

## Research Article

# Concurrent Exercise Training on Appetite Suppressant Hormones in Overweight Women

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**Received:** 10 October 2021

**Revised:** 28 October 2021

**Accepted:** 4 November 2021

### Abstract

**Background:** Concurrent exercises are one of the most practical exercises for the development of physical fitness factors. Therefore, the aim of this study was to investigate the effect of Concurrent training with calorie Aerobic on suppressing hormones of appetite (leptin, YY peptide and insulin) in overweight women.

**Materials and Methods:** The present study is quasi-experimental research with pre-test-posttest design. In this Study, 30 overweight women (with a BMI > 25), eligible subjects were selected and randomly divided into 2 groups of 15, including the concurrent exercise group and aerobic exercise group. The training protocol in this study was performed for 8 weeks and 3 sessions per week, the duration of each session was 90 minutes and one day in between. Data were evaluated using the statistical method of analysis of covariance at a significant level ( $P < 0.05$ ).

**Results:** The results showed that there was a significant difference between the pre-test and post-test variables of fat percentage, leptin hormone, insulin hormone, maximum oxygen consumption, BMI, muscle endurance in concurrent exercise group with calorie Aerobic and aerobic exercise group ( $P < 0.05$ ).

**Conclusion:** The results of this study show that doing concurrent exercises with calorie Aerobic in overweight women reduces weight and improves appetite-related hormones.

### Keywords:


Concurrent Exercise, Fat, Leptin, YY Peptide, Insulin

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## 1. Introduction

In today's modern world, obesity and overweight are one of the biggest health problems. Obesity refers to a weight higher than the desired weight or health weight, which is the result of an imbalance between energy intake and consumption (1). Obesity plays an important role in the development of cardiovascular disease, hypertension, type 2 diabetes, muscle diseases and some cancers (2). According to studies, weight loss in obese people due to exercise is rooted in adaptations to appetite-dependent hormones and is not just related to increased energy expenditure (3). Hence according to studies; The two main factors in obesity can be the lack of physical activity and sports and lack of appetite hormones (4). In the human body, the energy homeostasis system, as a complex physiological system, creates a balance between received and consumed energy, and the regulation of this balance in the body is influenced by internal and external factors (5). The hormones leptin, YY peptide, ghrelin, insulin and central neuropeptides are integrated in the hypothalamus and determine a person's appetite. On the other hand, it is possible that external factors such as meals, physical activity, temperature and climate affect appetite and calorie intake. Also, among the external factors affecting the energy balance in the body, physical activity is characteristic of an active lifestyle and plays an important role (6).

In the meantime, one of the types of physical activity methods is doing Concurrent exercises. Simultaneous training of several energy generating devices and simultaneous execution of several types of exercises (such as muscle endurance and aerobic exercises) is called Concurrent training. Concurrent training improves body composition and cardiovascular health factors more than separate endurance (aerobic) and strength training (7).

Muscle endurance training is created with dynamic contractions and is related to the ability of muscles to maintain contractile force. Aerobic exercise also causes some physiological adaptations such as increased oxidative enzymes, capillary density, number of mitochondria, maximal aerobic capacity, and cardiovascular function (8). Also, the mechanisms of molecular and genetic adaptation induced by resistance training (muscle endurance) and endurance training (aerobic) are different. The combination of strength and endurance training is more effective than any of the training methods alone to improve physical fitness, body composition and metabolic status (9). On the other hand, the results of another study showed that when endurance training was added to strength training in a combination training program, impaired improvement in physical fitness factors was observed. also; Understanding the effect of exercise on calorie intake requires understanding the relationship between the nervous-hormonal system. The hypothalamus, and especially the arcuate nucleus, are the main centers for controlling hunger and satiety in the brain. Environmental signals caused by changes in hunger and satiety hormones by sending information to the hypothalamus trigger the onset or termination of food intake and contribute to energy balance and homeostasis (10). Researchers have identified many endogenous hormones, including ghrelin, leptin, YY peptide, and insulin, which play an important role in controlling appetite, food intake, and body weight (11). Among these hormones, leptin, YY peptide and insulin have a suppressive effect on appetite. Leptin, a product of the ob gene, is a single-chain protohormone with a molecular mass of 16 kDa and plays a key role in regulating body weight (11).

YY peptide is a 36 amino acid peptide secreted by ileum and colon L cells in response to food intake. This hormone plays its role by binding to Y2 receptors in the hypothalamus (11). Also, although its effects depend on various blood glucose states, insulin also appears to be involved in the regulation and production of leptin(12) .

Regarding the effect of physical activity and calorie intake on appetite suppressant hormones in obese people, different results have been observed in different studies (13). On the one hand, it has been reported that a combined exercise program can be used as an effective exercise program to alter appetite-regulating hormones and improve insulin resistance by energy homeostasis mechanisms(14) . On the other hand, low-fat diet and exercise have been reported to reduce blood leptin levels and increase fat oxidation(15) .Therefore, due to the inconsistency of existing research, appetite suppressant hormones such as leptin, YY peptide and insulin are effective in muscle and aerobic endurance exercises. On the other hand, in various studies, major training programs have been only endurance or resistance. Therefore, there is little information about changes in appetite suppressant hormones after Concurrent muscular-aerobic endurance training. Therefore, due to the importance of performing muscular and aerobic endurance exercises and the lack of information about the effect of these Concurrent exercises, the aim of this study was to investigate the effect of Concurrent exercise with calorie intake on appetite suppressant hormones in overweight women and seeks to answer the question whether Does doing a Concurrent exercise program affect appetite suppressant hormones?

## 2. Materials and Methods

The present study is a semi experimental study. The research design was pre-test-post-test with two groups. In this study, in coordination with the Navy Sailors Club in Tehran, the people who referred to this club were selected. Therefore, 30 overweight women (BMI <25) who were randomly selected and these people were randomly divided into 2 groups of 15 (Concurrent exercise group with calorie control and aerobic exercise group). Also, prerequisites for study participants: 1) Have the necessary interest and physical ability to participate in the training program. 2) Do not have a history of illness and medication related to obesity to start an exercise program. 3) Their body mass index is above 25 kg / m<sup>2</sup>. Therefore, initially a session was planned to get acquainted with the training program. The correct way to do the exercises, the correct way of breathing during the movements, the main muscles involved in each movement and possible injuries during the wrong movements, as well as the desired muscular-aerobic endurance training program including number of stations, type of movements, rest time between stations, rest time between Sets, number of sets and number of movements were explained to the subjects. Before starting the main exercises, anthropometric measurements including height, weight, fat percentage, lean body mass, body mass index, maximum oxygen consumption and blood sampling were performed. After the initial blood sampling stage, the subjects performed their exercise program.

Blood samples were taken from the subjects at the pre-test stage and at the end of the training period, and frozen blood samples from each stage were sent to the laboratory center to measure the levels of leptin, YY peptide, and insulin. Plasma YY peptide concentration was measured using ELISA method, abcam kit from China with a sensitivity of 8.4 pg / ml and intra-assay 11.7% inter-assay 12.2. Plasma leptin concentration was measured using ELISA method, abcam kit from China with a sensitivity of 4.65 pg / ml and intra-assay 1.5% inter-assay 3.5. Plasma insulin using ELISA method Abcam was measured with a sensitivity of 4  $\mu$ U / ml. Insulin resistance index was calculated using the HOMA-IR formula.

### Exercise protocol

The training protocol in this study was performed for 8 weeks and 3 sessions per week, the duration of each session was 90 minutes and one day in between. At the beginning of each exercise session, the subjects performed warm-ups for 15 minutes, including two slow, stretching, and gentle movements. They then performed a muscular endurance program that included chest presses, forearms, back thighs, armpits, forearms, and bilateral downward stretching of the large upper and lower torso muscles. The muscular endurance strength program increased from 2 rounds with 16-18 repetitions and 40% of a maximum repetition at the end of the course to 3 rounds with 8-10 repetitions and 70% of a maximum repetition with a 2-minute break between sets. Immediately after exercising the muscular endurance force, the subjects performed aerobic exercise, which is running on a treadmill. Exercise intensity was determined based on maximal heart rate using the formula (age -220). The activity was performed in the first two weeks with an intensity of 50-60% of maximum heart rate for 30 minutes.

Then, in order to observe the principle of overload, every two weeks, 5% was strongly increased until finally, in the last two weeks of training, this intensity reached 65-75% of the maximum heart rate. The duration of the activity was increasingly increased by five minutes every two weeks; So that the duration of activity in the last two weeks reached 45 minutes. The aerobic exercise group did only aerobic exercise. The intensity of the exercises was Aerobicled using a pacemaker. By increasing or decreasing the running speed, the intensity of the exercises is adjusted so that the heart rate is within the set range for each person. After reaching this intensity, time was measured by a treadmill timer (7). Also, to measure aerobic power in individuals, Queens College Step Test was used to determine the maximum oxygen consumption VO<sub>2</sub>max(16).

$$VO_2Max = 65 / 81 - (\text{Heart Rate} \times 0/1847)$$

The required information was collected by SPSS 24 statistical software at a significance level of (P <0.05). Analysis of covariance or ANCOVA was used to test the research hypotheses. If a significant difference was observed in the analysis of covariance, Bonferroni post hoc test was used to determine the location of intergroup differences.

### 3. Results

The descriptive characteristics of the research subjects are given in Table 1. The findings of the present study showed that Concurrent exercise with calorie control compared to the aerobic exercise group had a significant difference on leptin ( $P = 0.001$ ). The results of Bonferroni post hoc test also showed that the Concurrent exercise group had significantly less leptin hormone than the Aerobic group ( $P = 0.001$ ). The results of Bonferroni post hoc test also showed that the Concurrent exercise group had significantly more peptide YY hormone than the Aerobic group.

Findings of the present study showed that Concurrent exercise with calorie control compared to the aerobic exercise group had a significant difference on insulin hormone ( $P = 0.001$ ). The results of Bonferroni post hoc test also showed that the Concurrent exercise group had significantly lower insulin levels than the Aerobic group. Findings of the present study showed that Concurrent exercise with calorie control compared to the aerobic exercise group had a significant difference in maximum oxygen consumption (increase), body mass index, fat percentage (decrease) ( $P = 0.001$ ). The results of all research variables are presented in Table 2.

**Table 1: Demographic characteristics of the subjects**

Group	Number	age(years)	Height (cm)	Weight (kg)
Concurrent exercise	15	$39.8 \pm 3.27$	$163 \pm 3.3$	$75 \pm 3.31$
Aerobic exercise	15	$40.2 \pm 3.78$	$161 \pm 4.75$	$72.6 \pm 4.42$

**Table 2: Changes in FOXA1, LDL levels between different experimental groups**

Group / Variable	stage	Concurrent exercise	Aerobic exercise	P value
<b>leptin</b> pg/ml	pre-test	13.7± 1.21	14.31± 1.72	0.001*
	Post-test	5.93± 1.43	14.83± 1.81	
<b>peptide YY</b> pg/ml	pre-test	13.47± 2.13	13.59± 1.43	0.001*
	Post-test	14.8± 1.41	13.44± 1.19	
<b>Insulin</b> µIU/ml	pre-test	7.51± 1.38	7.47± 1.72	0.001*
	Post-test	4.44± 1.49	7.5± 1.65	

Group / Variable	stage	Concurrent exercise	Aerobic exercise	P value
<b>Maximum oxygen consumption</b> mL/(kg•min)	pre-test	38.35± 2.11	38.13± 3.1	0.001*
	Post-test	48.95± 3.45	38.43± 2.7	
<b>Body mass index</b>	pre-test	27.98± 1.33	27.92± 2.62	0.001*
	Post-test	24.19± 1.73	28.09± 1.28	
<b>fat (%)</b>	pre-test	37.4± 1.38	36.46± 1.72	0.001*
	Post-test	26.73± 1.49	36.33± 1.65	

## 4. Discussion

The results of the present study, which examined the effect of Concurrent training with calorie control, showed that the Concurrent training group (endurance-aerobic) compared to the aerobic group after a period of training for 8 weeks significantly reduced the amount of leptin, insulin, index Body mass and fat percentage showed a significant increase in the amount of YY peptide hormone, maximum oxygen consumption and compared to the aerobic group compared to the aerobic group after 8 weeks of training. The results showed that these indicators improved due to Concurrent exercises. In the present study, participants in Concurrent exercise benefited from the physiological benefits of both types of exercise (Muscular endurance-aerobic) and the positive changes with this type of exercise in body composition are greater. Concurrent training is an effective and useful training method in improving aerobic capacity and body composition (17).

therefore; According to the results, Concurrent training has not disturbed the improvement and increase of the mentioned variables and leads to increased physical fitness and health. One of the obvious results of the present study is that the participants were faced with a decrease in body fat percentage and mass after 8 weeks of Concurrent training compared to the Aerobic group, which is consistent with the results of a number of similar studies (17-19) and with a number of other disparate (20) and (21). Concurrent research has suggested that this may be due to the interaction effects of the two training methods with each other, and therefore Concurrent training can have more effective effects on the body composition of individuals compared to other training methods alone (17).

Regarding the effect of Concurrent training with calorie Aerobic on appetite suppressant hormones, the results showed a decrease in serum leptin after a period of Concurrent training, which is in line with the results of some studies (22, 23) And is inconsistent other research (24). Therefore, several studies have shown that the longer the exercise volume and the Aerobic of calorie intake, the greater the decrease in leptin. Concurrent training in the present study, which included muscular endurance and aerobic training, also showed this decrease. According to the results of research, Concurrent exercises increase maximal oxygen consumption and decrease body fat, and since the hormone leptin is derived from adipose tissue, reducing body fat reduces leptin. Prolonging the duration of the exercise program and increasing the intensity of exercise increases the available intracellular energy, which leads to an increasing decrease in leptin levels (25); However, inconsistent studies have reported an increase or no change in leptin levels as a result of these exercises in their research. The researchers used acute protocols that differed from the present study, which examined the long-term effects of exercise (8 weeks). In general, the greater the volume of exercise, the greater the decrease in leptin.

Also, another result of the study showed an increase in appetite suppressant hormone (YY peptide) after a period of Concurrent exercise in overweight women, which was consistent with some studies (3, 26). According to previous research, the possible neurological or endocrine mechanism of increased PYY due to exercise is not known (27).

Increased this anti-appetite factor can indicate the desired effect of exercise on suppressing appetite and desire to eat and reduce energy intake. It may also alleviate the worry that exercise may increase food intake due to increased energy expenditure. Some other studies have reported similar results, for example, in a study of the effect of 31 weeks of aerobic exercise with a frequency of three sessions per week on obese adolescents, this hormone also increased by 23% compared to before exercise; Animal studies have also shown an increase in this hormone due to aerobic exercise. Studies that have not shown an increase in these hormones as a result of exercise have also suggested that further lack of fat and weight loss is a possible reason for this result (26).

Other results from the present study showed a decrease in blood insulin after Concurrent exercise in overweight women, which is consistent studies (28, 29). Insulin acts as the most important regulator of blood sugar levels, fat synthesis, protein and glycogen in adipose tissue, muscle and liver and inhibits the breakdown of glycogen, fat and protein (30). Of course, its increase in the blood can bring a feeling of satiety. Because a decrease in mitochondrial capacity in skeletal muscle indicates insulin resistance and muscle oxidative capacity as a significant predictor of insulin sensitivity, however, a rapid increase in skeletal muscle mitochondrial function following intermittent low-volume exercise may be a factor in reducing resistance. To insulin and improve blood sugar control (31).

Insulin levels are largely determined by the environmental sensitivity of insulin, which depends on the body's total fat stores and fat distribution. Visceral fat will play a key role in insulin sensitivity. Increasing the volume and intensity of exercise will further reduce blood glucose levels and consequently lower insulin levels. According to theoretical principles, insulin reduction during exercise, especially Concurrent exercise, occurs for the following reasons; First, long-term exercise, such as the present study, increases skeletal muscle glucose uptake by increasing the density of insulin-independent glucose carrier protein (GLUT4), thereby increasing insulin sensitivity, resulting in less insulin to regulate blood glucose after Practice more than before. As a result, increasing insulin sensitivity reduces insulin resistance and ultimately reduces insulin secretion (32). With proper exercise and reduced insulin, proper regulation of the secretion and Aerobic of appetite hormones may occur. The reason for the discrepancy between the results of the present study and some studies is expected to be due to differences in the type of training protocol and other methodological differences such as age and physical condition. Also, other results showed that after 8 weeks of Concurrent training in Concurrent with the improvement of body composition, the maximum oxygen consumption of overweight women was increased. therefore; Muscle endurance and aerobic training in the form of a Concurrent training protocol increases the maximum oxygen consumption. Increases the ability of skeletal muscles to produce energy through the aerobic system. for that reason, pointed out the benefits of Concurrent training and suggested it for people who are less prepared, beginners, and develop and strengthen different energy systems.

## 5. Conclusion

Therefore, according to the results of the present study, which indicates the positive effect of Concurrent exercise with calorie control on appetite suppressant hormones and other measured variables; It is recommended that overweight women use Concurrent exercises to reduce body fat percentage and mass to improve their body composition. Also, to improve their physical fitness, these people use Concurrent exercises to increase the maximum oxygen consumption. Finally, due to the improvement of appetite-related hormones in overweight women after a period of Concurrent exercise with calorie Aerobic, it is recommended that these people use this type of exercise to improve obesity-related hormones.

## Acknowledgements

The researchers hereby express their gratitude and thanks to all the people who helped us in this matter.

## Funding

This study did not have any funds.



## Compliance with ethical standards

**Conflict of interest** None declared.

**Ethical approval** the research was conducted with regard to the ethical principles.

**Informed consent** Informed consent was obtained from all participants.

## Author contributions

Conceptualization: S.F., A.Z., S.S.; Methodology: A.Z., R.R.; Software: A.Z., R.R., S.S.; Validation: A.Z., R.R., S.S.; Formal analysis: A.Z., S.F., R.R.; Investigation: S.F., A.Z., S.S.; Resources: R.R., A.Z., S.F.; Data curation: S.F., A.Z., S.S.; Writing - original draft: A.Z., S.F., R.R.; Writing - review & editing: A.Z., S.F., R.R.; Visualization: S.F., A.Z., S.S.; Supervision: S.F., A.Z., R.R.; Project administration: S.F., A.Z.; Funding acquisition: R.R., A.Z.;

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