

Comparison Between the Effects of Continuous and Intermittent Aerobic Exercise on Weight Loss and Body Fat Percentage in Overweight and Obese Women: A Randomized Controlled Trial

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ABSTRACT

Background: Prevalence of obesity and overweightness in different societies is increasing. Role of physical activity in weight loss and also prevention from some chronic diseases has been discussed previously. The objective of this study was to compare the effect of two different aerobic exercises (intermittent and continuous exercises) while prescribed with concurrent calorie-restrict diet on the weight loss and body fat of overweight and obese females.

Methods: Fifteen individuals in intermittent group performed 40 min moderate Intensity exercise in 3 bouts per day for 5 days per week; the 15 participants of continuous group exercised a single 40 min bout per day, 5 days per week. Also, 15 participants were included in control group without exercise program. A self-monitoring calorie-restrict diet was recommended to all participants. The body fat percentage, waist circumference, and also skin fold thickness of all participants were assessed at baseline and 12th weeks.

Results: The reduction of weight and BMI of participants in intermittent group (-3.33 ± 1.80 and -1.34 ± 0.70 , respectively) was significantly more than comparable changes in continuous group (-1.23 ± 1.60 and 0.49 ± 0.65 , respectively) ($P = 0.048$ and 0.041 , respectively). After the intervention, there was no significant difference between case and controls in terms of body fat percentage, waist circumference, and sum of skin fold thickness.

Conclusions: It seems that moderate intensity intermittent exercise for more than 150 min/ week is more efficient than continuous exercise in weight loss of obese and overweight women.

Key words: Continuous, Exercise, Intermittent, Weight, Women

INTRODUCTION

The ongoing high prevalence of obesity and overweightness in different societies, on one hand, and the paramount consequences of weight loss on the other hand might attracted the interest of investigators to run controlled and prospective studies particularly in challenging topics of this global issue to

decrease the rate of both costs and complications of this multifactorial condition.^[1-7]

In both developed^[1] and developing countries,^[8,9] high prevalence of overweight ($30 > \text{BMI} \geq 25$) and obesity ($\text{BMI} \geq 30$) has been reported.

Role of physical activity in weight loss and also prevention from some chronic diseases including diabetes, cardiovascular diseases, osteoarthritis, hypertension, and cancer has been reported previously. In this regards, 150 min per week (30 min per day and 5 days per week) physical activity with moderate intensity has been recommended to people for their general health,^[10-12] while more than 150 min^[13] and 200–300 min physical activity per week^[10] has been suggested for long-term weight loss and prevention from weight regaining. Although mostly single session physical activity per day was used as routine program for overweight and obese participants in different studies, it has been suggested that intermittent physical activities might have the same effect on increase of cardiopulmonary fitness and also reduction of risk factors of coronary artery diseases.^[11,14-16] Intermittent physical activity has been suggested as a practical method in changing the lifestyle and adapting obese and overweight individuals with performing physical activity per day.^[17] However, many discrepancies regarding the effect of intermittent physical activity on weight reduction have been reported.^[10,11,15]

Murphy *et al.*^[17] reported that encouraging overweight and obese women to short bouts of brisk walking might be considered as a more applicable method in attracting them to physical activity in comparison to long bouts physical activity. It is suggested that this effect can be particularly used in sedentary women especially in developing countries.^[17]

Respecting the high prevalence of overweight and obesity in women, the current randomized clinical trial was performed to compare the effect of intermittent and continuous exercise on weight and fat percentage of overweight and obese women.

METHODS

This study designated as a randomized clinical trial in the nutrition clinic of Sports Medicine Research Centre, Tehran University of Medical Sciences. Participants were included in this study

if they had all of the following inclusion criteria: (1) women in age range of 20–45; (2) BMI more than 25; (3) no history of regular physical activity (defined as at least 30 min physical activity per day in most of week days); (4) no smoking history in recent 6 months; (5) no history of weight loss or gain in recent 6 months (defined as change in body weight in amount of 10% of current body weight). Exclusion criteria were also defined as (1) pregnancy; (2) suffering from any disease could affect the method of the study, or might lead to any changes in weight of the participants; and (3) using drug or nondrug products that could affect the heart rate or appetite of the participants.

The recruited 45 participants were block randomized in blocks of six, into three groups (control group, group with continuous exercise, and group with intermittent exercise). Participants in continuous group were requested to do aerobic exercises (such as brisk walking) with a moderate Intensity (was defined as 64%–76% of maximum heart rate) for 40 min per day and 5 days per week. However, to adapt the participants with the protocol of the study, the bouts of walking in course of the first and the second weeks of the study were 20 and 30 min, respectively. In intermittent group, the participants were asked to walk with moderate Intensity in three short bouts per day and 5 days per week, as all the bouts were more than 10 min and sum of them was 40 min. The time gap between the walking bouts of each day was requested to be more than 4 h. Similar to the other group, for adaptation of the participants with the protocol of the study, the participants in intermittent group walked 2 and 3 bouts per day (each bout lasts 10 min) during the first week and the second week of the study, while the sum of their exercise was 20 and 30 min per day, respectively. The participants in control group were requested to continue their previous plan of physical activity throughout the study. At the beginning of the study, an educational class was held for all the participants. The objectives of this class were as follow: (1) education of moderate-intensity aerobic exercise by measuring the radial pulsation; (2) education of the Borg Rating of Perceived Exertion (RPE) and Talk test.

On basis of these educations, the participants could walk with a moderate intensity which was defined as walking while (1) the heart rate is in the range of 64%–76% of maximum heart; (2) RPE is between 13 and 14; and (3) the ability of talking of

the subjects is around two words. Also, to measure the maximum heart rate of each participant, the following formula was used: “220-age.” Indeed, two bouts of exercises for all participants were performed under supervision of the sports medicine specialist to set the standards of exercise according to prescribed protocol for the participants.

At the 3rd, 6th, 9th, and finally, 12th weeks of the study, all of the subjects were invited to the nutrition clinic of sports medicine research center, Tehran University of Medical Sciences for evaluation. In these visits, the participants were weighted and also encouraged compliance to the study protocol.

For all subjects following measurements were conducted at baseline and 12 weeks after start of the study: skin fold thickness, percentage of body fat employing bioelectric impedance, and waist circumference. The reliability and validity these instruments were previously approved by the American College of Sports Medicine.^[18]

Two hours after a light breakfast and 30 min after urination, using bioelectric impedance device (AVIS33 body composition analyzer, Jawon Medical Co. Ltd, South Korea), the percentage of body fat was measured for all subjects. In this regards, the participants were requested to avoid coffee drinking in the last day and also performing any exercise in the last 4–6 h.

For measurement of skin fold thickness (at baseline and after finishing the study), standard Harpenden skin fold caliper (British Indicators Ltd, UK) was employed in this study.^[19] In this regard, tester grasped a fold of skin firmly between the thumb and index finger of her left hand and lifted it away from the body. She rolled the fold to ensure that subcutaneous tissue (not muscles) were being measured, then jaws of the caliper positioned over the skin fold just 1 cm under her fingers. After releasing the grip, she waited 1–2 s and then read the caliper. The measurements were performed according to a triplicate protocol. In this regards, in sites of measurements, the tester carried out the measurements for three times and in case of more than 3 mm variations in three mentioned values, the measurement for the fourth time was being performed. We measured all sites on the right body side. To permit enough time for skin to regain normal texture and thickness, we moved from site to site after each measurement.

The skin fold thickness of following sites were measured: (1) abdominal site: in a raised vertical fold; 2 cm toward the right lateral side of the umbilicus; (2) triceps site: in a raised vertical fold; on the posterior surface of the right arm in mid, acromionoradial line; (3) subscapular site: in a raised oblique fold (45° angle), 1 to 2 cm under the lower angle of the scapula; (4) suprailiac site: in a raised horizontal fold just superior to the iliac crest where meet the mid axillary line; (5) supraspinale site: A cross marking the intersection of the iliospinale mark to the anterior axillary border with the horizontal line of the superior border of the ilium at the level of the iliocristale; (6) front thigh site: the vertical skin fold at the mid-point of the anterior (front) surface of the thigh, midway between patella (knee cap) and inguinal fold. Sum of six mentioned values were used in statistical analysis of the data.

Using Harris Benedict equation, a calorie-restrict diet, 500 kcal less than their daily energy expenditure for each person, was provided for all participants. According to the provided regimen, the energy uptake of each individual was including 45%–65% from carbohydrate and 15%–20% and 20%–35% from proteins and lipids, respectively.

At the baseline, 6th and 12th week of the study, according to the self-record of the participants, their intake during the last 24 h were collected and the energy intake of their report calculated using the FPI II software (Food Processor II, Nutrition System ESHA Research, Salem, Oregon 1987) and in case of remarkable difference with the previously recommended energy intake, proper diet suggestions were provided.

Using SPSS version 16 (SPSS Inc, Illinois, USA) data were analyzed. In this regard, to compare the quantitative values between the groups of the study, ANCOVA test (with adjustment of the baseline values) was implemented. Approval of this study was obtained from the Ethical Committee of Tehran University of Medical Sciences. The study was registered as number “IRCT138807182562N1” a registry of federally and privately supported clinical trials (i.e., Irct.ir). All the participants signed the informed consent form.

RESULTS

All participants ($n = 45$) randomly assigned equally to three groups of the study. As it is mentioned

before, a computer-generated sequence with a block size of six patients was used for randomization of the subjects. During the follow-up, six individuals from continuous group and 5 and 3 participants from intermittent and control group withdrew the study, respectively. Regarding the number of participants lost the study, there was no significant difference between the groups. The remained 31 participants finished the 12 weeks course of the study and their data were included in final analysis [Figure 1].

The demographic data of participants are provided in Table 1. It is shown that there are no significant differences between the basic characteristics of participants in each group.

As it is shown in Table 2, the changes in physically measured variables of each group after the course of study in comparison to the baseline were compared among groups. Weight and BMI of participants in intermittent group (-3.33 ± 1.80 and -1.34 ± 0.70 , respectively) have decreased significantly more than changes of weight and BMI of continuous group (-1.23 ± 1.60 and -0.49 ± 0.65 , respectively) ($P = 0.048$ and 0.041 , respectively). Also, weight and BMI of the subjects in the control group were decreased

(-2.03 ± 1.82 and -0.79 ± 0.72 , respectively); however, comparing the results with two other groups, no significant difference was found.

To decrease the effect of confounding factors including age and height on the analysis of obtained changes in the mentioned physical variables between the groups, using ANCOVA test, the results of the comparison between the groups were statistically adjusted for these variables.

No significant difference was found between the recommended energy and also energy intake of participants in the 6th and 12th week of the study among the groups [Table 3].

As it was mentioned before, exercise with moderate Intensity was recommended to both the groups. In this regards, the mean self-reported heart rate of the participants in both groups during the activity were compared and there was no significant difference between these findings among groups ($P > 0.05$).

DISCUSSION

The aim of current study was to compare the effect of intermittent and continuous

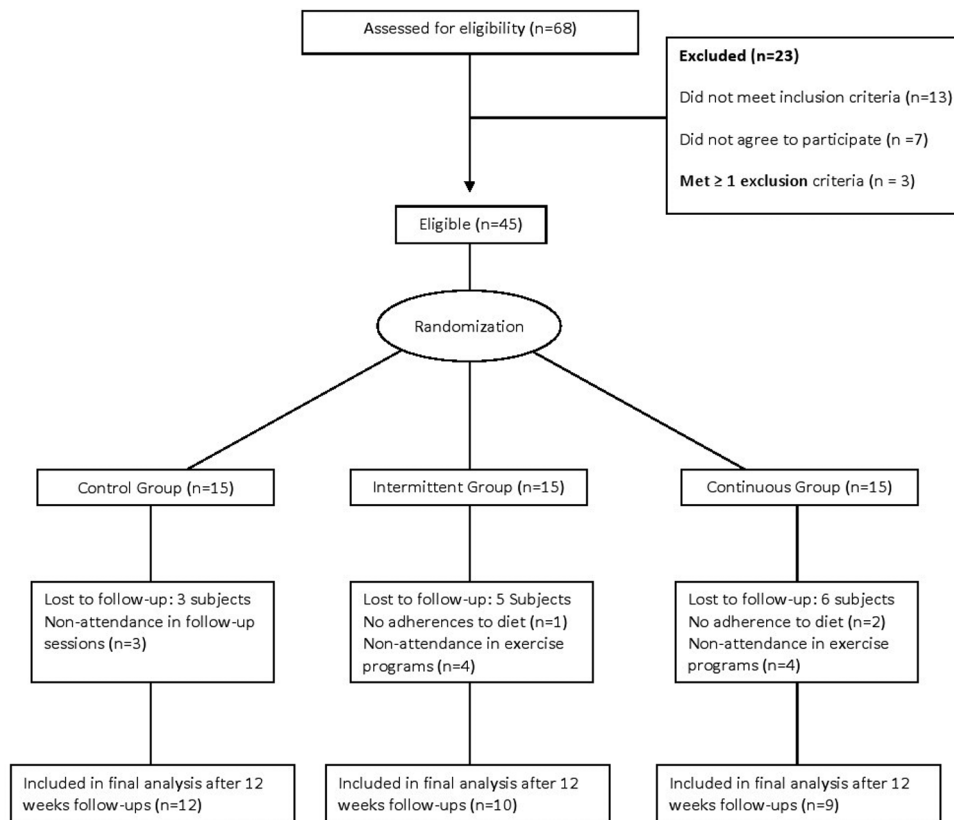


Figure 1: Flow chart of the study

Table 1: The basic characteristics of recruited participants in the study; mean \pm SD

Variables	Control group	Intermittent group	Continuous group	P value
Age (year)	34.5 \pm 6.2	33.1 \pm 7.7	32.4 \pm 9.5	0.810
Height (m)	1.61 \pm 0.03	1.57 \pm 0.04	1.56 \pm 0.06	0.087
Weight (Kg)	84 \pm 15.64	69 \pm 5.40	77.83 \pm 17.37	0.056
BMI (kg/m ²)	32.33 \pm 5.26	27.87 \pm 2.33	31.57 \pm 4.78	0.061
PBF(percent)	39 \pm 3.46	35.70 \pm 2.91	38.43 \pm 4.28	0.094

BMI = Body mass index; PBF = Percentage of body fat.

Table 2: Comparison between the changes of physical variables after course of the study among the participants in three groups

Variables	Control group	Intermittent group	Continuous group	P value (95% Confidence interval)		
				Control-continuous	Control-intermittent	Intermittent-continuous
Weight (Kg)	-2.03 \pm 1.82	-3.33 \pm 1.80*	-1.23 \pm 1.60*	0.591 (-1.19 to 2.79)	0.242 (-3.23 to 0.64)	0.048* (0.01 to 4.17)
BMI (Kg/m ²)	-0.79 \pm .72	-1.34 \pm .70*	-0.49 \pm .65*	0.615 (-0.48 to 1.08)	0.199 (-1.31 to .21)	0.041* (0.02 to 1.66)
PBF (percent)	-1.48 \pm 1.36	-2.20 \pm 1.09	-1.09 \pm 1.15	0.766 (-0.99 to 1.78)	0.402 (-2.06 to .63)	0.159 (-0.33 to 2.56)
Waist (Cm)	-0.9 \pm 2.0	-2.4 \pm 2.3	-2.0 \pm 2.9	0.573 (-3.74 to 1.56)	0.313 (-4.11 to 1.02)	0.912 (-2.30 to 3.21)
Skin Fold (mm)	-12.5 \pm 10.4	-17.8 \pm 7.5	-13.7 \pm 14.8	0.963 (-13.43 to 10.87)	0.515 (-17.10 to 6.50)	0.715 (-8.64 to 16.68)

BMI = Body mass index; PBF = Percentage of body fat. *Statistically significant ($P < 0.05$).

Table 3: The mean of self-reported intake of participants in three groups of the study in 24 hours before the visits

Variable	Type of measurement	Control group	Intermittent group	Continuous group
Energy (kcal)	Recommend	1859.6 \pm 238.8	1636.2 \pm 63.0	1772.7 \pm 293.7
	Week 6	1431.0 \pm 393.9	1359.4 \pm 419.6	1433.2 \pm 525.0
	Week 12	1630.3 \pm 410.7	1300.5 \pm 381.3	1423.0 \pm 362.3
Pro (g)	Baseline	62.5 \pm 17.0	67.7 \pm 15.3	51.9 \pm 13.3
	Week 6	51.2 \pm 16.7	46.5 \pm 11.4	54.0 \pm 22.1
	Week 12	53.6 \pm 14.1	47.2 \pm 15.2	51.8 \pm 15.1
CHO (g)	Baseline	218.2 \pm 80.6	226.0 \pm 36.0	165.3 \pm 58.8
	Week 6	182.7 \pm 52.9	172.0 \pm 56.0	184.9 \pm 57.5
	Week 12	202.6 \pm 50.7	154.1 \pm 44.6	178.2 \pm 52.2
Fat (g)	Baseline	83.5 \pm 18.7	85.7 \pm 21.2	51.2 \pm 21.4
	Week 6	58.2 \pm 19.4	57.1 \pm 23.6	56.4 \pm 28.8
	Week 12	70.0 \pm 21.5	57.8 \pm 18.9	58.9 \pm 18.1
Pro (%)	Baseline	13.3 \pm 1.7	13.8 \pm 2.3	16.0 \pm 3.0
	Week 6	14.4 \pm 3.5	14.1 \pm 4.6	14.6 \pm 1.6
	Week 12	13.0 \pm 1.4	14.3 \pm 3.4	14.5 \pm 3.2
CHO (%)	Baseline	45.5 \pm 8.7	46.5 \pm 6.2	49.7 \pm 8.0
	Week 6	50.1 \pm 5.2	49.1 \pm 9.1	52.0 \pm 7.7
	Week 12	49.4 \pm 5.2	46.5 \pm 2.8	49.0 \pm 5.0
Fat (%)	Baseline	41.0 \pm 9.1	39.5 \pm 6.3	33.8 \pm 8.2
	Week 6	35.5 \pm 5.5	36.7 \pm 6.7	33.2 \pm 7.9
	Week 12	37.5 \pm 4.5	39.1 \pm 2.8	36.5 \pm 4.7

exercise on weight loss in overweight and obese women. After 12 weeks follow-up of the study, it was found that BMI ($P = 0.041$) and weight

($P = 0.048$) of participants in intermittent group decreased significantly more than the continuous group. Although the skin fold thickness, waist

circumference, and fat percentage of participants in intermittent group were reduced more than the other groups, the relation was not significant.

In different studies, regarding the effect of short bouts of physical activity on the weight loss, inconsistent results have been obtained. According to some studies in which intermittent physical activity without nutritional interventions were prescribed for the participants, it was found that intermittent physical activity has no prominent effect on the weight loss.^[15,16,20,21] The comparison between the intermittent and continuous exercise programs regarding their role in weight loss have also been discussed in other studies;^[11,22] According to these studies, both intermittent and continuous exercise programs have been found to be effective in weight loss and no significant difference has been reported between them. While Donnelly *et al.*^[23] suggested that 150–250 min per week physical activity might lead to medium changes in weight of individuals, in most of studies were published in this regards, a less time of physical activity is prescribed for the participants.^[11,15-17,24,25] Jakicic *et al.*^[26] and also Chambliss *et al.*^[27] reported that a program containing more than 200 min physical activity per week could lead to significantly more weight loss in comparison to other prescribed activity programs containing less physical activity per week. This finding strengthens the importance of total time of physical activity on weight loss, as might been led to discordant findings in different studies.

Jakicic *et al.*^[28] similar to the current study requested the participants to perform 40 min physical activity per day; according to their report, there was no significant difference in weight loss of participants whether they follow the intermittent or continuous protocol; although more weight loss was found in intermittent group. In addition, Hardman *et al.*^[29] have reported that post exercise oxygen consumption in participants perform intermittent exercise is higher than those individuals recruited for continuous exercise.

As data show, it was found that there is no significant difference between the mean weight loss of participants in control and continuous groups, although the mean of weight loss in control group was higher than the continuous group. However, the skin fold thickness, fat percentage, and waist circumference were decreased more in continuous

group in comparison to control group. These findings might be due to recall bias of participants in all groups that could lead to obtaining discordant results, as Macfarland *et al.*^[16] and Schmidt *et al.*^[11] have also reported similar results. In these studies, over and under report of physical activity and calorie intake in groups with more and less weight loss, respectively, might be considered as probable reason of finding unexpected results.

According to reliable systematic review,^[30] it is recommended that concurrent exercise and nutritional intervention are more effective than only exercise or only nutrition intervention in weight loss of individuals. The impressive effect of exercise on cardiovascular and other chronic diseases can also be considered as another advantage of binary protocol in comparison to exercising or energy intake controlling alone.^[14,31]

It should be mentioned that all the participants in this study were female, while both sexes were being recruited in some other studies. It has been suggested that the effect of physical activity on weight loss is more in males in comparison to females^[10]; this can show the importance of current study which performed to investigate the effect of two types of exercise programs on the weight loss of obese and overweight women.

As an important point, it was found that the more the course of the study was passed, significantly the more accurately prescribed exercise were followed by the participants ($P < 0.001$). However, Schmidt *et al.*^[11] reported a reverse trend in their study; this might be due to the more precise supervision applied to control the physical activity of participants in the current study in comparison to mentioned one.

The participants in both intermittent and continuous groups of this study had a more amount of weight loss in comparison to other studies. This might be because of prescription of both exercise and individual nutritional intervention simultaneously in this study, in comparison to using one of them in other studies.^[15,25]

In our study, 31% of primary recruited participants left the study. The number of individuals left the study in different groups was not significant. The rate of lost to follow-up in our study can be compared well with the other studies.^[11,22,25] The remarkable lost to follow-up of the studies might be due to the application of extraordinary

changes in life style of the participants by the study protocol. Similar to other studies “having no time” has been found as the most common reason of discontinuing the study by the participants.^[15,21] Despite the randomization process, the mean BMI of three groups at the baseline are not comparable. This can be considered as another limitation of the study. As it is mentioned before, for analyzing the data of the study, the baseline values were adjusted between the groups; therefore, we tried to minimize this effect on the final results of the study.

CONCLUSION

It seems that medium intensity intermittent exercise for more than 150 min/week is more efficient than continuous exercise in weight loss of obese and overweight women. The comparison between the groups regarding the waist circumference, skin fold thickness, and body fat percentage were not significant, although all mentioned variables in the participants in intermittent group decreased more. Respecting the data obtained from current study, apparently, randomized controlled trials with more participants should be running to clarify the effect of two mentioned exercise protocols on the weight loss and other physical indices display the fat contribution of individuals.

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