]. HIIT burns more calories compared to moderate intensity steady-state training, and fat oxidation and energy consumption continue to increase after exercise [3]. HIIT protocols typically involve repeated brief sprinting at an all-out intensity immediately followed by low intensity exercise or rest. The brevity of

HIIT protocols is likely to be appealing to most individuals interested in fat reduction. However, a small number of studies have examined its effects on fat loss and health in special populations and patients [5]. HIIT significantly reduces subcutaneous fat as well as total body mass and improves VO<sub>2</sub> max [3,4].

High intensity focused ultrasound (HIFU) is a new promising method of fat reduction [6]. Ultrasonic cavitation (UC) is a low frequency, high energy level ultrasound (US) that induces physical effects on tissues and has recently been proposed as a method to non-invasively reduce the amount of adipose tissue [7]. With the rising demand for body contouring, noninvasive devices for fat reduction have become increasingly popular and have grown over the past decade. HIFU has been used for nearly half a century for noninvasive treatment of tumors of various organs, but has only recently been evaluated as a method for selective destruction of adipose tissue. HIFU works by ablating subcutaneous adipose tissue and causing molecular vibrations that increase the temperature of local tissue and induce rapid cell necrosis. Several studies reveal the safety and efficacy of HIFU for fat reduction in the abdomen and the flanks [6]).

Heydari et al. [8] examined the effect of a 12-week HIIT intervention on total body, abdominal, trunk, visceral fat mass, and fat free mass of young overweight males. The exercise group performed HIIT three times per week, 20 min per session, for 12 weeks. The exercise group had a significant reduction in visceral fat after 12 weeks of HIIT, while waist circumference was significantly decreased by week six. Also fat free mass was significantly increased in the exercising group.

Keating et al. [9] examined the effect of HIIT versus continuous aerobic exercise training (CONT) and placebo on body composition. They found significant reduction in trunk fat and android fat in CONT and placebo groups, but not in HIIT. They concluded that HIIT may be useful as a time-efficient strategy for eliciting comparable fitness benefits to traditional continuous exercise in inactive, overweight adults.

Saber et al. [10] studied the effect of UC on adipose tissue thickness in women. They found a significant decrease in fat thickness associated with a significant increase in waist-hip ratio in the intervention group after ultrasound cavitation treatment and weight maintenance program compared to control group.

Trapp et al. [11] examined the effect of a 15-week HIIT program on subcutaneous and trunk fat in young women. The results indicated a significant reduction in total body mass, fat mass, and trunk fat in HIIT group.

The purpose of this research is to examine the effect of HIIT with and without UC on body composition in sedentary women. Since there is a large number of women suffering from obesity, especially in the abdomen and hip, a mixture of HIIT which burns fat and local UC which causes lipolysis of fatty acids may prove to be a more effective method of fat reduction.

## MATERIALS AND METHODS

This research is quasi-experimental. The population consisted of the sedentary female students of Islamic Azad University, of whom 24 students (23-33 yrs.) were randomly selected as the sample and assigned to three groups in a double-blind experiment: HIIT, HIIT+UC, and control. Subjects' height, weight, VO<sub>2</sub> max, heart rate, blood pressure, and body composition were measured. Body fat percentage, total fat mass, trunk fat, and skinfold were measured through body composition analysis, and waist circumference was recorded. The HIIT protocol started with 5 minutes of walking or slow running at 40% MHR, followed by six repetitions of intense activity at 80-

90% MHR for 60 seconds and active resting at 25-30% MHR for 60 seconds (12 minutes total), and finally a 5-minute walking or slow running at 40% MHR for cool down. Overall, the protocol lasted for 22 minutes. The UC group underwent six sessions of massage at 20 Hz near the navel as the center of gravity. Blood samples were collected and analyzed at the end of the experiment. Data were analyzed using Kolmogorov-Smirnov test, covariance analysis, and Scheffe's test in SPSS.

## RESULTS AND DISCUSSION

The results of covariance analysis did not show any significant difference between HIIT, HIIT+UC, and control in post-test body fat percentage ( $F_{2,19} = 0.576$ ,  $p = 0.572$ ) (Table 1 and Figure 1).

**Table 1: Adjusted mean and standard error for body fat percentage and the results of covariance analysis**

Group	Adjusted Mean	SE		Sum of Squares	df	Mean Squares	F	Si g.
HIIT	32.599	0.374	Pr e-tes t	414.229	1	414.229	445.600	0.000
HIIT+UC	32.145	0.363	Gr ou p	1.070	2	0.535	0.576	0.572
Control	32.668	0.345	Er ror	17.662	19	0.930		
			To tal	2474.970	23			

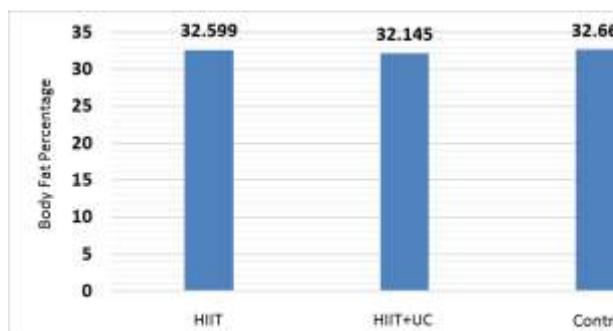


Figure 1: Comparison of adjusted post-test values for body fat percentage

Also there was no significant difference between the effects of the HIIT and HIIT+UC programs on total fat mass. The results of covariance analysis showed no significant difference between HIIT, HIIT+UC, and control in post-test total fat mass ( $F_{2,19} = 0.456, p = 0.641$ ) (Table 2).

Table 2. Adjusted mean and standard error for total fat mass and the results of covariance analysis

Group	Adjusted Mean	SE	Pr	Sum of Squares	df	Mean Squares	F	Si
HIIT	21.416	0.332	Pr	474.866	1	474.866	633.570	0.000
HIIT+UC	21.136	0.318	Group	0.683	2	0.342	0.456	0.641
Control	21.563	0.309	Error	14.241	19	0.750		
			Total	1104.021	23			

The results of covariance analysis showed no significant difference between the effects of HIIT, HIIT+UC, and control in post-test trunk fat ( $F_{2,19} = 0.394, p = 0.680$ ) (Table 3).

Table 3: Adjusted mean and standard error for trunk mass and the results of covariance analysis

Group	Adjusted Mean	SE	Pr	Sum of Squares	df	Mean Squares	F	Si
HIIT	13.3	0.	Pr	250.	1	250	613	0.

T	79	245	e-test	185		.185	.289	000
HIIT+UC	13.243	0.235	Group	0.322	2	0.161	0.349	0.680
Control			Error	7.751	19	0.408		
			Total	440.779	23			

The results of covariance analysis showed no significant difference between the effects of HIIT, HIIT+UC, and control in post-test waist circumference ( $F_{2,19} = 0.684, p = 0.517$ ) and skinfold ( $F_{2,19} = 0.505, p = 0.612$ ).

### CONCLUSION

This is the first study to employ high intensity interval training (HIIT) and ultrasonic cavitation (UC) to assess changes in body composition. The results showed no significant reduction in body fat percentage, total fat mass, trunk fat, skinfold, and waist circumference following a six-week HIIT program. There was also no significant increase in HDL and no significant decrease in serum triglyceride and LDL after the HIIT program. Also the HIIT+UC program had no significant effect on body fat percentage, total fat mass, trunk fat, skinfold, and waist circumference. These variables decreased by the protocol, but the changes were not statistically significant. HIIT is a useful exercise that can be performed by trained and untrained individuals for fat reduction. However,

HIIT and HIIT with UC had no significant effect on the sample which consisted of sedentary women. Our findings are inconsistent with the results of Heydari et al. [8], Keating et al. [9], Saber et al. [10], and Trapp et al. [11]. Indeed there is room for further research on this topic. Future research can employ different intensities of HIIT and different exercise sessions in different populations to provide more insights into the effectiveness of this exercise.

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