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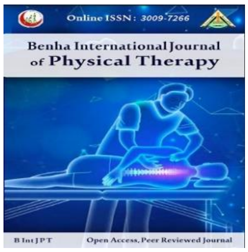

Original research

Effect of pyramidal training on selected risk factors of atherosclerosis in women with central obesity.

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Abstract

Background: Central obesity is linked to atherosclerosis, diabetes, and cardiovascular disease. Atherosclerosis improved with aerobic exercise intensity and diet restriction. Previously, progressive aerobic (pyramidal) training was not tested on specific atherosclerosis risk factors in centrally obese women. **Purpose:** To examine the influence of pyramidal training exercise on a specific risk factor for atherosclerosis in women with central obesity. **Methods:** The study included 50 centrally obese women aged 30–40 with a BMI between 30 and 34.9 kg/m2. They were randomly assigned to two equal groups: the study group received pyramidal treadmill training for 40 minutes three times a week for eight weeks, and the control group received diet health advice only for eight weeks. BMI, waist circumference, and waist hip ratio, as well as laboratory measurements (lipid profile and Homeostatic Model Assessment for Insulin Resistance), were measured pre- and post-intervention for 8 weeks. **Results:** After 8 weeks of intervention, the study group showed significant decreases in BMI, waist circumference, waist hip ratio, and laboratory variables such as total cholesterol, LDL, triglycerides, AIP, and HOMA IR. The control group had significantly lower waist-hip ratio, total cholesterol, LDL, triglycerides, and AIP. Pre- and post-intervention BMI, waist circumference, and HOMA IR were not significantly different in the control group. BMI, HDL, and LDL didn't differ significantly between the study and control groups after treatment. **Conclusion:** This study found pyramidal training improves BMI, waist circumference, waist hip ratio, lipid profile, and HOMA IR in centrally obese women with selected risk factors for atherosclerosis, so we recommend pyramidal training.

Key words: Atherosclerosis, Central obese women, Risk factor, Pyramidal training.

Introduction

The World Health Organization (WHO) describes obesity as the improper and extreme storage of fat. The main reason why individuals are overweight or obese is because their caloric intake is higher than their caloric expenditure. Obesity is an acquired condition that mainly depends on personal decisions affecting about one's lifestyle, such as inactivity and a history of overeating. Despite the effects of genetic and epigenetic factors[1]. There are four types of obesity based on the relationship between Body

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Mass Index and Waist Circumference: non-obesity (normal BMI along with WC), general obesity (normal WC along with abnormal BMI), central obesity (normal BMI but abnormal WC), as well as compound obesity (abnormal BMI along with WC). Obesity may contribute to pathogenesis of chronic diseases differently depending on the type. To identify obesity indicators for disease avoidance, it is important to examine at the relationships among different types of obesity and diseases[2].

According to the WHO, central obesity is a disease burden affecting the entire world and is considered to have a WC greater than 94 centimeters for males and 80 centimeters for females[3]. Waist circumference measurement of abdominal fat deposition is thought to be a better measure of obesity concerning metabolic syndrome, type II diabetes, as well as cardiovascular diseases than BMI. Numerous risk variables, including female gender, have been linked to both obesity and central obesity[4].

There is a significant association between visceral adiposity and the vascular risk associated with obesity. The cellular components of adipose tissue release cytokines and adipokines that may have an impact on vascular disease. It has been shown that visceral fat in obese people expresses more inflammatory cytokines than subcutaneous fat. The increase in macrophages that has been observed with the growth of fat storage may be reflected in the adipose tissue secretory profile. A systemic, chronic low-grade inflammatory state may result from this macrophage invasion. The inflammation caused by adipose tissue may be a factor in the rise in vascular disease because circulating indicators of inflammation are linked to cardiovascular events[5].

Common Obesity-Related Dyslipidemia is characterized by elevated levels of Triglycerides (TG) and Free Fatty Acid (FFA), diminished levels of High-Density Lipoprotein Cholesterol (HDL-C) connected with impaired functioning of HDL, and normal or slightly elevated levels of Low-Density Lipoprotein Cholesterol (LDL-C) along with higher levels in LDL[6]. The major features of metabolic dyslipidemia are excessive TG levels and declined HDL-C levels. Even if there is a possibility of more LDL particles, LDL-C values could be ideal or slightly elevated. Obesity and the acquirement of type II diabetes mellitus, cardiovascular illnesses, and some forms of cancer are all strongly correlated with dyslipidemia[7].

There is a strong correlation between insulin resistance as well as atherosclerosis, as evidenced by the frequent co-occurrence of obesity and insulin resistance with significant rises in inflammatory markers. Insulin resistance is a powerful predictor of atherosclerosis (Cardio Vascular Disease). As a result of its significant cellular infiltration and active adipokines production, atherosclerosis behaves in many respects like an inflammatory condition[8].

In the primary prevention of cardiovascular illnesses, exercise can be a way to deal with risk factors. Training increased HDL-C levels and the HDL/LDL-C ratio while declining plasma LDL-C in addition to TG concentrations[9]. Exercise interventions that increase personal amount of physical activity, especially in individuals with sedentary lifestyles and obesity, are successful at lowering insulin resistance and adiposity[10].

For people with dyslipidemia, aerobic activity is necessary. The relationship among aerobic exercise as well as HDL-C is advised to be trained three or more sessions a week for 30 to 45 minutes per session. Recent findings indicate that HDL-C levels exhibit greater sensitivity to aerobic exercise compared to both LDL-C and TG levels[11]. The pyramidal aerobic training system may be employed to decrease cardiovascular risk factors in individuals diagnosed with type II diabetes. It is possible to raise the intensity during aerobic exercise. Additionally, the running time or distance can be changed to match the rise in exercise intensity[12].

While high-intensity exercise uses carbohydrates rather than fat as the energy source, low-intensity exercise done over extended periods of time uses fat as the energy source. It has been suggested as a result of this research that traditional low to moderate intensity exercise is preferable to high intensity exercise for producing changes in lipid parameters. For the objective of losing weight and lowering atherogenic index, high intensity intermittent exercise has recently received attention[13].

Patients with chronic cardiovascular illnesses and metabolic syndrome who underwent interval exercise training, which consists of high-intensity and low-intensity exercise bouts, saw an improvement in endothelium-dependent vasodilation[14].

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Progressive aerobic exercise -pyramidal training- is different from traditional aerobic exercise, very limited research on the effect of -pyramidal- training on lipid profile it was done on healthy adult in Iran. Therefore, the aim of this study was to investigate effect of pyramidal training exercise in management selected risk factor of atherosclerosis -insulin resistance and lipid profile- in women with central obesity.

Methods

Ethical approval from the faculty of physical therapy, Cairo University was obtained before the study by No (P.T.REC/012/004666). The study of technique and objectives were well understood by the patient and adhered to ethical guidelines. Written informed consent was acquired from every patient involved. Patients were classified as either included or excluded based on the following criteria Fifty women with central obesity, Waist circumference > 88 cm, their age was ranged from 30-40years old, Body mass index ranged from 30 to 34.9 kg/m2, High border line of lipid profile (total cholesterol > 200 mg/dl, HDL< 50 mg/dl, LDL >130mg/dL or triglycerides >150 mg/dl) and atherogenic index of plasma (AIP) ranges 0.11-0.2, HOMA-IR > 1.9. With 25 patients per group, the patients were split into two groups (Study group): 25 participants performed pyramidal training by treadmill for 40 minutes per session three sessions per week for eight weeks in addition to the diet health advices. (Control group): 25 participants performed diet health advices, for eight weeks. they had been recruited from Al Hayat specialized Hospital in Cairo and outpatient clinic of faculty of physical therapy, Cairo University, Egypt. Those with musculoskeletal problems, uncontrolled pulmonary disease, missed more than two weeks of the program or want to terminate the program, unstable angina, uncontrolled cardiac arrhythmia, decompensated heart failure, hearing impairment or mental disorders, implanted pacemaker. Diabetes and hypertension were excluded from the study. They received their training from august 2023 to November 2023.

Randomization:

The participants were randomly assigned into therapeutic group (n=25) and control group (n=25) by an independent person who was selected blindly from sealed envelopes containing numbers created by a random number generator. The randomization was restricted to permuted blocks to ensure that equal numbers were allocated to therapeutic group and control group. The sequences assigned to the participants were placed in enveloped containing the allocation to each group. The aim and procedures of the study were informed to eligible patients

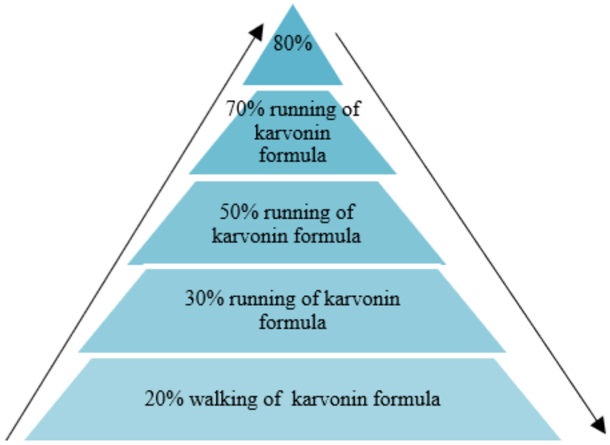
Measures and Procedure:

A standard height and weight scale in addition to tape measurements was utilized to measure the subjects' height, weight, waist size, along with hip ratio. Over eight weeks, participants engaged in pyramidal training (progressive aerobic) three times a week for twenty minutes a session, with 10 minutes of active recovery in between sets of exercises for an overall duration of forty minutes of cardio at an intensity level ranging from twenty to eighty percent. Participants' target heart rates were measured across five sets of progressive and regressive aerobic exercise, with each set consisting of two minutes on a treadmill. Each the individual's target heart rate was managed utilizing a pulse oximeter (Model LOX100A, manufactured in China) according to the Karvonen Heart Rate formula (Figure 1).

Each session consists of a 5-minute warming up, the main exercise (figure 1), and a 5-minute cooling down with stretch. Time or a predetermined percentage of the Karvonen formula determined which level the therapist moved to next. Blood sampling was conducted 48 hours before the first training session and 48 hours after the last training session. Participants were instructed to stop eating for at least eight hours prior to the blood sample. To control sampling time 5 ml of blood were collected in tubes for lipid profile and insulin fasting test without anticoagulant, but glucose fasting tube on sodium fluoride. Blood then centrifuged by centrifugation (2000 rpm speed for 5 min). samples were stores at -80 degrees freezers.

A glucose-oxidase technique was used to measure the plasma glucose level. An enzyme-linked immunosorbent test (ELISA) was used to measure the amount of insulin in the blood after fasting. Homeostatic Model Assessment for Insulin Resistance was determined by dividing fasting insulin by 22.5, which is equal to fasting blood glucose (in mmol/L). 15 A device developed in India called the Mispa-Viva Biochemistry

Analyzer was used to measure the concentrations of TC, TG, as well as HDL-C in the plasma. To determine LDL-C, the Friedewald formula was used, which is as follows: LDL-C (mg/dL) = TC - (HDL-C + TG / 5). Participants was asked to get on the treadmill and start the program, the therapist was monitoring the heart rate by using a pulse oximetry, and when the participants reached targeted percent of Karvonen formula, the therapist set the treadmill by increasing the speed to enter or start the up next level till reaching the highest level then start the decremental phase of the pyramidal training. The therapist shifted between the level by time or targeted percent of Karvonen formula which came first. The therapist had to end the session immediately if the participants complain of exertional symptoms as chest pain, cyanosis and Dizziness, mental confusion or coordination loss.



Statistical analysis:

Data were checked for tests of normality as well as homogeneity of variance. After identifying and removing outliers utilizing box and whiskers plots, the data was found to be normally distributed (P>0.05) according to a Shapiro-Wilk test for data normality. There was also no statistically significant difference (P>0.05) when tested for homogeneity of variance using Levene's test. Parametric as well as non-parametric analyses were both employed by these results. Parametric analysis is performed on normally distributed data. Software developed by SPSS, Inc. of Chicago, IL, USA, version 25 for Windows, was utilized to do the statistical analysis.

The statistical data for women is presented as the mean with standard deviation. This includes demographic data such as age, weight, height, as well as body measurements including BMI, waist circumference, in addition to waist hip ratio. Laboratory tests include total cholesterol, HDL-C, LDL-C, TG, atherogenic index of plasma, as well as HOMA IR. Mixed design 2 x 2 Multivariate analysis of variance (MANOVA) test was utilized for the 1st independent variable (among subject factors) was the tested group using two levels (study group vs. control group) and the 2nd independent variable (within subject factor) was measurement periods using two levels (pre-intervention vs. post-intervention) with the main dependent variables were the body and laboratory measurements. At the probability level (P < 0.05), every statistical analysis was concluded to be significant.

Results

In the present study, an overall of 50 women with central obesity were participated and randomized into two equal groups. The findings of clinical general demographic data as represented in (Table 1) revealed that no significant differences (P>0.05) in mean values of patients age (P=0.342), weight (P=0.256), height (P=0.378), and BMI (P=0.067) between the two groups.

Table 1. Clinical general characteristics for participant's women in both groups

Items	Groups (Mean ±SD)		*P*-value
	Therapeutic group (n=25)	Control group (n=25)	
Age (year)	34.84 ±3.55	35.80 ±3.54	0.342
Weight (kg)	85.62 ±6.10	83.88 ±7.74	0.256
Height (cm)	158.52 ±3.90	159.84 ±4.25	0.378
BMI (kg/m^2)	34.06 ±1.92	32.83 ±2.78	0.067

Data are reported as mean ±standard deviation. P-value: probability value , P-value > 0.05: non-significant

Statistical multiple pairwise comparisons for body measurement variables within each group as represented in (Table 2) revealed significant decline in weight (P=0.0001), BMI (P=0.0001), waist circumference (P=0.0001), and waist hip ratio (P=0.0001) after treatment within therapeutic group. However, in control group, no significant difference in weight (P=0.165), BMI (P=0.110), and waist circumference (P=0.130), while a significant difference was detected (P<0.05) in waist hip ratio (P=0.024) after treatment. These significant changes are in favor of the therapeutic group.

Statistical multiple pairwise comparison tests for body measurement variables (weight, BMI, waist circumference, as well as waist hip ratio) among both groups as represented in (Table 2) revealed that no significant differences (P>0.05) at pre-treatment in weight (P=0.378), BMI (P=0.067), waist circumference (P=0.064), and waist hip ratio (P=0.147). At post-intervention, there were significant difference (P<0.05) in weight (P=0.047), waist circumference (P=0.0001), and waist hip ratio (P=0.0001), while no significant differences (P>0.05) in BMI (P=0.121) among therapeutic group and control group.

Statistical multiple pairwise comparison tests for laboratory measurement variables (total cholesterol, HDL, LDL, triglycerides, AIP, as well as HOMA IR) within each group as represented in (Table 3) revealed that there were significantly (P<0.05) decreased in total cholesterol (P=0.0001), LDL (P=0.0001), triglycerides (P=0.0001), AIP (P=0.0001), and HOMA IR (P=0.0001) at after treatment compared to before-treatment within therapeutic group. Also, in control group, there a significant decline (P<0.05) in total cholesterol (P=0.003), LDL (P=0.0001), triglycerides (P=0.0002), and AIP (P=0.007) at after treatment compared to before-treatment. A significant (P<0.05) rise in HDL at after treatment within therapeutic group (P=0.0001) as well as control group (P=0.0001). While, no significant difference (P>0.05) in HOMA IR at post-intervention (P=0.411) within control group. These significant decreased in laboratory measurements are favor of therapeutic group than control group. Moreover, the women with central obesity received pyramidal training as well as the diet health advices program (therapeutic group) improved higher total cholesterol (20.03%), HDL (24.80%), LDL (29.65%), triglycerides (36.24%), AIP (47.79%), and HOMA IR (56.09%) than central obese women in control group who received diet health advices program (7.42, 13.29, 23.03, 6.14, 22.08, and 5.38%, respectively).

Statistical multiple pairwise comparison tests for body measurement variables (total cholesterol, HDL, LDL, triglycerides, AIP, and HOMA IR) between both groups as represented in (Table 3) indicated that no significant differences (P>0.05) at before-treatment in total cholesterol (P=0.910), LDL (P=0.053), HDL (P=0.844), triglycerides (P=0.885), AIP (P=0.737), and HOMA IR (P=0.872). At post-intervention, there were significant difference (P<0.05) in total cholesterol (P=0.0001), triglycerides (P=0.0001), AIP (P=0.001), and HOMA IR (P=0.0001), while no significant differences (P>0.05) in HDL (P=0.116) and LDL (P=0.130) between therapeutic group as well as control group.

Table 2: Within as well as between groups comparison for body measurements

Variables	Items	Groups (Mean ±SD)		Change	*P*-value
		Therapeutic group (n=25)	Control group (n=25)		
Weight	Pre-intervention	85.62 ±6.10	83.88 ±7.74	1.74	0.378
	Post-intervention	77.32 ±5.32	81.12 ±8.33	3.80	0.047*
	Change (MD)	8.30	2.76		
	Improvement %	9.69%	3.29%		
	95% CI	4.38 – 12.22	-1.15 – 6.67		
	P-value	0.0001*	0.165		
Body mass inde (BMI)	Pre-intervention	34.06 ±1.92	32.83 ±2.78	1.23	0.067
	Post-intervention	30.72 ±1.07	31.76 ±3.04	1.04	0.121
	Change (MD)	3.34	1.07		
	Change %	9.81%	3.26%		
	95% CI	2.01 – 4.64	-0.24 – 2.38		
	P-value	0.0001*	0.110		
Waist circumference (WC)	Pre-intervention	102.16 ±4.59	105.52 ±4.57	3.36	0.064
	Post-intervention	90.20 ±3.04	103.72 ±4.27	13.52	0.0001*
	Change (MD)	11.96	1.80		
	Change %	11.71%	1.71%		
	95% CI	9.61 – 14.30	-0.54 – 4.14		
	P-value	0.0001*	0.130		

Waist hip ratio (WHR)	Pre-intervention	0.887 ±0.027	0.906 ±0.015	0.018	0.147
	Post-intervention	0.834 ±0.008	0.894 ±0.014	0.061	0.0001*
	Change (MD)	0.053	0.011		
	Change %	5.98%	1.32%		
	95% CI	0.044 – 0.064	0.002 – 0.021		
	P-value	0.0001*	0.024*		

Data are reported as mean ± standard deviation (SD), MD: Mean difference
CI: confidence interval P-value: probability value * Significant (P<0.05)

Table 3: Within and between groups comparison for laboratory measurements

Variables	Items	Groups (Mean ±SD)		Change	*P*-value
		Therapeutic group (n=25)	Control group (n=25)		
Total cholesterol (TC)	Pre-intervention	215.64 ±26.44	215.04 ±17.36	0.60	0.910
	Post-intervention	172.44 ±17.16	199.08 ±10.02	26.64	0.0001*
	Change (MD)	43.20	15.96		
	Improvement %	20.03%	7.42%		
	95% CI	32.71 – 53.68	5.47 – 26.44		
	P-value	0.0001*	0.003*		
High density lipoprotein (HDL)	Pre-intervention	39.20 ±4.64	41.52 ±3.50	2.32	0.053
	Post-intervention	48.92 ±3.05	47.04 ±5.21	1.88	0.116
	Change (MD)	9.72	5.52		
	Change %	24.80%	13.29%		
	95% CI	7.36 – 12.07	3.16 – 7.87		
	P-value	0.0001*	0.0001*		
Low density lipoprotein (LDL)	Pre-intervention	150.64 ±27.21	152.06 ±34.36	1.42	0.844
	Post-intervention	105.98 ±15.90	117.04 ±20.97	11.06	0.130
	Change (MD)	44.66	35.02		
	Change %	29.65%	23.03%		
	95% CI	30.30 – 59.00	20.67 – 49.37		
	P-value	0.0001*	0.0001*		
Triglycerides (TG)	Pre-intervention	124.64 ±49.59	126.36 ±46.81	1.72	0.885
	Post-intervention	88.40 ±20.27	118.60 ±44.58	30.20	0.0001*
	Change (MD)	36.24	7.76		
	Change %	36.24%	6.14%		
	95% CI	12.66 – 59.81	1.58 – 13.94		
	P-value	0.0001*	0.002*		
Athentogenic index of plasma (AIP)	Pre-intervention	0.475 ±0.193	0.462 ±0.122	0.013	0.737
	Post-intervention	0.248 ±0.097	0.360 ±0.190	0.112	0.001*
	Change (MD)	0.227	0.102		
	Change %	47.79%	22.08%		
	95% CI	0.151 – 0.303	-0.010 – 0.214		
	P-value	0.013	0.112		
HOMA IR	Pre-intervention	3.94 ±0.91	3.90 ±1.31	0.04	0.872
	Post-intervention	1.73 ±0.58	3.69 ±0.42	1.96	0.0001*
	Change (MD)	2.21	0.21		
	Change %	56.09%	5.38%		
	95% CI	1.71 – 2.70	-0.28 – 0.69		
	P-value	0.0001*	0.411		

Data are reported as mean ± standard deviation (SD)
MD: Mean difference CI: confidence interval P-value: probability value * Significant (P<0.05)

Discussion

Several studies have demonstrated that aerobic exercise improves body composition as well as lipid profiles by decreasing acyl-CoA production, an enzyme critical for fat storage in adipose tissue[16]. Aerobic training is associated with enhancements in the energy system that relies on oxidative metabolism, as well as improvements in the type of muscle fibers, metabolic capability, as well as cardiorespiratory fitness[17].

In both older and younger patients, varying the intensity of aerobic training contributed to a significant decrease in myonectin levels, insulin resistance, adiponectin alterations, and maximum oxygen consumption[18]. In the study was done to assess the impact of aerobic exercise at three different intensities on the body weight as well as body fat of obese patients. The findings revealed that performing higher intensity exercise and expending more energy can contribute to significant decline in body weight, body fat, waist circumference, along with waist-hip ratio[19].

O'Brien et al. (2016) found that engaging in regular aerobic exercise, either continuously or in intervals, or using a combination of aerobic exercise as well as progressive resistive exercise, 3 sessions a week for a minimum of five weeks, is both safe and effective in improving various outcomes including cardiorespiratory Fitness (measured by maximum oxygen consumption along with exercise time), body composition (such as lean body mass, percentage body fat, along with leg muscle area), and psychological well-being (like quality of life as well as symptoms of depression and sadness) [20].

Consistent moderate-to-vigorous aerobic training for an extended period of time led to significant weight loss, waist circumference decreases, and decline in subcutaneous and visceral adiposity in in comparison with a non-exercising group. Activity energy consumption rises during aerobic exercise, which explains its impact on anthropometric results.[21]

Progressive aerobic training promoted significant enhancement in WC, fasting glucose, HDL-C, TG as well as diastolic blood pressure in middle-aged and older adults.[22] The study of Mann et al., (2014)[23] stated that High-intensity aerobic exercise can improve lipid profiles by lowering the risk of cardiovascular problems including heart attacks, strokes, as well as coronary artery disease by clearing plasma LDL-C and TG.

The study of Lakhdar et al., (2019)[24] was done to examine the impact of diet combined with chronic aerobic exercise on adipose tissue in obese women, demonstrated that, in this study, the authors found that a combination of an aerobic training program and a healthy diet significantly improved the body composition, insulin resistance, as well as lipid profiles of obese women. Additionally, the program reduced chemerin levels, which are related with insulin resistance.

Sixty woman obese having metabolic syndrome were randomized into four groups of equivalent number: aerobic exercise, resistance exercise, combined exercise in addition to control were divided randomly into 4 treatment as well as control groups, the treatment group underwent aerobic training showed difference in anthropometric indicators following 8 weeks of training. Additionally, fasting serum glucose as well as insulin resistance index were improved.[25]

Mezghani et al., (2022)[26]who discovered that aerobic training with moderate, high, or alternating intensities improved body composition, physiological variables, muscle adaptations, as well as insulin resistance, with the greatest gains in the areas of mass and BMI.

According to Antunes et al., (2020)[27]acute aerobic exercise sessions can modify atherogenic as well as anti-

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atherogenic markers, with high intensity training having the greatest impact.

The research conducted by Mezghanni et al., (2012)[28] examined the impact of exercise training intensity upon body composition, lipid profile, as well as insulin resistance among middle-aged obese women. The study found that aerobic exercise training either on moderate or high intensities promotes weight reduction and declines total fat mass. Specifically, the training program beginning at 50% of Heart Rate Reserve resulted in a substantial decline of LDL-C and an enhancement in insulin status that accompanied weight loss, total fat, and WC. Body mass in addition to total fat were significantly reduced by the training program at 75% HRR compared to the one at 50% HRR.

Ghanbari., (2007)[29] who discovered that participating in interval progressive (pyramidal) aerobic training over 14 weeks significantly reduced serum TG and Very Low-Density Lipoprotein Cholestrol concentrations as well as TC/HDL-C and LDL/HDL-C ratios, while significantly increasing serum HDL-C levels. Results currently show that the training program improved cardiovascular indices without significantly affecting TC or LDL-C levels, suggesting that it altered lipid as well as lipoprotein metabolism.

Moreover, the outcome of our study came in accordance with Ghanbari-Niaki et al., (2013)[30] who examined the impact of pyramidal training on plasma lipid profile of sedentary participant. They found that when comparing the training group to the control group, there was a statistically significant reduction in total cholesterol, LDL density, in addition to blood viscosity.

Studies contradict the present study results. There was no improvement significantly in blood lipids on obese women after moderate-intensity aerobic exercise program was applied for duration of 3 days a week for eight weeks to the exercise group was performed by Hazar et al., (2021)[31]

Esmail Alamdari et al., (2016)[32] found that eight-week aerobic exercise with intensity of 60-70% of the heart rate reserve and frequency was 3 sessions per week on obese women did not affect glucose concentration, insulin Resistance, interleukin-6 serum, fat percentage, waist to hip ratio and BMI.

Taghian et al., (2014)[33] After 12-week aerobic exercises the cholesterol level, LDL-C and glucose did not have any significant changes. The experimental group received aerobic exercises for a period of 12 weeks each three sessions on treadmill workout. The treadmill speed was based on a 60-65 and 80-85 maximal heart rate percentage and duration of 15-20 and 45-50 minutes, at the beginning and the end of exercise.

In this study (pyramidal training) was done on central obese women which had risk factor of atherosclerosis to assess the impact of pyramidal training on anthropometric measurement (BMI, waist circumference and waist hip ratio) and laboratory variables (lipid profile and HOMA IR). which is not discussed in previous studies

Strengths and limitations of the study:

Women who are centrally obese and at high risk for atherosclerosis were the primary subjects of the study. This population may benefit from a preventative approach that combines health dietary recommendations with progressive aerobic exercise, such as stair climbing, to reduce dyslipidemia and insulin resistance. Based on our research, pyramidal training may help reduce the risk of atherosclerosis as well as vascular disease in high-risk individuals.

Some limitations must be considered. We recommend additional studies with more assessment tools, extended duration and another fixed monitor of heart rate instead of pulse oximeter because it is exposed to displace during exercise and the study's limited sample size, which was restricted to specific risk factor of atherosclerosis in central obese women

Conclusion

It was concluded from this study that (pyramidal) aerobic training has an effect on the improvement of body composition, lipid profile in addition to insulin resistance in central obese woman, so we recommended pyramidal training in addition to diet health advices as an integral intervention for selected risk factor in central obese woman.

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Data Availability Statement: Data is available from corresponding author upon reasonable request.

Conflicts of Interest: None.

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