

The Effects of a Six-Week Weight Loss Program on Blood Lipid Profiles and Cardiovascular Health

Original Research

Jamie M. Blöse¹, Paul Stickles¹, Antonia Battaglino¹, Alexis Trumbetti¹, Jared James¹, Katie Cooper¹, Anna Schade¹, Melissa Reed, PhD¹, Selen Razon, PhD¹, Melissa A. Whidden, PhD¹

¹Department of Kinesiology, West Chester University, West Chester, PA USA

Abstract

Introduction: The purpose of this study was to investigate blood lipid profiles and cardiovascular adaptations associated with a six-week weight loss program.

Methods: Body weight, total cholesterol, high density lipoprotein (HDL) cholesterol, low density lipoprotein (LDL) cholesterol, triglycerides, fasting plasma glucose, resting blood pressure, and resting heart rate were assessed before and after the six-week program in 40 middle-aged sedentary women.

Results: There was a significant decrease in body weight ($P = 0.00$), total cholesterol ($P = 0.00$), and LDL cholesterol ($P = 0.01$). HDL cholesterol, triglycerides, fasting plasma glucose, resting heart rate and blood pressure did not change after the six-week weight loss program

Conclusions: This weight loss program was effective in decreasing body weight while reducing total and LDL cholesterol levels. However, this combination of diet, exercise, and water consumption was not effective in changing HDL cholesterol, triglycerides, fasting plasma glucose levels, or resting heart rate and blood pressure. This study contributes to the necessity to create an exercise and diet program of optimal duration and intensity that is effective in weight loss while eliciting improved cardiovascular physiology.

Key Words: Weight Loss, Cholesterol, Blood Pressure

Corresponding author: Melissa A. Whidden, mwhidden@wcupa.edu

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Introduction

Obesity is on the rise in the United States, as 42.5% of adults are obese⁶. The comorbidities and chronic conditions associated with obesity include but are not limited to, heart disease, stroke, type 2 diabetes, and cancer⁶. To avoid these health complications and comorbidities, losing weight is crucial for individuals who carry excess weight. Exercise training and a balanced, healthy diet are crucial components of living a healthy lifestyle. Cardiovascular, skeletal muscle, and body composition changes are some of the many adaptations associated with physical activity and healthy nutrition. Weight loss programs are becoming more popular due to their structured nature as well as the sense of community and support that they provide. The duration, type, and intensity of these programs, however, are constantly being investigated to determine the ideal qualities of a program that result in successful weight loss but that also elicit positive physiological health benefits. A meta-analysis published in 1997 found that participants who utilized both diet and exercise for ~15 weeks lost on average 24.2 ± 1.32 pounds and they were more successful in maintaining their weight loss one year post-program when compared to just dieters or just exercisers alone¹⁴. Some research shows that short duration exercise training produces positive changes in cardiovascular measures, such as resting blood pressure and heart rate, in just four weeks¹¹ and blood lipids in twelve weeks¹². Nevertheless, an ideal duration for an exercise program to elicit significant physiological adaptations has not yet been defined. Given the inconsistent results with regards

to the effects of short-term weight loss programs on blood lipid profiles, cardiovascular measures, and body weight, there is need for further research to develop an exercise and diet program that allows individuals to become healthier and lose weight.

Incorporating both cardiovascular and resistance exercise into daily routines while maintaining a healthy diet are some of the most effective ways to lose weight while reaping the physiological and health benefits of these interventions. Aerobic exercise stimulates the cardiovascular and pulmonary systems and results in improvements in heart and lung functioning as well as circulation¹⁵. On the other hand, resistance training decreases body fat as fat-free mass increases¹³. Incorporating a hypocaloric diet into an exercise program also contributes to weight loss due to the lack of consumed calories. The combination of both types of exercise and a hypocaloric diet increases health, fitness, and overall well-being. The purpose of this study was to determine if a short-term, weight loss driven program would also yield substantial improvements in blood lipid profiles and cardiovascular health in middle-aged women. The results of this study will further supplement the current literature by providing information about the health-related benefits of a short duration weight-loss program. We hypothesized that from pre- to post-6-week weight loss program measurements, we would see significant improvements in blood lipid profiles and resting cardiovascular measures in addition to the anticipated weight loss.

Methods

Participants

Forty female adult subjects (age 39.4 ± 10.4 years) from a local gym across six different six-week weight loss challenges spanning an entire year were included in this study. Each subject was required to meet all the inclusion criteria to be eligible to participate in this study. Subjects had to be over the age of 18 and had to complete all the prerequisite requirements of the local gym that sponsored this weight loss challenge. Women with a history of myocardial infarction or known cardiovascular disease were excluded from this study. If data that was collected prior to the six-week challenge appeared to present a risk factor for cardiovascular or metabolic disease, the subject was notified for their decision to continue or discontinue the six-week program at their own discretion. Data collection occurred pre- and post-six-week weight loss program. This study was conducted in compliance with the federal requirements for protection of human subjects and with the approval of West Chester University Institutional Review Board.

Six-Week Challenge Orientation

Prior to each six-week challenge, participants were recruited via social media by a local gym to participate in a 20-pound weight loss program. Interested participants were asked to report to the gym two weeks prior to the start of each challenge for orientation. At orientation, details surrounding the weight-loss challenge, including food and water consumption and exercise expectations, were presented to the participants. Participants were encouraged to purchase a fitness tracker that measured heart rate so that exercise intensity could be self-monitored at class. Furthermore, participants were required to pay for the six-week program up front. If the participants attended 30 workouts over the six weeks, adhered to the diet, and successfully lost 20 pounds, then they would receive all their money back at the end of the challenge. Our research team attended every orientation to recruit subjects for our study. The subjects we recruited were required to report to our laboratory the weekend before their six-week challenge began so we could collect pre-program measurements. Our subjects were also asked to report back to our lab the day of their weigh-out by the local gym for post-program measurements.

Exercise Protocol

The exercise program took place at a local gym and was run entirely by coaches at the gym. Subjects were required to participate in five 50 minute workouts per week for six weeks (30 workouts). If a subject missed a workout, they were excluded from our study. The local gym confirmed all 30 workouts for our subjects at the end of the six-week program. The workouts were moderate to high intensity, boot camp style sessions. Coaches continually monitored participant intensity and knew when to push the participants harder in class. Subjects chose from two upper body, two lower body, and two whole body workouts that were available weekly. Each workout began with a five-minute dynamic stretching warm-up. Upon completion, subjects then began three moderate to high intensity circuits consisting of dumbbell, TRX, and body weight exercises. The difficulty of the program increased weekly; therefore, the structure and theme of the weekly workouts changed accordingly. Each workout ended with a cool

down. Subjects were encouraged to regularly check in and post on social media to boost morale and interact with other participants of the weight-loss challenge.

Diet Protocol

In addition to the exercise program, subjects were to follow a structured, calorie restrictive diet plan. The local gym provided participants with a list of approved proteins, carbohydrates, and vegetables to eat at orientation (Table 1). The participants were required to eat five to six meals per day and breakfast, lunch, and dinner had to include a protein, carbohydrate, and vegetable from the list. The other two to three snacks throughout the day were required to consist of only protein; a protein shake or protein snack. Participants were instructed to eat every two to three hours. The local gym strongly encouraged participants to keep a diet log for at least 1 week of the challenge, so that if problems arose with a lack of weight loss, coaches could adjust the participants meal time consumption or suggest different options from the list. Our research team did not analyze the diet logs. Participant condiment usage was limited and they were instructed to drink a gallon of water per day.

Table 1: Approved Proteins, Carbohydrates, and Vegetables for the 6-Week Weight Loss Program

Protein	Carbohydrates	Vegetables
Eggs or Egg Substitute	Oatmeal	Broccoli
Chicken Breast	Quinoa	Brussel Sprouts
Turkey Breast	Brown Rice	Spinach
Tilapia	Sweet Potato	Kale
Halibut	Baked Potato	Celery
Buffalo	Ezekiel bread	Cucumber
Swordfish	Blackberries	Green Beans
Salmon	Raspberries	Cauliflower
Low-fat Cottage Cheese	Blueberries	Peppers
Crab	Strawberries	Mushrooms
Lobster	Yam	Lettuce
1% Lean Ground Turkey		Tomato
Tuna		Artichoke
Orange Roughly		Zucchini
Top Round Steak		Asparagus
Shrimp		
Top Sirloin Steak		
7% Lean Ground Beef		

Experimental Measures and Materials

Subjects were asked to fast overnight prior to pre- and post-program data collection sessions. After our subjects arrived at our lab, they had their blood lipid profiles and fasting plasma glucose measurements taken via finger prick. The blood was analyzed using the Alere Cholestech LDX (Alere San Diego, Inc., San Diego, CA) machine which was calibrated the morning of each data collection day. The same member of our research team measured blood lipid profiles pre- and post-program to minimize variability. While waiting for the blood results, subjects had their resting blood pressure (RBP) and resting heart rate (RHR) measured in the upright seated position after sitting still for a minimum of five minutes. Resting blood pressure was measured at the brachial artery using a stethoscope and a sphygmomanometer. Resting heart rate was manually measured using the palpation technique at the radial artery. The same member of our research team measured resting heart rate and blood pressure pre- and post-program to minimize variability. After the cardiovascular measures were taken, subjects total body weight was measured with a scale attached to the Bod Pod (COSMED USA, Inc., Chicago, IL). Subjects wore skin tight clothing and the scale was calibrated the morning of each data collection day. Upon completion of the data collection, subjects began their six-week weight loss program the next day. They returned to our lab after six weeks and followed the same procedures in the same order to collect post-program measurements.

Statistical Analysis

The average results of the blood lipid profiles and resting cardiovascular measures across all six cohorts were calculated. Data is presented as means \pm SEM. Paired t-tests were used to analyze differences

between pre- and post-program measurements. Statistical significance was set at $P \leq 0.05$. Analyses were performed with the use of SPSS (version 25).

Results

Participant Characteristics

Six different cohorts of subjects completed the six-week challenge. Forty subjects out of 58 recruited completed the program as well as returned to West Chester University for post-program measurements. Additionally, 9 subjects came from the February to April six-week challenge (22.5%), 10 subjects came from the April to June six-week challenge (25%), 5 subjects came from the June to July six-week challenge (12.5%), 7 subjects came from the July to September six-week challenge (17.5%), 4 subjects came from the September to October six-week challenge (10%), and 5 subjects came from the November to December six-week challenge (12.5%).

Body Weight and BMI Classification

Total body weight (Pre: 192.2 ± 7.1 , Post: 183.3 ± 6.6 ; $P = 0.00$) significantly decreased when comparing pre- to post-program values (Figure 1). Furthermore, body mass index (BMI) (Pre: 32.6 ± 1.1 , Post: 31.1 ± 1.0 ; $P = 0.00$) was significantly lower post-program when compared to pre-program. When we examined our subjects BMI further, 5 subjects (12.5%) were normal weight (BMI between 18.5-24.9), 12 subjects (30%) were overweight (BMI between 25-29.9), 9 (22.5%) were considered obese (BMI between 30-34.9), and 14 (35%) were classified as extremely obese (BMI > 35) pre-6-week weight loss program. Following the 6-week weight loss program, 8 subjects were normal weight (20%), 13 subjects were overweight (32.5%), 8 subjects were considered obese (20%), and 11 were classified as extremely obese (27.5%). When examining BMI values per individual, 34 out of 40 subjects saw a decrease in their BMI.

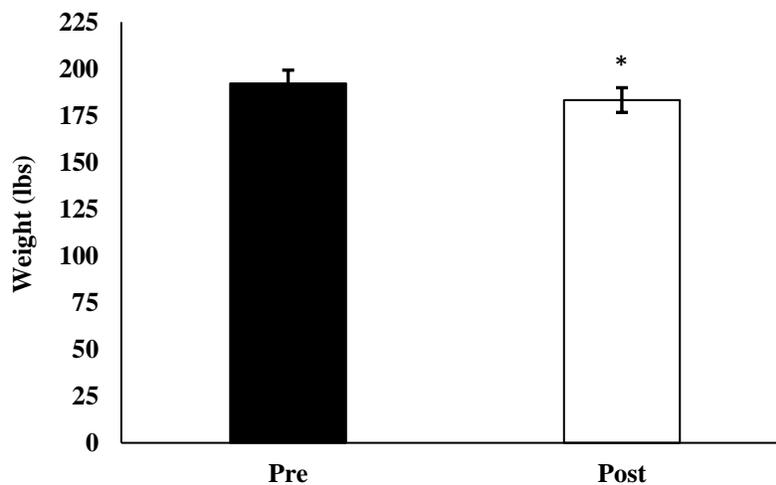


Figure 1. Changes in weight between pre- and post-6-week weight loss program data collection. Data are means \pm SEM. *Significantly decreased versus pre-program ($P \leq 0.05$).

Blood Lipid Profile

Blood lipid profile values are shown in Table 2. Fasting plasma glucose ($P = 0.75$), HDL cholesterol ($P = 0.28$), triglycerides ($P = 0.57$), and total cholesterol/HDL ratio ($P = 0.27$) levels did not change significantly over the course of the six-week weight loss program. However, total cholesterol (Pre: 187.4 ± 6.4 , Post: 172.2 ± 6.3 ; $P = 0.00$) and LDL cholesterol (Pre: 110.8 ± 7.3 , Post: 100.9 ± 6.6 ; $P = 0.01$) levels significantly decreased when comparing pre- to post-program values.

Table 2: Blood Lipid Profile and Fasting Plasma Glucose Levels Pre- and Post-6 Week Program

Variable (mg/dL)	Pre-Program	Post-Program	Significance
Fasting plasma glucose	93.1 ± 1.0	92.6 ± 1.7	0.75
Total cholesterol	187.4 ± 6.4	172.2 ± 6.3	0.00*
HDL cholesterol	57.8 ± 2.7	55.7 ± 2.9	0.28

LDL cholesterol	110.8 ± 7.3	100.9 ± 6.6	0.01*
Triglycerides	100.8 ± 6.8	105.9 ± 10.9	0.57
Total Cholesterol/HDL Ratio	3.4 ± 0.2	3.3 ± 0.2	0.27

Data are Means ± SEM. * Indicates a significant difference from pre-program value ($P \leq 0.05$).

Resting Cardiovascular Measures

Resting cardiovascular measures are shown in Table 3. Systolic blood pressure ($P = 0.70$), diastolic blood pressure ($P = 0.34$), and resting heart rate ($P = 0.56$) were measured to analyze cardiovascular health, and they did not differ significantly over the course of the six-week weight loss program.

Table 3: Resting Cardiovascular Measures Pre- and Post-6 Week Program

	Pre-Program	Post-Program	Significance
Systolic blood pressure (mmHg)	124 ± 1.5	123 ± 1.3	0.70
Diastolic blood pressure (mmHg)	83 ± 1.2	82 ± 1.0	0.34
Resting heart rate (bpm)	70 ± 1.3	69 ± 1.5	0.56

Data are Means ± SEM.

Discussion

Main Findings

It was hypothesized that the six-week weight loss challenge would result in changes in total body weight, resting cardiovascular measures, and blood lipid profiles. Specifically, we expected to see a significant decrease in total cholesterol, LDL cholesterol, fasting plasma glucose, triglycerides, total cholesterol/HDL cholesterol ratio, resting blood pressure, resting heart rate, and body weight. In addition, we expected to see an increase in HDL cholesterol levels. This study is different than previously published literature, for it studied the physiological effects of a financially driven program prescribed to individuals looking to lose weight by combining increased water consumption, daily caloric deficits, and short-duration exercise training. Our hypotheses were partially supported, as some variables did not improve significantly from pre- to post-program. This weight loss program produced significant decreases in body weight, total cholesterol, and LDL cholesterol levels.

Body Weight

With almost half of the United States population being classified as obese⁶, it is more important than ever to find a weight loss plan that works. To avoid health complications and comorbidities associated with obesity, losing weight is the first step for individuals who carry excess weight. In this study, it is evident via the BMI values, that most of our subjects were classified as being overweight or obese prior to the six-week weight loss program. As expected, body weight decreased significantly over the course of six weeks. While the subjects in this study performed exercise five days/week for six weeks, they were also on a hypocaloric diet when compared to their diet consumption prior to the six-week program. Hypocaloric dieting refers to a reduced-calorie meal plan in which more calories are burned than consumed. Previous research has shown that consuming fewer daily calories results in weight loss, especially when combined with exercise, but that the hypocaloric diet is often difficult to maintain⁸. Our findings agree with previous research in which hypocaloric dieting combined with increased water consumption and short-duration exercise training promoted weight loss^{2,7}. Furthermore, when combined with a hypocaloric diet, any type of exercise intervention is successful in reducing body weight and changing body composition⁵. While the goal of this weight loss program was for participants to lose 20 pounds in six weeks, only 5% of the participants achieved that goal. On average, our subjects lost ~9 pounds. While this program was effective in improving body weight, factors such as duration and intensity of the program may need to be manipulated to result in more individuals reaching the intended weight loss goal.

Blood Lipid Profile

When an individual engages in a diet and exercise program, it is important to determine if the plan also improves other markers of health. Prior to the six-week challenge, our subjects were classified as overweight and sedentary. A blood lipid profile analysis helps to determine if any risk factors for cardiovascular disease are present. According to the ACSM, the following are suggested concentrations for the following blood lipid components, total cholesterol < 200 mg/dL, LDL cholesterol < 100 mg/dL,

HDL cholesterol \geq 40 mg/dl, triglycerides $<$ 149 mg/dl, and fasting plasma glucose levels between 60-99 mg/dL and deviations from these norms could result in health complications^{3,9}. We found a significant decrease in total cholesterol and LDL cholesterol like Halbert et al. (1999) who found that total cholesterol levels decreased with exercise training¹⁰. The significant decreases in total cholesterol and LDL cholesterol may indicate that this specific diet and exercise program may be beneficial for individuals with hyperlipidemia. However, significant differences were not seen when analyzing pre- to post-program blood lipid profiles in terms of fasting plasma glucose levels, HDL cholesterol, triglycerides, and total cholesterol/HDL cholesterol ratio. Interestingly, HDL cholesterol decreased by 3% throughout the course of this study. This contradicts previous evidence suggesting that exercise programs consisting of aerobic and resistance training for a minimum of four weeks can increase HDL cholesterol by 4%¹⁰. Kang et al. (2016) also found an increase in HDL cholesterol after twelve-weeks of exercise training¹². HDL cholesterol levels may have decreased in this study because the subjects were very limited in their food choices and the foods available to them were not high in HDL cholesterol. We did not find any significant changes in triglycerides or fasting plasma glucose levels. Pre-program triglyceride levels were within normal levels and may not have changed throughout the weight loss program as the subjects were limited in their food choices. Our data on fasting plasma glucose levels are not in accordance with previous research that found significant decreases in fasting plasma glucose levels after short-duration, high-intensity exercise bouts¹. This could be due to factors such as the short duration of this weight loss program or our subjects not following the given diet plan. Another explanation may be the fact that our subjects pre-program fasting plasma glucose levels were within normal levels.

Resting Cardiovascular Measures

Resting cardiovascular measures give an indication on heart health. Resting blood pressure that is equal or greater than 130/80 mmHg indicates hypertension and a resting heart rate over 100 bpm is a serious sign of a heart problem⁴. Over time with continuous exercise training, resting heart rate can decrease about five beats per minute and resting blood pressure can be lowered¹⁵. Variances in resting cardiovascular measurements in this study were insignificant. Resting systolic blood pressure, diastolic blood pressure and heart rate showed an insignificant change when comparing pre- and post-program values. This specific weight loss program was not effective in reducing resting heart rate or blood pressure. These findings are not in accordance with previously published literature^{11,12}. Specifically, Halbert et al. found that individuals who engaged in aerobic and anaerobic exercise between 50-85% of their VO_{2max} for at least three days/week for four weeks, saw blood pressure levels decrease¹¹. Like our study, Miller et al. (2014) investigated the effects of a short-duration circuit training protocol on blood lipid profiles, body composition, and resting heart rate and blood pressure. Consistent with their results, we found a significant decrease in total cholesterol. However, inconsistent with their results, we did not find significant deviations in resting heart rate and blood pressure¹⁴. This study differed from our research in that diet was not an independent variable, the sample size was smaller, and all subjects were obese and sedentary males. These differences could possibly explain the discrepancy between the findings. The insignificant changes in our subjects' cardiovascular physiology due to this program could be attributed to the duration and intensity of the program or because their pre-program resting cardiovascular measures were already within normal and healthy values.

Limitations

There were several limitations readers should be aware of in the present study. First, the methods in which each variable were tested pre- and post-program were carefully planned and executed; however, the researchers were not involved in the exercise and diet protocols administered to the subjects. Food diaries and exercise logs were not required, so the subjects could have deviated from these program requirements, thus affecting the results of their weight loss challenge. While a member of our research team was present at each workout, we were simply there to observe and take notes. Second, no males were included in this study. This may limit the generalization of the results to the entire population. Third, while only women were included in this study, we did not keep track of their menstrual cycle and differences in menstrual cycle phases could have certainly impacted our results. Fourth, the hypocaloric nature of the subjects' diet plan could be another limitation. While the subjects' caloric intakes were significantly decreased, and their total daily energy expenditures were increased compared to their lifestyle prior to the six-week challenge, there was variability in the amount of decreased caloric consumption across all subjects. In conjunction with the interval training, the diet could have contributed to the health-related changes that resulted from this weight loss program that may not have occurred if this program

consisted of exercise alone. However, the ability to maintain the six-week nutritional plan for an extended period appears unrealistic, and this may impact the subjects' weight loss and health maintenance moving forward.

Conclusions

The present study suggests that this specific weight loss program is effective in improving body weight while decreasing total cholesterol and LDL cholesterol. However, this specific combination of diet, exercise, and water consumption was not effective in producing significant changes in fasting plasma glucose levels, HDL cholesterol, triglycerides, and resting blood pressure and heart rate. These findings provide evidence that this specific weight loss program is effective for individuals looking to lose weight and improve cholesterol levels. More evidence is required to determine the factors of an optimal exercise and nutrition program that simultaneously improves body weight and cardiovascular health.

Media-Friendly Summary

The present study sought to determine if a six-week weight loss program that included a strict hypocaloric diet, excess water consumption, and a total of 30 moderate-high intensity exercise workouts, would result in significant improvements in body weight, cholesterol levels, and resting cardiovascular measures. The results of the present study show that a six-week weight loss program is beneficial for losing total body weight and reducing total and bad cholesterol levels. Unfortunately, a six-week weight loss program may not be sufficient to promote improvements in cardiovascular health.

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