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RESEARCH ARTICLE

EFFECT OF INTERMITTENT FASTING DIET AND AEROBIC EXERCISE ON OBESITY IN POSTMENOPAUSAL WOMEN

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ABSTRACT

Background: postmenopausal obesity leads to many serious health risks such as cardiovascular disease, diabetes and psychological disorder. **Purpose:** This study aimed to determine the effect of intermittent fasting diet and aerobic exercise on obesity in postmenopausal women. **Subjects:** sixty obese postmenopausal women participated in this study, their ages ranged from 50-60 years, their body mass index (BMI) ranged from 30-35 kg/m^2, and they were selected randomly from outpatient clinic of the Medical Complex in New Cairo Police Hospital, Cairo Governorate. They were treated by low caloric intermittent fasting diet for 3 months and aerobic exercises in the form of walking on the treadmill for 30 min, three times per week for 3 months. **Material and method:** assessment was done by assessing (body weight, height, BMI and waist and hip circumference), and lipid profile pre and post treatment program. **Results:** comparing pre and post treatment results, there was a significant reduction in body weight, body mass index, waist hip ratio, total cholesterol, triglyceride, low density lipoprotein and increase in high density lipoprotein after treatment program. **Conclusion:** combined therapy of intermittent fasting diet and aerobic exercise is an effective method in improving lipid profile and body weight in obese postmenopausal women.

INTRODUCTION

Menopause is a normal physiologic process, defined as the permanent cessation of menses for 12 months or more due to cessation of ovarian hormone production. According to the World Health Organization (WHO) classification, premenopausal women are those who have experienced regular menstrual bleeding within the last 12 months, premenopausal women are defined as those women who have experienced irregular menses within the last 12 months or the absence of menstrual bleeding for more than 3 months but less than 12 months, and postmenopausal women are those who have not experienced menstrual bleeding for 12 months or more. Women with iatrogenic menopause are those for whom periods have stopped as a result of medical or surgical intervention, for example, due to chemotherapy or radiation of ovaries, hysterectomy or oophorectomy, or both. The age at natural menopause is between 45 years and 50 years. Early menopause is defined as menopause occurring before the age of 45 years, while premature menopause occurs before the age of 40 year (AlDughaither *et al*., 2015).

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Along with obesity come related diseases of metabolic derangement such as dyslipidemias, hypertension, insulin resistance, and diabetes. Each of these metabolic alterations develops gradually and progressively. They tend to be found in association with each other and all increase the risk of developing cardiovascular disease (Romero-Gómez *et al*., 2017). Obese women have lower estradiol levels, lower inhibin b levels, and higher FSH levels compared to non-obese women in the earliest stages of the menopausal transition. On the other hand, postmenopausal obese women have higher estradiollevels compared to non-obese women. The associations between obesity and hormones reverse in the transition stages (Kassi *et al*., 2011). Overweight female had times greater prevalence of abnormal LDL cholesterol, TG, and HDL cholesterol concentrations than those who are lean. Although the pathogenic mechanism of dyslipidemia is multifactorial and still debated, visceral obesity and insulin resistance represent one of the most important markers of its progression (D'Adamo *et al*., 2015). Aerobic exercises, aquatic exercises and relaxation are non-pharmacological methods used to control hypertension in overweight hypertensive postmenopausal women (Arca *et al*., 2014 &Saensak *et al*., 2013 & Swift *et al*., 2012). Low intensity exercises reduced systolic blood pressure.

Moderate-intensity aerobic exercise (40-70% maximal oxygen consumption) is associated with a significant reduction of blood pressure in hypertensive, normotensive, overweight and normal weight participants (Petriz *et al*. 2015)

Aim of the study: The aim of the study is to determine the effect of intermittent fastingdiet and aerobic exercise on obese postmenopausal women

Subjects' criteria: Sixty obese postmenopausal women had participated in this study. They were selected randomly from The Medical Complex in New Cairo Police Hospital.

Inclusion criteria: All of women had hyperlipidemia(Cholesterol above 240 µg/dl, Triglycerides above 150 µg/dl, HDL below 30 µg/dl, LDL above 150µg/dl) :Their age ranged from 50-60 years, Their body mass index (BMI) ranged from 30- 35 kg/ m^2, 3- The menstruation stopped since at least 12 months ago.

Exclusion criteria: Female with the following criteria was excluded from the study: Women with absent menstruation less than 12 months, Women diagnosed with Diabetes, Hypertension, Heart disease, Kidney disease, Liver disease, Hyperthyroidism or hypothyroidism and BMI more than 35 kg/ m^2 or less than 30 kg/ m^2.

Design of study: They had been divided into three group pre-test and post-test design. They were assigned randomly into three groups equal in number (A, B &C).

- **Group (A):** consisted of twenty postmenopausal women. They were treated by a low caloric (1200-1500) Kcal intermittent fasting diet (16 hours fasting and 8 hours feeding) only for 3 month.
- **Group (B):** consisted of twenty postmenopausal women. They were treated by aerobic exercise only for 3 month.
- **Group (C):**consisted of twenty postmenopausal women. They were treated by a low caloric (1200-1500) Kcal intermittent fasting diet (16 hours fasting and 8 hours feeding) and aerobic exercise for 3 month.

The assessment and treatment protocols were thoroughly explained to all participants. Before participating in this study, each woman signed an informed consent form (**Appendix I**).
Ethical approval was obtained from the institutional review board at Cairo University's Faculty of Physical Therapy with number p.t

Instrumentations

- **Data recording sheet**: Each woman's data and details were documented on a data recording sheet. (**Appendix II**).
- **Standardweight-height scale**: weight and height scale (floor type, RGT-200, made in china): was used for measuring the weight and height for each patient to calculate the BMI.Fig. (1)
- **Tape measurement:** it was used for measuring the waist circumference and hip circumference for each patient to calculate the waist hip ratio.
- **Laboratory instruments by using ELISA Kits:** they were used to measure the lipid profile.
- **Disposable plastic syringes:** they were used for drawing venous blood samples.
- **Polypropylene tubes with EDTA:** they were used for keeping blood samples and centrifuge which were used for separating blood serum.
- **Analyzing chemicals and ELISA Kits:** were used to measure the level of lipid profile after 12 hour fasting.
- **ELISA reader (stat fax -2100):** were used for estimation of lipid profile fig. (2).
- **Cotton.**
- **Disinfection solution.**
- **Gloves.**
- **Electrical Treadmill:** (pro Hanson EH-ET1435WIN Treadmill, made in china) Fig. (3).

Procedures

Evaluation procedures: All the participants had signed consent from and they were assessed before starting and after the treatment program through:

Weight and height measurements: Standard weight and height scale (floor type, RGT-200, made in china) was used to calculate body mass index (BMI) for each women.

BMI= body weight (KG)/ height in (m^2) (Kg/ $m^{2)}$.

Waist hip ratio: Each patient was evaluated by using tape measurement to measure waist hip ratio. Waist circumference and hip circumference were measured for each woman in the study before and after the program to calculate WHR. Waist circumference (cm) was taken with a tape measure as the point midway between the costal margin and iliac crest in the mid-axillary line, with the women standing and breathing normally. Hip circumference (cm) was measured at the widest point around the greater trochanter. The waist-to-hip ratio was calculated as the waist measurement divided by the hip measurement.

Assessment of lipid profile: After a written consent and use of local antiseptic for the skin, a fasting sample of venous blood (3mls) was collected from each participant included in the study before and after treatment program, from the arm directly in a centrifuge tube for serum preparation. Serum levels of total cholesterol (TC), triglyceride (TG), low density (LDL), and high density lipoproteins(HDL) were measured by using reagents, ELISA Kits, and ELISA reader (stat fax -2100).

Treatment procedures: Each woman in this study was treated by using:

Electrical treadmill for exercise program for each patient in group (B & C): The aerobic exercises included walking on the treadmill for 30 min including three phases. Warming-up phase which consisted of walking on the treadmill for five minutes, with low intensity (40% of Maximum Heart Rate, MHR), actual phase which consisted of walking on the treadmill for 20 min with moderate intensity (60-75% of MHR) and Cooling phase which consisted of walking on the treadmill for five minutes with low intensity (40% of MHR). MHR will be calculated according to the equation (220-age in

years). The frequency of exercise will be three times per week for three months. During the training session, the therapist was standing near the patient to observe and detect any interrupting signs of the exercise as dexterity, pain, dizzy or shortens of breath.

Intermittent fasting diet: Each patient in both group (A & C) will receivelow caloric(1200-1500 Kcal)Intermittent fastingdiet (16 hours fasting and 8 hours feeding) for 3 month only (appendix III).

DATA ANALYSIS

Descriptive statistics and ANOVA test were conducted for comparison of subject characteristics between groups. Normal distribution of data was checked using the Shapiro-Wilk test for all variables. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Mixed MANOVA was performed to compare within and between groups effects on weight, BMI, W/H ratio, TC, LDL, HDL and TG. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparison. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

RESULTS

Subject characteristics: Table (1) showed the subject characteristics of the group A, B and C. There was no significant difference between groups in age, weight, height and BMI ($p > 0.05$).

Effect of treatment on weight, BMI, W/H ratio, TC, LDL, HDL and TG: Mixed MANOVA revealed that there was a significant interaction of treatment and time ($F = 23.18$, $p = 0.001$). There was a significant main effect of time ($F = 503.51$, $p = 0.001$). There was a significant main effect of treatment ($F = 3.02$, $p = 0.001$). Table 2-3 showed descriptive statistics of weight, BMI, W/H ratio, TC, LDL, HDL and TG and the significant level of comparison between groups as well as significant level of comparison between pre and post treatment in each group.

Within group comparison: Within-group comparison revealed a significant improvement in the three groups. There was a significant decrease in weight, BMI, W/H ratio, TC, LDL and TG and significant increase in HDL in the three groups post treatment compared with that pre treatment ($p < 0.05$). (table 2-3).

Between group comparison: Between group comparisonpre treatment revealed a nonsignificant difference in all parameters ($p > 0.05$). There was a significant decrease in weight, BMI, W/H ratio, TC, LDL and TG and significant increase in HDL of group C compared with that of group A and B post treatment ($p < 0.05$). There was a significant decrease in TC, LDL and TG and significant increase in HDL of group A compared with that of group B post treatment ($p < 0.01$) while there was no significant difference in weight, BMI and W/H ratio between group A and B ($p > 0.05$). (table 2-3).

DISCUSSION

Obesity is a worldwide epidemic due to the availability of many unhealthy food options and limited physical exercise. Restriction of the daily food intake results in weight loss, which is also associated with better health outcomes including triglycerides, total cholesterol, low density lipoprotein cholesterol, blood pressure, glucose, insulin, and C-reactive protein (Ganesan *et al*., 2018). Therefor current study aimed to investigate the effect of intermittent fastingdiet and aerobic exercise on obese postmenopausal women. Each patient in group (B & C) receive aerobic exercises consist of walking on the treadmill for 30 min including three phases. Warming-up phase which consisted of walking on the treadmill for five minutes, with low intensity (40% of Maximum Heart Rate, MHR), actual phase which consisted of walking on the treadmill for 20 min with moderate intensity (60-75% of MHR) and Cooling phase which consisted of walking on the treadmill for five minutes with low intensity (40% of MHR). MHR will be calculated according to the equation (220-age in years). The frequency of exercise will be three times per week for three months, each patient in both group **(A & C)** will receivelow caloric(1200-1500 Kcal)Intermittent fastingdiet (16 hours fasting and 8 hours feeding) for 3 month only Assessment of each patient was done through assessing body weight by weight height scale, body mass index by dividing body weight on height per meter square, waist hip ratio by dividing waist round measurement on hip round measurement and lipid profile which consist of total cholesterol, triglycerides, high density lipoprotein and low density lipoprotein before and after treatment program. The results of this study revealed that after treatment, body weight, BMI, waist hip ratio, total cholesterol, triglyceride, and low density lipoprotein cholesterol all decreased significantly, while high density lipoprotein cholesterol increased significantly.

The result of the present study came in agreement withDavis *et al* (2016), found that dietary plans had significant weight loss in intermittent fasting (IF) groups. Seimon *et al* (2015), in his systematic review found that intermittent fasting diet was as effective as daily restriction of calories both for short and long-term interventions. The result of the present study came in agreement with Wing *et al*.,(2011) who reported that an intermittent fasting diet regimen can result in weight loss in overweight and obese adults which resulted in an average weight loss in the order of 0.2–0.8 kg/week, which, if maintained, for a 100 kg individual would result in a 5% reduction in weight over a 5-week to 6-month time period. For overweight or obese individuals, a 5% reduction in body weight is considered to be achievable and to reduce health risks by reducing blood pressure and the risk for type 2 diabetes. These findings came in accordance with Nasr *et al*., (2020), who reported that intervention of intermittent fasting caused a 5.96 % weight loss, reduced BMI, waist circumference which used as an indirect indicator of visceral fat mass, waist/hip ratio. Also, the result of this study agreed with (Kunduraci, and Ozbek, 2020), who reported that 8 week of IF in overweight or obese individuals can experience greater reduction in body weight and composition. These findings came in accordance with Arguin *et al*, (2012), who note that their participants showed between 50 and 100% improvement in total cholesterol, low-density lipoprotein cholesterol and triglyceride levels during the first 5% body weight loss. Given this weight-loss benefit, the results of this systematic review show that an intermittent fasting diet has the potential to offer

Table 1.Basic characteristics of participants

	Group A	Group B	Group C	p-value
Age, mean ± (SD), years	55 ± 3.19	53.05 ± 2.32	54.25 ± 2.98	0.1
Weight, mean ± (SD), kg	91.35 ± 8.64	91.05 ± 8.8	92.05 ± 8.89	0.93
Height, mean ± (SD), cm	164.65 ± 6.31	165.2 ± 5.8	164.9 ± 6.24	0.96
BMI, mean ± (SD), kg/m²	33.61 ± 1.4	33.28 ± 1.7	33.75 ± 1.02	0.56

SD, standard deviation; p-value, level of significance

Table 2.Mean weight, BMI and W/H ratio pre and post treatment of group A, B and C

	Group A	Group B	Group C	p-value		
	mean ± SD	mean ± SD	mean ± SD	A vs B	A vs C	B vs C
Weight (kg)						
Pre treatment	91.3±8.64	91.05 ± 8.8	92.05 ± 8.89	1	1	1
Post treatment	81.8±8.35	84.75 ± 7.54	75.2 ± 7.66	0.72	0.03	0.001
MD	9.55	6.3	16.85			
% of change	10.45	6.92	18.31			
	p = 0.001	*p = 0.001*	*p = 0.001*			
BMI (kg/m²)						
Pre treatment	33.61 ± 1.4	33.28 ± 1.7	33.75±1.02	1	1	1
Post treatment	30.1 ± 1.74	31 ± 1.31	27.57±1.23	0.17	0.001	0.001
MD	3.51	2.28	6.18			
% of change	10.44	6.85	18.31			
	p = 0.001	*p = 0.001*	*p = 0.001*			
W/H ratio						
Pre treatment	1.05±0.05	1.04±0.07	1.04±0.06	1	1	1
Post treatment	1.02±0.06	1.01±0.06	0.95±0.06	1	0.008	0.02
MD	0.03	0.03	0.09			
% of change	2.86	2.88	8.65			
	p = 0.03	*p = 0.001*	*p = 0.001*			

SD, Standard deviation; p-value, Level of significanc

Table 3. Mean TC, LDL, HDL and TG pre and post treatment of group A, B and C

	Group A	Group B	Group C	p-value		
	mean ± SD	mean ± SD	mean ± SD	A vs B	A vs C	B vs C
TC (mg/dl)						
Pre treatment	267.97±18.06	269.7±16.18	271.69±15.88	1	1	1
Post treatment	230.67±11.47	249.18±15.74	218.51±12.97	0.001	0.01	0.001
MD	37.3	20.52	53.18			
% of change	13.92	7.61	19.57			
	p = 0.001	*p = 0.001*	*p = 0.001*			
LDL (mg/dl)						
Pre treatment	201.19 ± 15.09	198.43±12.3	200.87±14.58	1	1	1
Post treatment	156.7 ± 14.86	170.48±16.14	144.27±13.17	0.01	0.03	0.001
MD	44.49	27.95	56.6			
% of change	22.11	14.09	28.18			
	p = 0.001	*p = 0.001*	*p = 0.001*			
HDL (mg/dl)						
Pre treatment	24.92 ± 2.4	25.94 ± 1.69	24.74 ± 2.62	0.48	1	0.3
Post treatment	31.61 ± 1.82	28.92 ± 1.57	33.72 ± 2.14	0.001	0.002	0.001
MD	-6.69	-2.98	-8.98			
% of change	26.85	11.49	36.30			
	p = 0.03	*p = 0.001*	*p = 0.001*			
TG (mg/dl)						
Pre treatment	171.75 ± 11.36	169.23 ± 11.53	172.53±13.59	1	1	1
Post treatment	142.33 ± 10.6	155.94±11.46	129.98±14.9	0.003	0.008	0.001
MD	29.42	13.29	42.55			
% of change	17.13	7.85	24.66			
	p = 0.03	*p = 0.001*	*p = 0.001*			

SD, Standard deviation; p-value, Level of significance

an effective weight-loss alternative for individuals. Also, the results of the present study could be explained by the results of Guerrero *et al*., (2020) who suggest that the underlying mechanisms responsible for the effects of intermittent fasting on lipidemia are related to metabolic adaptation to fasting, during fasting, the glucose concentration decreases and the glycogen reserves in the liver are consumed, activating gluconeogenesis and fatty acid oxidation. When glucose stores are depleted, the body begins to use ketones that arise from the fatty acids transformation released by adipocytes in the lipolysis process; these metabolic processes would result in weight loss and an improvement in the concentration of plasma lipids. also (Santos and Macedo, 2018), suggested IF diets could increase HDL-c levels. Contrary to our finding Meng *et al*., (2020), suggested that IF and energy-restricted diets are effective in improving circulating TC, LDL-c, and TG levels but not HDL-c, The result of the present study came in agreement with Riou *et al*., (2015) who hypothesized that subjects who used moderate intensity exercise would show increases in aerobic capacity, decreases in body weight and body fat, and would improve blood lipids, insulin and glucose.

The result of the present study came in agreement with Friedenreich *et al*., (2011), who reported that aerobic exercise intervention among postmenopausal women resulted in statistically significant reductions in overall and abdominal adiposity, Furthermore, women achieved a higher duration of physical activity, experienced greater average decreases in body weight. The result of the present study came in agreement with Gentil *et al*., (2019) Which is in line with Astorino and Schubert, (2018), and Zhang *et al*., (2017),who reported that body weight, BMI and body composition significantly after 12 weeks of aerobic exercise. These results showed that aerobic exercise is an effective way for controlling body composition. The result of the present study came in agreement with Leon and Sanchez, (2001), who conducted a meta-analysis of 51 interventions involving 12 weeks or more of aerobic exercise (n = 4,700). It was reported that, on average, HDL cholesterol increased by 4.6 % while triglyceride levels fell by 3.7 % and LDL cholesterol fell by 5 %. Total cholesterol remained unchanged, although the HDL:LDL cholesterol ratio improved considerably, suggesting that the increased intensity and structure normally associated with aerobic exercise has a more consistent impact upon triglycerides and LDL cholesterol than moderate levels of physical activity.

Also Mann *et al*, (2014), reported significant reductions in plasma triglycerides (from 1.4 to 1.2 mmol/L, $p < 0.05$) and increases in HDL cholesterol (from 1.4 to 1.8 mmol/L, $p < 0.05$) after training three times weekly at 70–75 % HR_{max} for 30 min for the first 8 weeks, progressing to four times weekly at 85 % HR_{max} for 45 min thereafter. The data suggested that shorter-term interventions will be effective also if the training volume is high enough. Further Mann *et al*, (2014). Observed a 13 % reduction in the body fat percentage (from 26.4 to 22.9 %, $p < 0.05$). Also, Juhas *et al*., (2020), who reported that 8 weeks of mainly aerobic activity of moderate to vigorous intensity, caused significant improvements in blood lipid profile and aerobic capacity in young healthy females. The most important significant changes were (1) improvement of VO_{2max} and the increase in endurance measured through shuttle run test (2), the increase in HDL levels, with concomitant improvement of TH/HDL levels, and (3) the decrease of LDL levels. We have also registered a significant increase in TG levels. Contrary to our finding, Le *et al*., (2016), showed that both short and long-term aerobic exercise is successful in improving insulin resistance in postmenopausal women without a major shift in body weight. Accordingly, it can be concluded that intermittent fasting diet and aerobic exercise is an effective and successful therapy in treating obese postmenopausal women.

Conclusion

It can be concluded that combined therapy of intermittent fasting diet and aerobic exercise is an effective method in improving body weight, body mass index, waist hip ratio and lipid profile.

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