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Comparison between the Effect of Endurance and Strengthening Exercises on Plasma Lipoprotein in Central Obese Female Subjects.

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ABSTRACT

Obesity is associated with disorders such as hypertension, diabetes, hypercholesterolemia, and liver disease. In comparison with endurance training, less information exists to support resistance training as a modifier of plasma lipids. Studies were often contradictory, with some showing positive benefits of resistance exercise on the lipid profile and others finding no benefits. The present study served to compare the effects of endurance and strengthening exercise training on female central obesity lipid profile. Pretest- posttest design, forty subjects were in included in this study. They were divided equally into two experimental groups, first group performed endurance exercise while the second group performed the strengthening exercise. Each subject in the study was instructed to maintain his usual activities during the experimental period. The program in each group was continued for 8 weeks (three sessions per week); plasma lipoproteins were measured before and after the exercise program for both groups. The dependent paired t-test was utilized to determine the within group changes from pre- to post-test. The independent unpaired t-test was utilized to determine the between-group changes from pre- to post-test. The dependent paired t-test revealed that there were significant reductions of total cholesterol, triglyceride, in both groups while there were a significant reduction of HDL, and LDL in endurance exercise group only. The unpaired t test for pre exercise measurements revealed that there were no significant difference in total cholesterol, triglyceride ,HDL, and LDL, While for post exercise measurements revealed that there were no significant difference in total cholesterol, triglyceride, but there were significant reduction of HDL, and LDL in endurance exercise group only. The endurance exercises are more effective than strengthening exercises by decreasing total cholesterol, triglyceride, and increasing HDL-cholesterol.

Keywords: Endurance exercise, Strengthening exercise, Plasma lipoprotein, Central obesity.

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INTRODUCTION

While it is clear that obesity increases risk to a number of life threatening diseases, the link to mortality is less clear. In this regard, throughout the history of medicine, the connection between obesity and mortality has been of considerable interest and debate. Suboptimal levels of lipids and lipoproteins represent a major risk factor for cardiovascular disease (CVD) [1, 2.]

However, many studies investigate the effects of endurance exercise on lipids and lipoproteins in adults with CVD have yielded conflicting results, possibly due to differences in initial lipid and lipoprotein levels, exercise program characteristics, duration of the intervention, or other confounding variables (eg, concomitant dietary and/or medication-induced changes) [3].

Although the strengthening exercise increase the free fat mass and reduce the fat mass , it can decrease the high density lipoprotein (HDL) only and has no effect on the other component of lipid profile [4].

The literature review reveal that there is no sufficient studies compared between the effect of endurance versus strengthening exercise program on plasma lipoprotein on obese person. So the present study serves to compare the effects of endurance and strengthening exercise training on female central obesity.

MATERIAL AND METHODS

This study was conducted in physical therapy department in the out clinic of the Faculty of physical therapy of the Cairo university to compare the effect of endurance and strengthening exercise training on plasma lipoprotein in female obesity.

Design of the study

Pretest- Posttest design; Forty volunteer women with central obesity and BMI>30 were participate in this study. They were randomly divided into two groups.

The first experimental group(A): Endurance exercise group consist of 20 obese subjects . They enrolled in day after day endurance exercise program on bicycle ergometer and tread meal in addition to static abdominal exercise for 2months in addition to low lipid diet.

*The second experimental group(B):*Strengthening exercise group consist of 20 obese subjects. They enrolled in day after day strengthening exercise in the form of eight different exercise :military press, leg extension, bench press , standing leg curl(ankle weight), lateral pull down, dumbbell triceps push down, dumbbell seated biceps curl, and sit up(abdominal curls)for 2 months in addition to low lipid diet.

Selection of the subjects

Forty obese female subjects were selected randomly from the physiotherapy department outpatient clinic in faculty of physical therapy- Cairo University .*Inclusion criteria* :Key inclusion criteria were as follows: the Subjects age were 25-40 years of old. Subjects' serum cholesterol level were less than 300mg /dl. Subjects ' body mass index(BMI) ? 30 kg/m^2 and ≤35Kg/m^2.All subjects were instructed to maintain their typical diet and activity pattern throughout the study, and compliance with this instruction was assessed via food frequency and physicalactivity questionnaires administered at the beginning and at the end of the study. Exclusive criteria: Subjects with serum cholesterol level more than 300mg/dl. Pregnant women. Smoking women. Subject with any uncontrolled condition (pulmonary disease, diabetes mellitus, hypertensive, cardiovascular disease).Patient with hemorrhagic disease.

Equipment and tools

(A*)Evaluation equipment and tools:* Tape measurement: to measure the abdominal and hip circumference in cm. Body weight and height scale: Health made in china. It was used to measure the subject's

weight and height to calculate the BMI according to the formula:

BMI= body weight in Kilogram /height in meter squared.

(B)*Training equipment: Bicycle ergometer*: Stationary bicycle ergometer manufactured by Enraf-Nonius international. Trade meal :manufactured by Enraf-Nonius international. Free weight: for strengthening exercise.

PROCEDURES

The study procedures were carried out at Outpatient Clinic of the faculty of physical therapy, Cairo University, Egypt. Evaluation Procedures: After the subjects were carefully chosen, all of the subjects underwent several evaluation steps including.

Preliminary Assessment

It was undertaken by a physical therapist. Careful history was taken for any pervious chest diseases, any old fractures or traumatic insults and any neurological problem that may cause pain during the exercise. Resting Blood Pressure (RBP) and Resting Heart rate (RHR):Each subject's (RBP) and(RHR) were measured in supine(after five minute of resting) and seated (after five minute) position , any subject with hypertension(i.e.>140/90) or hypotension (i.e.<80/40) was excluded from the study. Each subject's arterial BP was measured with a Mercury sphygmomanometer (speidel ,Keller ,minia Tur 300, Germany).The mercury column was positioned at the same level as the subject's heart level during the monitoring . the left arm of each subject was supported utilized throughout the investigation. The Anthropometric measures: A calibrated medical scale (Health made in china) was used to weigh subjects in kilograms (kg) (to the nearest 0.1 kg). Each subject's stature was measured in centimeters (cm) (to the nearest 0.5cm). Then BMI was calculated to select subjects with BMI from 30 to 35 kg/m^2 [5].

Calculation of BMI: BMI= weight (kg) / height (m^2).

Blood collection protocol

Twelve-hour fasting blood samples were collected on the mornings of days 0, 53, 54, and 55 of the trial. Blood was centrifuged for 15 min at 520 x *g* and 4 °C to separate plasma from red blood cells and was stored at –20 °C until analyzed [6].

Plasma total cholesterol, HDL cholesterol, LDL cholesterol and triacylglycerol concentration were measured by a bio chemistry physician in a qualified chemical lab.

Blood analyses

Plasma total cholesterol, HDL-cholesterol ,and triglyceride concentrations were measured in duplicate with the use of enzymatickits, standardized reagents, and standards with the use of a VP Autoanalyzer (Abbott Laboratories, North Chicago, IL). LDL-cholesterol concentrations were calculated with the use of the Friedwald equation. The within-run CVs were 2.1% for total cholesterol concentrations, 1.9% for HDL-cholesterol concentrations, and3.2% for triglyceride concentrations [7].

Training Procedure

Procedure of group A: Endurance Training Exercise prescription: Bicycle ergo meter treatment protocol: the exercise was carried out at the morning for all subjects. All of the subject received full explanation of the purpose of the treatment, the therapeutic and physiological benefits of this method of treatment. Before starting the treatment, all the previous measurement of each patient in this group were taken for a comparison. The patient sit on stationary bicycle ergo meter with his back in relaxed position, before the exercise the limit of each subject tolerance should be assessed by exercise test, which was composed of 3 minutes control period of unloaded pedaling, followed by an incremental ramp on a cycle ergo meter at a rate of 10 W / Minute to the limit of subjects tolerance [8].Then the subject cycled at 30 W for warming up and then

the intensity was increased every 60 seconds by 15 W until exhaustion, then the cycled at 30 W for cooling down. The frequency of this treatment for each subject was 3session per week every other day for two months.

Trade meal treatment protocol

This exercise was carried out at the morning for all subjects. All of the subject received full explanation of the purpose of the treatment, the therapeutic and physiological benefits of this method of treatment. Before starting the treatment , all the previous measurement of each patient in this group were taken for a comparison. The patient stand on stationary trade meal with his back in relaxed position, before the exercise the limit of each subject tolerance should be assessed by exercise test, which was composed of 3 minutes control period of unloaded pedaling, followed by an incremental ramp on a trade meal at a rate of 10 W / Minute to the limit of subjects tolerance. Then the subject walk at 30 W for warming up and then the intensity was increased every 60 seconds by 15 W until exhaustion, then the cycled at 30 W for cooling down .The frequency of this treatment for each subject was 3session per week every other day for two months [9].

Treatment procedure of group B: Resistance Training Exercise Prescription: Type: resistance exercise (RT) in the form of eight different exercises performed during each workout :military press, leg extension, bench press, standing leg curl (ankle weights),lateral pull-down, dumbbell triceps push-down, dumbbell seated biceps curl, and sit-ups (abdominal curls. Intensity: moderate defined as 60% to 70% of 1 RM (maximum repetition) for upper body exercise sand 70% to 80% of 1 RM for lower body exercises. However, it appears that the impact of progressive resistance training on muscle mass and muscle strength in both young and older individuals is more pronounced if higher training intensities (70 and 90% of the one-repetition maximum strength[1-RM]) are used [5] .Frequency: Most studies report that RT 3 days per week elicits superior strength gains when compared with training regimens of lower frequency. Duration: eight-week period [10.]

Weekly Training Sessions

In accordance with this trend, the present study necessitated that the exercising subjects train three times per week (non-consecutively) over the eight-week period. This gave rise to a total of 24 training sessions required per an exercise group subject Warming up: Several authors have emphasized the necessity of an adequate warm- up prior to moderate or strenuous activity. Subjects performed a brief warm-up consisting of static stretching for five min. before each training session Active phase: Eight different exercises were performed during each workout: military press, leg extension, bench press, standing leg curl (ankle weights),lateral pull-down, dumbbell triceps push-down, dumbbell seated biceps curl, and sit-ups (abdominal curls) [11].

All subjects were required to perform each repetition in a slow, controlled manner, with a rest of (90–120) s between sets. Three sets of (8–10) repetitions will be performed for all exercises at each training session. All sessions were supervised to ensure correct technique and to monitor the appropriate amount of exercise and rest intervals. Training workload was increased regularly as tolerated for each muscle group after subjects successfully achieved three sets of 10 repetitions with appropriate technique [5].

However, it appears that the impact of progressiver esistance training on muscle mass and muscle strength in both young and older individuals is more pronounced if higher training intensities (70 and 90% of the one-repetition maximum strength[1-RM]) are used [11].

During the first and second weeks of training, the resistance was set at 50–60% of each individual's 1-RM. The1-RM was defined as the maximum amount of resistance that could be moved through the full range of motion of an exercise for no more than one repetition ,thereafter, the goal will be to achieve between 75 and 85% of the current 1-RM. Subjects followed an individually monitored progressive resistance training program using free weights and a multiple-station weight machine ,subjects trained with a partner and all training sessions were carefully supervised by the investigators. Each subject was encouraged to perform each set and repetition with utmost effort. The exercise performed, the sets and repetitions completed, and the average amount of weight lifted were recorded for every exercise session [5].

Cooling down: Each study group subject had to conclude each of their exercise sessions with static stretching for five min. after each training session.

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Statistical procedure

The dependent paired t-test was utilized to determine the within group changes from pre- to post-test. The independent un paired t-test was utilized to determine the between-group changes from pre- to post-test.

- Subjects characteristics. The subjects were divided into 2 groups: Group (A) consisted of 20 subjects received endurance exercise.
- Group (B) consisted of 20 subjects received resisted exercise.

1-As shown in (figure 1) the mean, standard deviation, maximum minimum of age, weight, and height of the two different groups. The endurance exercise group, their age ranged from 25 to 40 years with means of (35.9±3.059)years the height ranged from 159 cm, to 175 cm, with a mean of (167.9 ± 5.3 cm), weight ranged from 78 to 95 kg, with means of (87.3 ± 5.8 kg) and BMI ranged from 30. kg/m^2, to 34.9 kg/m^2, with means of (32.25 ± 1.34 kg/m^2). While the resisted exercise group, their age ranged from 25 to 40 years with means of 34.4 ± 3.3 years the height ranged from 156 cm, to 183 cm, with a mean of 168.6 ± 9.3 cm, weight ranged from 69 kg, to 97 kg, with means of (88.1 ± 9.3 kg) and BMI ranged from 30.1 kg/m^2, to 34.5 kg/m^2, with means of (33.4 ± 2.7 kg/m^2) .

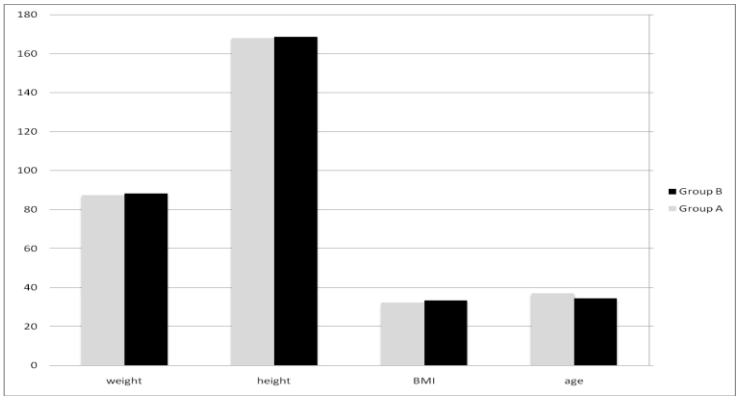

Figure 1. shows the mean of the age, BMI, weight and height of the 2 different groups

2-Change in total cholesterol: As shown in (Figure 2) the Endurance Exercise group have mean and standard deviation of (222.6 ± 27.7) in pre exercise and mean and standard deviation of (187.5 ± 24.9) in post exercise, with t -Value of 18.32 and P. Value<0.001. So there was significant reduction in total cholesterol level in pre and post exercise for endurance exercise group, on the other hand, the statistical analysis for TC in the Resisted Exercise group have mean and standard deviation of (217.5 ± 21.1) in pre exercise and mean and standard deviation of 209.8 ± 21.3 in post exercise, with t-Value of 16.1 and with P. Value<0.001. So there was significant reduction in total cholesterol level in pre and post exercise for resisted exercise group. While the unpaired t test between the both group revealed that the t value was 0.92 for pre exercise measurements and 4.3 for post exercise measurements with p value 0.35 and <0.001 respectively , so there was no significant difference between the both group for pre exercise measurement but there was significant reduction in total cholesterol level in the post exercise measurement for the both group

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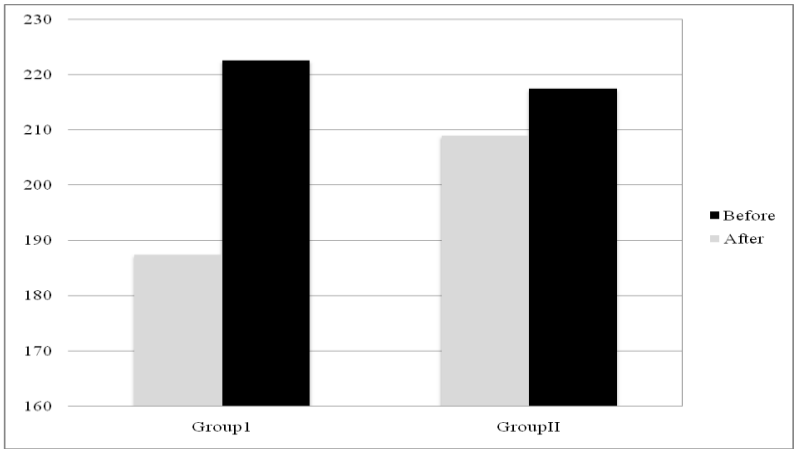

Figure 2. Total cholesterol between both groups before and after the exercise program.

3-Change in triglyceride level: As shown in(Figure 3) the Endurance Exercise group have mean and standard deviation of 169.2 $\pm$ 30.7 in pre exercise measurement, with mean and standard deviation of (122.3 $\pm$ 28.1) in post exercise, with t-Value of 30.2 and P. Value<0.001. So there was significant reduction in triglyceride level in post exercise measurement for endurance exercise group. On the other hand, the statistical analysis for triglyceride level in the Resisted Exercise group have mean and standard deviation of (159.4 $\pm$ 40.4) in pre exercise and mean and standard deviation of(153.5 $\pm$ 37.2) in post exercise, with paired t-Value of 5.98 and with P Value of <0.001. So there was significant reduction in triglyceride level in post exercise measurement for resisted exercise group. While the unpaired t test between the both group revealed that the t value was 1.22 for pre exercise measurements and 4.2 for post exercise measurements with p value of 0.22 and <0.001 respectively , so there was no significant difference between the both group for pre exercise measurement but there was significant reduction in triglyceride level in the post exercise measurement for endurance exercise program.

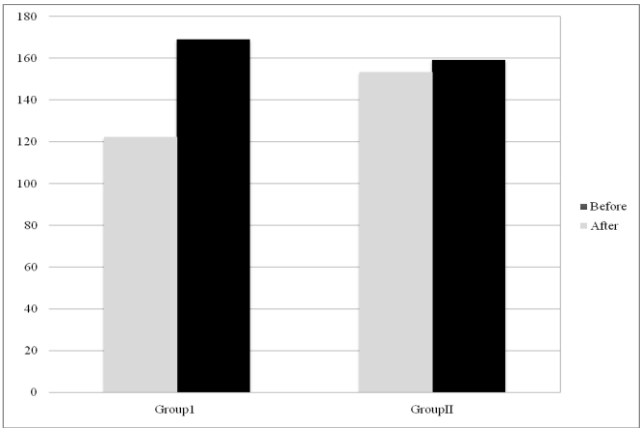

Figure 3. The triglyceride level between both groups before and after the exercise program.

4-Change in HDL: As shown in (Figure 4) the Endurance Exercise group have mean and standard deviation of (52.2 $\pm$ 6.1) in pre exercise and mean and standard deviation of(58 $\pm$ 7) in post exercise, with t -Value of 8.43 and P Value <0.001. So there was significant reduction in HDL level between pre and post exercise for endurance exercise group .On the other hand, the statistical analysis for triglyceride level in the Resisted Exercise group have mean and standard deviation of (50 $\pm$ 6.7) in pre exercise and mean and standard deviation of 48.9 $\pm$ 9.3 in post exercise, with t-Value of 1.31 and with P Value of 0.19. So there was no significant difference in HDL level between pre and post exercise for resisted exercise group, while the unpaired t test between the both group revealed that the t value was 1.55 for pre exercise measurements and 4.95 for post exercise measurements with p value of 0.12 and <0.001 respectively , so there was no significant difference between the both group for pre exercise measurement but there was significant reduction in HDL level in the post exercise measurement for endurance exercise group.

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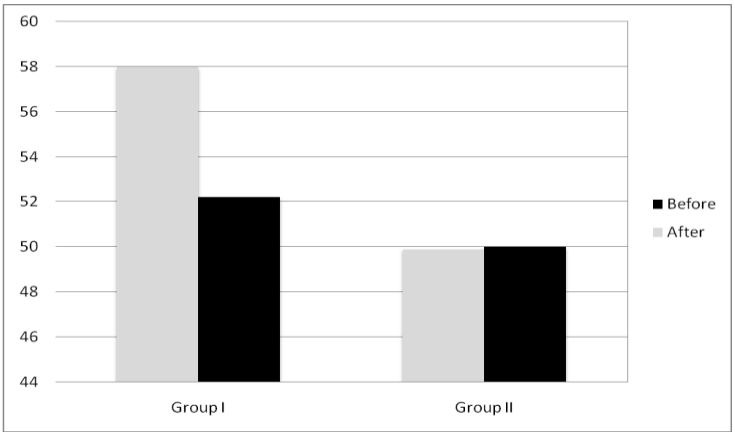

Figure 4. High density lipoprotein between both groups before and after the exercise program.

5-Change in LDL: As shown in (Figure 5) the Endurance Exercise group have mean and standard deviation of (140 $\pm$ 30.1) in pre exercise measurement and mean and standard deviation of (102.7 $\pm$ 11.4) in post exercise measurement, with t -Value of 12.02 and P. Value <0.001. So there was significant reduction in LDL level in post exercise for endurance exercise group .On the other hand, the statistical analysis for triglyceride level in the Resisted Exercise group have mean and standard deviation of (134.3 $\pm$ 23.6) in pre exercise and mean and standard deviation of (127.4 $\pm$ 24.5) in post exercise, with paired t-Value of 10.4 and with P Value of <0.001. So there was significant difference in LDL level between pre and post exercise for resisted exercise group .While the unpaired t test between the both groups revealed that the value of t was 0.94 for pre exercise measurements and 5.77 for post exercise measurements with p value of 0.34 and <0.001 respectively , so there was no significant difference between the both group for pre exercise measurements but there was significant reduction in LDL level for the post exercise measurement in endurance exercise group.

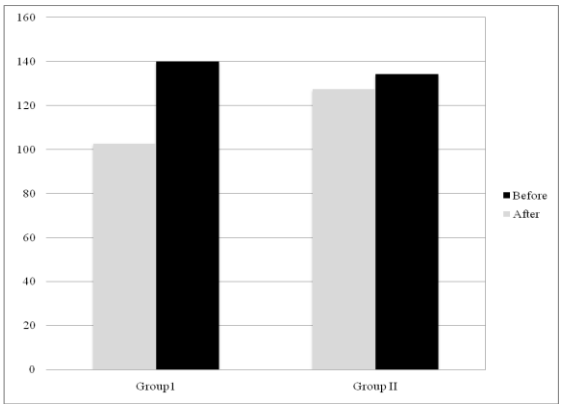

Figure 5. Shows low density lipoprotein between both groups before and after the exercise program.

RESULTS

The dependent paired t-test revealed that there were significant reductions of total cholesterol , triglyceride, in both groups while there were a significant reduction of HDL, and LDL in endurance exercise group only. The unpaired t test for pre exercise measurements revealed that there were no significant difference in total cholesterol, triglyceride ,HDL, and LDL, While for post exercise measurements revealed that there were no significant difference in total cholesterol, triglyceride, but there were significant reduction of HDL, and LDL in endurance exercise group only.

DISCUSSION

The main purpose of this study was to investigate the effect of the endurance exercise versus

strengthening exercise on plasma lipoproteins in central obese female subject. The measures in this study were plasma total cholesterol, triglyceride LDL - cholesterol and HDL- cholesterol concentrations. In the present study, it was found that a program of resistance exercise, 3 days per week, for 8 weeks led to a significant improvement in the plasma lipoproteins in sedentary middle-aged central obese female. Therefore, In comparison with endurance training, less information exists to support resistance training as a modifier of plasma lipids. Studies are often contradictory, with some showing positive benefits of resistance exercise on the lipid profile and others finding no benefits ,Others previous studies showing no improvement, little improvement and/or significant improvement in all or some lipoprotein- lipid profiles.[12]

In the present study, it was found there were a significant reduction of total cholesterol, triglyceride , in both groups while there were a significant reduction of LDL and increasing HDL in endurance exercise group only.

It is now fairly well recognized that endurance exercise training can increase plasma HDL cholesterol levels if the exercise training stimulus is sufficient [13,14]. Furthermore, several studies have suggested that the HDL-raising effect of endurance exercise training could be largely explained by the concomitant loss of body mass or fat[15, 16]. Therefore, among high-risk overweight dyslipidemic patients with insulin resistance, hyperinsulinemia, hypertriglyceridemia, and low HDL cholesterol levels, the net increase in the daily energy expenditure produced by regular endurance exercise may eventually induce mobilization of body fat and weight loss. In turn, this may ultimately reduce the amount of abdominal fat, improve insulin action, lower TG levels, and increase plasma HDL cholesterol concentrations[17]. These favorable metabolic improvements explain why regular endurance exercise of moderate intensity but of long duration is advocated for the management of obesity and of its related high TG/low HDL cholesterol dyslipidemia [15, 16].

However, low plasma HDL cholesterol is a heterogeneous condition. Apart from rare monogenic disorders, it is not uncommon to find individuals with low HDL cholesterol levels in the absence of abdominal obesity, insulin resistance, or hypertriglyceridemia. Finally, 2 additional points need to be emphasized. First, subjects with isolated low HDL cholesterol could still benefit from regular endurance exercise through metabolic adaptations that are beyond body mass control, insulin sensitivity, and plasma lipoprotein levels. Second, it is still controversial whether all patients with isolated low HDL cholesterol are at increased risk of CHD. It is not uncommon to find low HDL cholesterol levels among lean subjects on a low-fat intake who also have low plasma cholesterol and LDL cholesterol levels[18]. It is doubtful that this lipid profile is associated with a very high CHD risk. Further studies are needed to better characterize the isolated low HDL cholesterol phenotype from a metabolic and genetic standpoint. Other many studies report different results as there is no change in HDL cholesterol levels but favorable changes in TC, LDL cholesterol, and TRI after 6 months of aerobic exercise at 70% HR max [19,20], also another study reported no change in any variable except TRI after 6 months of AT [21]. The reason for the discrepancies in the result is unclear but may be related to the exercise intervention itself. There is some evidence that suggests that a reduction in cardiovascular risk is associated with both the intensity and the amount of endurance exercise [22]. The exercise intensity used in the present study was higher than that used with elderly women. The present study exercised young women for 60 minutes with higher exercise intensity.

The results of this present study found there were significant decrease in TC and TG in RT and no significant difference in HDL and LDL in RT. The results of this study come in contrast with the findings of several researchers who demonstrated non-significant changes in TC following a period of RT [5]. The various studies suggest that the duration of the exercise program is not a factor and demonstrated that after a single session of RT, TC did not change significantly and even small (insignificant) changes return to pre-exercise values 24 hours after exercise. In this regard , When the effect of a longer period of RT was investigated, It was found that 16 weeks of RT only brought about a 0.50% decrease in TC .

The results of this study support some studies have demonstrated decreased TG levels in their studies like [12]. In these studies, the various subjects' mean TG levels decreased of up to 40%. The results of this study come in contrast with other researchers found no significant changes in TG levels using a variety of RT intensities and durations ranging from 60-85% of 1-RM and from (8-20) weeks. Several researchers also demonstrated that RT had no statistically significant effect on TG in various groups of women [11].

The results of this study support the findings of other studies in women following a period RT, The

studies that have found favorable changes in LDL-C in women have demonstrated decreases of between 13.69% and 16.67% [23]. The results of other previous researchers, who employed RT in their studies ,In one of these studies, [11] reported non-significant decrease (2.6%) for LDL-C after eight weeks of supervised, low intensity resistance training (80% of 10 repetition maximum (10RM)) in twenty five sedentary volunteered sedentary postmenopausal women.

In the present study no significant effects for HDL-C levels which comes in contrast with the findings of other researchers. Observed raised HDL-C concentrations in hormone depleted postmenopausal women after a 16 week Dynaband resistance exercise program [24]. Results of this study come in agreement with the findings of several researchers who demonstrated There were no significant effects (1%) for HDL-C after eight weeks of supervised, low intensity resistance training (80% of 10 repetition maximum (10RM)) in twenty five sedentary volunteered sedentary postmenopausal women [11].

CONCLUSION

Endurance exercise leads to improve plasmalipoprotain profile more than strengthening ex because endurance exercises lead to lower TC , TG , LDL and increase HDL while strengthening exercises decrease TC , TG,LDL and has no effect on HDL. The data obtained in the present investigation revealed statistically that endurance exercises are more significant than strengthening exercises by decreasing total cholesterol, triglyceride, and increasing HDL-cholesterol.

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