Original Research

Reducing Diet and/or Exercise Training Decreases the Lipid and Lipoprotein Risk Factors of Moderately Obese Women

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Key words: obese, diet, lipid, lipoprotein

Objective: This study was designed to measure the influence of diet, exercise or both on serum lipids and lipoproteins in obese women.

Methods: Obese subjects were randomly divided into one of four groups: diet alone (1,200–1,300 kcal/day, NCEP, Step I), exercise alone (five 45 minute sessions per week at 78.4 ± 0.5% maximum heart rate), exercise and diet, and controls. Maximal aerobic power, body composition, diet, serum lipids and lipoproteins were measured in all subjects at baseline and after a 12-week intervention period. Subjects included 91 moderately obese (45.6 ± 1.1 y, body mass index 33.1 ± 0.6 kg/m^2) and 30 nonobese (43.2 ± 2.3 y, body mass index 21.4 ± 0.34 kg/m^2) women who were recruited from the surrounding community. Independent *t* tests were used to compare obese and nonobese subjects at baseline. The 12-week intervention data from the obese groups were analyzed using a 4 × 2 repeated measures ANOVA design.

Results: Cross-sectional comparisons at baseline showed obese subjects had significantly higher total cholesterol, triacylglycerol, total cholesterol/HDL-C and LDL-C values and lower HDL-C values. Prospective results showed that subjects in diet and exercise and diet lost 7.8 ± 0.7 and 8.1 ± 0.6 kg body mass, with no significant change for exercise relative to control. Serum cholesterol and triacylglycerol improved in both diet and in exercise and diet after 12 weeks of intervention, and was most strongly related to weight loss.

Conclusion: Weight loss is the most effective means of reducing lipid and lipoprotein risk factors in obese women.

INTRODUCTION

Coronary heart disease is the leading cause of morbidity and mortality in women, middle-aged and older [1,2]. Major risk factors for coronary heart disease in women are elevated low-density-lipoprotein (LDL-C) and total cholesterol, and reduced levels of high-density lipoproteins (HDL-C) [3]. Current guidelines from the National Cholesterol Education Program (NCEP) and the American Heart Association (AHA) to reduce risk for coronary heart disease by normalizing plasma lipids are weight reduction, physical activity, and decreasing total fat, saturated fat and cholesterol consumption in the diet [4,5].

Although, weight loss is recommended to reduce lipoprotein lipid risk factors in women, the individual contribution of weight change, improved dietary quality and increased exercise is still unclear. Research studies designed to measure the effects of exercise training on the lipid profile in obese subjects have often been confounded by concomitant dietary changes and/or weight loss. Moderate aerobic exercise appears to have little or no independent effect on the levels of total cholesterol or LDL-C, with variable effects on triacylglycerol [6–17]. However, exercise may be able to increase or attenuate the decrease in HDL-C that occurs during active weight loss [6–9].

Weight loss has been associated with variable changes in lipid profiles in obese subjects [8–14,18–20]. A meta-analysis of 70 studies [20] found that triacylglycerol, total cholesterol

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(TC), and low-density lipoprotein cholesterol (LDL-C) decrease with weight loss. High-density lipoprotein cholesterol (HDL-C) usually increases after significant weight reduction and a stabilization period. However, during active weight loss, females show no change or a decrease in HDL-C.

Few studies have examined the effect of both an energy restricted-diet and exercise training on serum lipid changes in obese women. While changes in lipoproteins have often been ascribed to weight loss, they may instead be better related to changes in dietary quality. Improvements in dietary quality, particularly decreases in saturated fat have been associated with marked improvements in the lipid profile [5,21,22]. A 10% to 15% decrease in weight may be sufficient to show favorable changes in the lipid profile [18], yet the speed at which such changes occur has not been adequately explored [8,23].

The purpose of this study was to examine the independent and combined effects of exercise training, weight loss and changes in dietary quality on alterations in the serum lipid profile (magnitude, direction and speed) in a group of moderately obese women who were randomly divided into one of four groups: control, exercise, diet, and exercise diet. Prior to the study, a cross-sectional comparison of aerobic fitness, body composition and blood lipid profile was made between obese and non-obese subjects to provide a reference point for interpretation of the data measured during the 12-week intervention period. Results should aid health professionals in designing weight management programs that would have the most favorable effect on reducing lipid and lipoprotein risk factors.

METHODS

Subjects and Research Design

Obese female subjects were recruited from the surrounding community through advertisements according to these selection criteria: (1) between the ages of 25–75 years, (2) in good health, with no known diseases including diabetes, cancer or heart disease, (3) a body mass index between 25–65 kg/m^2, (4) not currently on an energy-restricting diet or exercise program ($<$3 moderate to vigorous aerobic sessions per week of $>$20 minutes/session), (5) not using supplements in excess of 100% RDA on a regular basis, (6) not using cigarettes or abusing alcohol. Before being included in the study, subjects had to agree to be randomized to any one of the four groups (control, exercise, diet, exercise and diet), avoid vitamin/mineral supplements in excess of 100% of the recommended dietary allowance and not participate in any formal exercise or weight loss program outside of that provided during the study. Blood chemistry panels (two separate tests) revealed that all subjects were normoglycemic. Informed consent was obtained from each subject, and the experimental procedures were in accordance with the policy statement of the American College of Sports Medicine and the institutional review board of Appalachian State University.

Thirty nonobese women who were physically active ($>$3 sessions/week, $>$20 minutes/session) with a body mass index of less than 25 kg/m^2, but who otherwise met all of the subject selection criteria were also recruited for pre-study cross-sectional comparisons to the obese subjects.

Measurements of cardiorespiratory fitness, body composition, serum lipids and lipoproteins, and glucose were conducted in all subjects before and after a 12-week exercise and/or energy restriction intervention period (1,200–1,300 kcal/day), with data analyzed using a 4 (obese control, exercise, diet, and exercise and diet groups) $\times$ 2 (pre- and post-study) repeated measures design. Obese subjects were randomized to one of the four groups.

Body Composition, Cardiorespiratory Fitness and Lipid Measurements

During the week prior to and at the end of the 12-week study, all subjects were tested for body composition using underwater weighing [24,25]. Residual volume was measured by the nitrogen washout procedure using the Vmax 229LV metabolic cart form the SensorMedics Corporation (Yorba Linda, CA.). Body mass was tested pre- and post-study for all subjects, with weekly weigh-ins conducted for all obese subjects during the 12-week intervention. Serum total cholesterol (TC), HDL-C, triacylglycerols, and glucose were measured pre-, three week and post-study by a national clinical laboratory (Lab Corp, Burlington NC). LDL-C was estimated using this equation: LDL-C $=$ TC $-$ HDL-C $-$ (triacylglycerol/5). Samples were analyzed the day they were collected. Lab Corp meets laboratory standardization guidelines for precision (CV $\leq$ 3%) and accuracy (bias $\leq$ 3%). Maximal aerobic power (VO_{2max}) was determined utilizing the Bruce graded maximal treadmill protocol [26]. Oxygen uptake and metabolic responses were measured using the MedGraphics CPX Express metabolic system (Medical Graphics Corporation, St. Paul, MN).

Exercise Training

Subjects in the two exercise groups (exercise and exercise and diet) were required to walk five times a week, 45 minutes per session, at 60% to 80% of maximum heart rate (MHR), for 12 weeks (60 total exercise sessions). Supervised sessions were held four days per week at an indoor track, with duration, heart rate and distance walked measured and recorded. Subjects walked one session per week without supervision. Duration and intensity of exercise were gradually increased over a three week period from 25–30 minute/sessions at 60% to 65% MHR during the first week to 45 minutes at 70% to 80% MHR from weeks 4 through 12. Exercise heart rates were measured with chest heart rate monitors (Polar CIC Inc., Port Washington, NY). Subjects in the two non-walking groups (control and diet) reported to the exercise facility four days per week for 45 minutes of stretching and mild range of motion calisthenic exercises. The intent was to keep heart rates below 100 beats per minute while exposing the control and diet groups to the same staff attention received by the exercise and exercise and diet groups.

Energy Restricted-Diet

Prior to the study, all subjects kept a three-day food record after receiving instructions from the project dietitians. Obese subjects were placed on a 1,200–1,300 kcal, NCEP, Step I diet for 12 weeks. The dietary menu was based on dietary exchanges (two fruit, three vegetable, two milk, six bread, two fat, five lean protein and 100 kcal optional foods). Subjects were instructed by the project dietitian on portion sizes, food exchanges, and how to record dietary intake using a daily exchange checklist. Compliance to the diet/non-diet was measured in all subjects by random, weekly, 24-hour dietary recalls (11 per subject during the study). Nutrient intake from the three-day food records and 24-hour dietary recalls was assessed using the computerized dietary analysis system, Food Processor Plus, version 6.0 (ESHA Research, Salem, Oregon) [24]. Subjects in the two diet groups (diet and exercise and diet) also attended a weekly 45-minute nutrition class. During this class, they were weighed on a scale and received additional instruction on weight loss principles, nutrition, exercise guidelines and the importance of compliance to all aspects of the study.

Statistical Analysis

Independent *t* tests were calculated, comparing all measured variables in the obese and nonobese groups. Statistical significance was set at the $p < 0.05$ level, and values are expressed as mean ± SE. Obese groups were compared using a 4 (control, exercise, diet, and exercise and diet groups) × 3 (pre-, three week, and post-study time points) repeated measures ANOVA. When the group × time interaction *p*-value was ≤0.05, the Duncan multiple comparison test was used to compare exercise, diet, and exercise and diet group changes relative to changes in the control group. Statistical significance was set at the $p < 0.05$ level and values were expressed as mean ± SE.

RESULTS

Of the 102 subjects recruited for the study, all but 11 complied with the research design, giving a final subject count of 91 subjects. During the 12-week study, subjects in the calisthenics exercise groups (control and diet) were required to attend 48 exercise sessions: actual attendance was 84%, with make-up sessions increasing this to 95%. Heart rates during the calisthenics exercise sessions averaged 96 ± 2 beats/minute. Subjects in the walking groups were required to attend 48 sessions, and exercise once per week on their own time (60 total sessions). Actual attendance at the supervised walking sessions was 83%; unsupervised and make-up sessions resulted in the overall 95% exercise record (just under the goal of five walking sessions per week). Following the initial three-week period of adaptation to the walking program, subjects in the walking groups averaged 45 minutes per session at a heart rate of 137 ± 2 beats/minute (78.5 ± 0.5% of maximum heart rate) and walked an average of 4.33 ± 0.08 km/session. Attendance by the subjects in the energy restriction groups at the weekly weight management classes was 83% for the 12-week study period.

The obese and nonobese groups were of similar age and height (Table 1). Obese subjects had a greater body weight, BMI, and percent body fat, and a lower fitness level than the nonobese subjects (VO_{2max}). Serum total cholesterol, triacylglycerols, LDL-C, TC/HDL-C ratio and glucose were significantly higher in the obese subjects, while HDL-C was significantly lower. Prior to the study, three-day food records indicated a similar intake between groups except for a slightly higher carbohydrate and a lower fat intake percentage in the nonobese group (data not shown).

All of the subject characteristics referenced in Table 1 were similar between the four treatment groups. Prior to the study, three-day food records indicated a caloric intake of 2065 kcal/day and 1884 ± 84 kcal/day for the diet group (diet and exercise and diet) and the non-diet group (control and exercise), respectively.

The body composition and aerobic fitness data are summarized in Table 2. Subjects in the diet and exercise and diet groups lost 7.8 ± 0.7 and 8.1 ± 0.6 kg body mass, respectively, during the study, with no significant change for the exercise group relative to the control group [$F(6,174) = 43.76$, $p < 0.001$]. Body mass index and percent of body fat also decreased significantly for the diet and exercise and diet groups, but not for the exercise group, relative to the control group. VO_{2max} (mL/min) increased significantly for exercise (14%) and exercise and diet (8%) but not diet, compared to control [$F(3,87) = 8.87$, $p < 0.001$].

Table 3 and Fig. 1 summarize the serum lipid and lipoprotein data. Serum cholesterol and triacylglycerol decreased significantly for the diet and exercise and diet groups, but not for

Table 1. Subject Characteristics for Obese (N = 91) and Non-Obese (N = 30) Subjects

	Obese	Non-Obese	*p*-value
Age (years)	45.6 ± 1.1	43.2 ± 2.3	0.304
Height (m)	1.65 ± 0.01	1.66 ± 0.01	0.672
Body Mass (kg)	89.9 ± 1.5	55.7 ± 1.0	<0.001
Body Mass Index (kg/m^2)	33.1 ± 0.6	21.4 ± 0.34	<0.001
Body Fat (%)	43.7 ± 0.6	23.3 ± 1.4	<0.001
VO2max (mL/kg/min)	22.6 ± 0.4	40.1 ± 1.4	<0.001
Cholesterol (mmol/L)	5.36 ± 0.10	4.79 ± 0.16	0.005
Triglycerides (mmol/L)	1.599 ± 0.08	0.88 ± 0.08	<0.001
HDL (mmol/L)	1.15 ± 0.03	1.52 ± 0.07	<0.001
LDL (mmol/L)	3.44 ± 0.08	2.86 ± 0.12	0.001
TC/HDL	4.86 ± 0.13	3.26 ± 0.13	<0.001
Glucose (mmol/L)	5.24 ± 0.09	4.59 ± 0.07	<0.001

Table 2. Effect of Exercise Training and Energy Restriction on Body Composition and Aerobic Fitness over 12 Weeks in Obese Females

	Controls (N = 22)	Exercise (N = 21)	Diet (N = 26)	Exercise & Diet (N = 22)	Group × Time Effect *p*-Value
Body mass (kg)					
Pre-study	90.5 ± 2.4	88.4 ± 2.9	90.6 ± 3.8	89.9 ± 2.5	<0.001
Post-study	89.7 ± 2.5	87.4 ± 2.8	82.8 ± 3.7*	81.8 ± 2.3*	
Body mass index (kg/m^2)					
Pre-study	32.8 ± 1.0	32.3 ± 1.1	34.2 ± 1.6	32.6 ± 1.0	<0.001
Post-study	32.5 ± 1.0	32.0 ± 1.1	31.3 ± 1.5*	29.7 ± 0.9*	
Body fat (%)					
Pre-study	43.4 ± 1.0	43.1 ± 1.3	44.3 ± 1.1	43.3 ± 1.1	<0.001
Post-study	42.3 ± 1.1	42.1 ± 1.5	40.1 ± 1.4*	39.6 ± 0.9*	
VO_{2max} (mL/min)					
Pre-study	1986 ± 77	2018 ± 61	1993 ± 45	1995 ± 73	<0.001
Post-study	2057 ± 69	2303 ± 73*	2018 ± 59	2157 ± 72*	

* $p < 0.05$, Duncan multiple comparison test, group changes pre- to post-study, compared to controls.

Table 3. Effect of Exercise Training and Energy Restriction on Serum Lipids and Glucose over 12 Weeks in Obese Females

	Controls (N = 22)	Exercise (N = 21)	Diet (N = 26)	Exercise & Diet (N = 22)	Group × Time Effect *p*-Value
Cholesterol (mmol/L)					
Pre-study	5.12 ± 0.24	5.62 ± 0.19	5.37 ± 0.19	5.34 ± 0.17	
3-week	5.26 ± 0.24	5.61 ± 0.22	4.83 ± 0.21*	4.75 ± 0.19*	<0.001
12-week	5.10 ± 0.23	5.65 ± 0.24	4.84 ± 0.19*	4.70 ± 0.15*	
Triglycerides (mmol/L)					
Pre-study	1.57 ± 0.14	1.64 ± 0.17	1.63 ± 0.18	1.54 ± 0.14	
3-week	1.44 ± 0.15	1.67 ± 0.18	1.34 ± 0.13*	1.31 ± 0.13	0.011
12-week	1.81 ± 0.19	1.77 ± 0.19	1.44 ± 0.13*	1.29 ± 0.10*	
HDL (mmol/L)					
Pre-study	1.02 ± 0.05	1.29 ± 0.06	1.18 ± 0.05	1.14 ± 0.06	
3-week	1.08 ± 0.06	1.34 ± 0.07	1.07 ± 0.06*	1.05 ± 0.06	0.001
12-week	1.08 ± 0.06	1.34 ± 0.07	1.15 ± 0.06	1.14 ± 0.06	
LDL (mmol/L)					
Pre-study	3.37 ± 0.19	3.58 ± 0.16	3.34 ± 0.18	3.49 ± 0.15	
3-week	3.51 ± 0.21	3.49 ± 0.17	3.13 ± 0.15*	3.09 ± 0.16*	0.005
12-week	3.19 ± 0.19	3.49 ± 0.18	3.01 ± 0.15	2.96 ± 0.13*	
TC/HDL					
Pre-study	5.24 ± 0.31	4.59 ± 0.27	4.70 ± 0.19	4.93 ± 0.26	
3-week	5.11 ± 0.31	4.40 ± 0.28	4.65 ± 0.21	4.70 ± 0.23	0.313
12-week	5.04 ± 0.33	4.39 ± 0.26	4.41 ± 0.21	4.34 ± 0.25	
Glucose (mmol/L)					
Pre-study	5.31 ± 0.19	5.09 ± 0.15	5.22 ± 0.17	5.33 ± 0.18	
3-week	5.40 ± 0.20	4.91 ± 0.15	4.92 ± 0.12*	5.02 ± 0.11*	0.054
Post-study	5.39 ± 0.18	4.91 ± 0.10	4.84 ± 0.09*	4.91 ± 0.12*	

* $p < 0.05$, Duncan multiple comparison test, group changes pre- to post-study, compared to controls.

the exercise group relative to the control group. LDL-C decreased significantly for the diet and exercise and diet groups; however, only the change measured for the exercise and diet group was significant compared to the control group. Significant decreases in cholesterol, triacylglycerols, LDL-C, and glucose were evident at three weeks in the diet and exercise and diet groups relative to the control group. HDL-C had not changed at the end of the 12-week study in any group, although there was a decrease at three weeks in the diet and exercise and diet groups, but not in the exercise group relative to the control group. The decrease in HDL-C at three weeks was correlated with the change in kg for the diet and exercise and diet groups (r = 0.37, $p < 0.001$). No change in any lipid value or glucose occurred in the normal weight subjects at three weeks or 12 weeks (data not shown).

Table 4 compares the dietary intake of subjects who were on a diet (diet and exercise and diet) *versus* those in non-diet groups (exercise and control). Diet groups had lower kcal, fat, saturated fat (SFA), polyunsaturated fat (PUFA), monounsaturated fat (MUFA) and cholesterol consumption during the

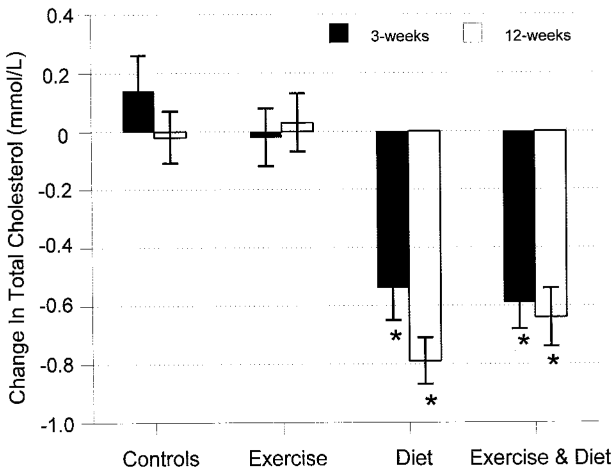

Fig. 1. Comparison of change in total cholesterol after 3 and 12 weeks between control, exercise, diet, and diet and exercise groups. *$p < 0.05$, Duncan multiple comparison test, group changes pre- to post-study, compared to controls.

12-week study. The diet groups had an average of 1270 kcal/day and were complaint to the NCEP, Step I recommendations. Fat consumption was 27% lower, while fiber was 23% higher in the diet groups *versus* the non-diet groups.

The predicted effects of change in diet quality and body weight on serum total cholesterol were also examined in this study. The revised Hegsted equation [27] was used to estimate the effect of change in diet quality. A multiple regression equation that modeled both diet and weight variables was used to establish the effect of weight changes on serum cholesterol. Change in body weight was estimated to account for nearly all of the actual changes in serum total cholesterol. The decrease in triacylglycerols was also examined in obese groups and was predicted by both the decrease in body weight and increase in fitness level. Our data showed that for every 1 kg of weight loss, serum cholesterol decreased by 0.07 mmol/L and triacylglycerol decreased by 0.025 mmol/L.

DISCUSSION

In this randomized, controlled 12-week study of a group of 91 moderately obese women, energy restriction alone or in combination with exercise training significantly lowered body mass, body mass index, percent body fat, total cholesterol and triacylglycerol. Because dietary intake was carefully monitored and exercise was equal in both the exercise and exercise and diet groups, these results can be directly attributed to weight loss rather than exercise. Improvements in lipid profiles and a 4% decrease in body mass were apparent after three weeks of treatment with an energy restricting diet.

Although VO_{2max} increased by 10% to 15% in the two exercise groups, moderate exercise was not associated with a decrease in body weight or change in body composition. One recent meta-analysis showed that exercise alone has little effect on change in body weight in the obese, while the combination of exercise and energy restriction has only a minor influence on

Table 4. Comparison of Pre-Study and during Dietary Intake for Diet and Non-Diet Treatment Groups

	Diet (N = 46)		Non-Diet (N = 42)	
	Pre-Study	During	Pre-Study	During
Energy (kcal)	2065 ± 76	1270 ± 39*	1884 ± 84	1552 ± 54
Carbohydrate (g)	271 ± 12	191 ± 6	238 ± 12	208 ± 9
Protein (g)	80.2 ± 3.6	60.6 ± 2.0	71.5 ± 3.4	63.8 ± 1.9
Fat (g)	76.1 ± 3.8	31.7 ± 1.7	71.6 ± 4.1	52.9 ± 2.5**
SFA (g)[a]	25.7 ± 1.4	9.82 ± 0.59	24.2 ± 1.6	17.9 ± 1.0**
PUFA (g)[b]	16.0 ± 0.9	7.48 ± 0.38	14.7 ± 1.3	10.6 ± 0.6**
MUFA (g)[c]	26.4 ± 1.3	10.4 ± 0.5	25.5 ± 1.5	18.3 ± 0.9**
Cholesterol (mg)	286 ± 33	129 ± 9	225 ± 17	195 ± 15
Fiber (g)	18.7 ± 1.2	18.4 ± 0.8	16.9 ± 1.2	14.2
Cholesterol (mg)/1000 kcal	134 ± 11	101 ± 6	123 ± 10	126 ± 9*
Fat (% total energy)	33.0 ± 1.0	22.3 ± 0.7	34.0 ± 1.1	30.5 ± 0.8**
Carbohydrate (% total energy)	52.5 ± 1.3	60.3 ± 0.9	50.8 ± 1.3	53.5 ± 1.1**
Protein (% total energy)	15.6 ± 0.5	19.1 ± 0.3	15.5 ± 0.7	16.8 ± 0.4**
SFA[a] (% total energy)	11.2 ± 0.4	6.89 ± 0.29	11.3 ± 0.6	10.3 ± 0.3**
PUFA[b] (% total energy)	6.94 ± 0.30	5.30 ± 0.20	6.87 ± 0.37	6.11 ± 0.22**
MUFA[c] (% total energy)	11.5 ± 0.4	7.36 ± 0.29	12.2 ± 0.5	10.6 ± 0.4
P/S ratio[d]	0.66 ± 0.03	0.80 ± 0.03	0.65 ± 0.04	0.61 ± 0.02**

[a] SFA = saturated fatty acid.
[b] PUFA = polyunsaturated fatty acid.
[c] MUFA = monounsaturated fatty acid.
[d] P/S ratio = polyunsaturated to saturated fatty acid ratio.
* $p < 0.05$.
** $p < 0.01$.

accelerating body weight loss [28]. We reviewed this information in more detail elsewhere [29].

Numerous studies and reviews have concluded that moderate exercise training has little effect on total cholesterol or LDL-C unless combined with weight loss or change in dietary quality [6–14,17]. In our study, exercise alone was insufficient to stimulate change in any lipid or lipoprotein measures.

Several studies have shown weight loss to be a strong predictor of reductions in total cholesterol and LDL-C [8,10,11,14]. Datillo [20], in a meta-analysis of 70 studies, concluded that for every 1 kg of weight loss there was a decrease of 0.05 mmol/L in TC, 0.02 mmol/L in LDL-C and 0.015 mmol/L triacylglycerol. Our data support these findings, with one kg of weight loss associated with a significant decrease in serum cholesterol (0.07 mmol/L) and triacylglycerol (0.025 mmol/L). LDL-C decreased in both the diet (9.9%) and the exercise and diet (15.2%) groups, but only the exercise and diet group was significant compared to the control. A few studies showed no change in total cholesterol with weight loss [9,12,13], but these studies had several limitations, such as small sample size, significant differences in weight between groups at baseline and/or no control group.

Exercise when combined with an energy-restricting diet has been found to attenuate the decrease in HDL-C that occurs with weight loss [6–9,13,14]. In contrast, our findings showed a significant decrease in HDL-C at three weeks in both the diet only and diet and exercise groups compared to no change in the exercise or control groups, with no change in any group at 12 weeks. LDL-C significantly decreased in both diet groups at three weeks. By 12 weeks LDL-C had further decreased in both diet groups, but only the combination of exercise and an energy-restricting diet was significant.

In our study the diet groups followed a hypocaloric, NCEP, Step I diet. Many studies that include diet as a part of their intervention groups do not distinguish whether the lipid and lipoprotein changes were a result of weight loss or change in dietary quality [9–13,20,30]. Howell [21], in a meta-analysis of 224 published studies, concluded that modifying the current American diet to a NCEP, Step I diet would reduce the average plasma total cholesterol concentration by 0.264 mmol/L (10.2 mg/dL) with a further reduction of 0.204 mmol/L (7.0 mg/dL) with a shift from Step I to Step II. Schaefer, Nicklas and Dengal showed that an isocaloric, AHA diet alone significantly improved lipid risk factors [31–34]. Dengel [31] and Nicklas [34] studied the AHA diet with and without weight loss and concluded the combination was most beneficial because weight loss had a strong positive effect on HDL-C, not seen with improvements in dietary quality alone. Results from our study showed the change in total cholesterol that occurred in diet groups was almost fully explained by weight loss. Nieman and Haig [8] using similar equations predicted that modifications in dietary quality accounted for 60% and weight loss 40% of the change in total cholesterol.

Changes in the lipid profile occurred by three weeks with only a small decrease in body weight (4%). Two other studies have confirmed a rapid lipid change with dietary and/or weight changes [8,23]. This study included subject randomization and a control group. Lifestyle factors including smoking, alcohol use, physical activity, diet composition and body weight were controlled for, lending strengths to our findings.

CONCLUSION

Obese women have lipid profiles that place them at higher risk for cardiovascular disease than normal weight women of similar age and height. Our research indicates that weight loss by energy restriction in contrast to exercise alone or improvement in diet quality is the strongest predictor of improvements in lipid profile. Significant reductions in total cholesterol and LDL-C occurred after a modest weight loss three weeks into the program.

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