

Weight Loss and Cardiovascular Fitness During a 1-Week Diet and Exercise Program

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ABSTRACT

Fifty-two adults ranging in age from 18 to 70 years completed a 1-week diet program involving both aerobic and anaerobic exercise. The subjects were divided into 2 groups, providing for a single-blinded, randomized control study design.

The control group did not participate in the diet and exercise program and had measurements repeated at a 1-week interval to assess reliability of repeated measures in the study. The experimental group, after baseline measurements, engaged in a combined 1-week 1200 calorie per day diet and exercise program. For the exercise program, on each of 6 days, the subjects in the experimental group exercised following an aerobic exercise video. After the video was over, on alternate days, they exercised for an additional 15 minutes with another video called the *Total Body Strengthening Workout* from Savvier LP, Carlsbad, Ca. On the other alternate days, they exercised for 1.5 minutes accomplishing core abdominal exercise on a Cross Crunch machine (Savvier LP).

The results of the study showed

weight loss of 2.4 ± 0.7 kg (5.3 ± 1.5 lb) for the exercise group with no change in the control group. Body fat was reduced by $1.2\% \pm 0.6\%$. Blood pressure and heart rate were reduced by 6.3 ± 5.1 systolic/ 4.9 ± 3.8 diastolic mmHg and 6.1 ± 7.2 beats per minute, respectively. The results show a good positive benefit for such a program.

INTRODUCTION

Diets, especially those that are low in fat, can cause an increase in thermogenesis that, in turn, increases the caloric expenditure of the body.¹ This, in turn, increases weight loss. Concurrent exercise adds to this,² not only during the exercise, but throughout the day.³⁻⁵ Thus, exercise and diet are a good combination of modalities for a weight loss program.⁵⁻⁸ In addition, there are numerous psychological benefits of exercise and weight loss programs.^{9,10}

This combination of weight loss and exercise also has many general health care benefits. Lack of exercise, for example, leads to obesity,¹¹⁻¹⁴ an increase in plasma triglycerides, borderline high glucose levels, and a rise in low-density lipoprotein (LDL) that can lead to heart disease.¹²⁻¹⁴ Furthermore, obesity, in turn, causes an increase in inflammatory cytokines and C reactive protein, which can then lead to the early onset of type



Figure 1. A subject using the Cross Crunch machine (Savvier LLP, Carlsbad, CA).

2 diabetes.⁵⁻⁸

Recent studies show that considerable muscle activity and training can be achieved with simple abdominal exercise machines or following exercise videos.⁵⁻⁸ Of all types of exercise, abdominal exercise is important because it can lead to an increase in core muscle strengthening. By stabilizing the central axis of the body,¹⁵ there is a reduction in lower back pain^{16,17} and less orthopedic stress on the hips and knees.^{16,17} Like other types of exercise, there is also a reduction in plasma lipids,¹⁸ increased recovery in oxygen kinetics following exercise training,¹⁹ improved function in cardiac patients,²⁰ and better blood pressure control during orthostatic stress.²¹

However, strength training of the abdominal muscles alone does not fully benefit the heart. The best workout for cardiovascular benefit is balanced with aerobic and anaerobic exercise.²² This type of workout fully increases the benefit to the heart as well as maximizes weight loss. In the present investigation, a portable abdominal trainer was used for anaerobic exercise combined with an exercise video for aerobic exercise. To test the effectiveness of this program, 27 subjects went on a 1200 calorie per day diet for 1 week, and cardiovascular fitness, muscle strength, body weight, and girth were measured.

SUBJECTS

All subjects were free of cardiovascular disease. The mean age, height, and weight of the subjects are provided in Table 1. The subjects were randomly divided into 2 groups: the control group (n=25) and the experimental group (n=27). An additional 7 subjects started in the experimental group but never completed more than the first few days, therefore their data are not included. All subjects signed an informed consent form and all procedures were approved by the Human Review Committee of Azusa Pacific University.

METHODS

Exercise Device

The exercise machine was a commercial exercise device produced by Savvier LP of Carlsbad, California, called the Cross Crunch machine (Figure 1). The device consisted of a rectangular plastic frame with an elastic band on the inside to adjust resistance. Resistance could be increased in 2 different stages so that it became increasingly difficult to compress the rectangle (50 or 75 lb [22.7 or 34 kg]). The upper part of the rectangle was placed in the subject's hands with the base of the machine on the seat to the left or right of the subject (Figure 1).

Table 1. General Characteristics of the Subjects (Mean \pm Standard Deviation)

	Height (cm)	Weight (kg)	Age (y)
Controls (n=25)	170.6 \pm 8.9	86.6 \pm 21.7	29.9 \pm 8.0
Experimental (n=27)	168.8 \pm 11.4	82.3 \pm 16.8	39.1 \pm 12.2



Figure 2. Measuring muscle strength.

The device was then compressed fully by the subject flexing his or her trunk to the side, thereby exercising the core muscles.

COMPLIANCE

For the experimental group, a compliance scale was used. Subjects were asked to complete a log sheet on a daily basis for compliance with the diet and exercise program, as well as log any foods eaten that were not on the diet and the date they were eaten.

The diet compliance scale was as follows:
0=deviated from the diet completely all days

- 1=deviated from the diet 6 days
- 2=deviated from the diet 5 days
- 3=deviated from the diet 4 days
- 4=deviated from the diet 3 days
- 5=deviated from the diet 2 days
- 6=deviated from the diet 1 day
- 7=did not deviate.

The exercise compliance scale was as follows:
0=deviated from the exercise completely all 6 days

- 1=deviated from the exercise 5 days
- 2=deviated from the exercise 4 days
- 3=deviated from the exercise 3 days
- 4=deviated from the exercise 2 days
- 5=deviated from the exercise 1 day
- 6=did not deviate.

MEASUREMENT OF STRENGTH

Strength was measured with a modified exercise device. The device consisted of standard abdominal crunch machine with strain gauges added to measure the compression force (Figure 2). Subjects were asked to compress the device with their abdominal muscles while bending to the left and right sides. Force was measured on 3 occasions with 1 minute between each measurement. The strength of each 3-second contraction was recorded on a Biopac MP100 system (Biopac Inc., Goleta, CA) and the greatest strength in each direction was recorded as the maximum strength.

GIRTH MEASUREMENTS

Girth measurements were made by a measuring tape with a tensionometer that applied 3 grams of force during the measurements. The same person, a sen-

Table 2. Menu Used in the Diet for First Week

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Breakfast	1 scrambled egg white 1 scrambled egg with yolk 1/2 banana 8-12 oz water	1/2 orange 1/2 c chicken 8-12 oz water	1 c plain yogurt 1/2 banana 3 frozen pineapple slices 1 tsp coconut extract 8-12 oz water	1 scrambled egg white 1 scrambled egg with yolk 1/2 banana 8-12 oz water	1/2 orange 1/2 c chicken water	1 c plain yogurt 1/2 banana 3 frozen pineapple slices 1 tsp coconut extract water	1 scrambled egg white 1 scrambled egg with yolk 1/2 banana 8-12 oz water
Snack	1 c yogurt 8-12 oz water	1 large apple 8-12 oz water	1 orange 8-12 oz water	1 c yogurt 8-12 oz water	1 apple 8-12 oz water	1 orange 8-12 oz water	1 c yogurt 8-12 oz water
Lunch	3/4 c pasta 1/4 c chicken breast 1/4 apple 5 Tbl salsa 8-12 oz water	1/2 c cooked broccoli 1/2 bag ramen noodles boiled 1/2 bag crunched up eaten dry 1/2 c snow peas 1 orange 3 thin slices of turkey meat 1 tsp light sesame seed dressing or vinaigrette 8-12 oz water	2 slices whole wheat toast 1/2 chicken breast 1 slice sharp cheddar cheese 10 large spinach leaves mustard 8-12 oz water	3/4 c angel hair pasta 1 Tbl peanut butter for pasta 1/2 c broccoli 1/4 apple 8-12 oz water	1/2 c cooked broccoli 1/2 bag ramen noodles boiled 1/2 bag crunched up eaten dry 1/2 c snow peas 1 orange 3 thin slices of turkey meat 1 tsp light sesame seed dressing or vinaigrette 8-12 oz water	2 slices whole wheat toast 1/2 chicken breast 1 slice sharp cheddar cheese 10 large spinach leaves mustard 8-12 oz water	3/4 c pasta 1/4 c chicken breast 1/4 apple 5 Tbl salsa 8-12 oz water
Snack	1 c strawberries 8-12 oz water	1 banana 8-12 oz water	1 orange 8-12 oz water	Large handful leafy spinach 8-12 oz water	1 c strawberries 8-12 oz water	1 orange 8-12 oz water	1 c strawberries 8-12 oz water
Dinner	3 oz chicken breast 1/2 c grapes 1/2 c strawberries 1/2 c celery 1/2 c pineapple slices 1 Tbl ranch dressing 8-12 oz water	1 c spinach 2 tangerines 4 almonds 4 thin slices of peppered turkey meat 1/2 c cooked broccoli 1 tsp light sesame seed leaves dressing or vinaigrette 8-12 oz water	1/2 lb ground turkey 3 mushrooms 1 c celery 2 Tbl Jamaican jerk seasoning 1 c spinach 2 tsp light vinaigrette 8-12 oz water	3 oz chicken breast 1/2 c cooked broccoli 3 cooked asparagus spears 1 slice sharp cheddar cheese 1/2 c seedless grapes 8-12 oz water	1 c spinach leaves 2 tangerines 4 almonds 4 thin slices of peppered turkey meat 1/2 c cooked broccoli 1 tsp light sesame seed dressing or vinaigrette 8-12 oz water	1/4 lb ground turkey 3 mushrooms 1 c celery 2 Tbl Jamaican jerk seasoning 1 c spinach 2 tsp light vinaigrette 8-12 oz water	3 oz chicken breast 1/2 c cooked broccoli 3 cooked asparagus spears 1 slice sharp cheddar cheese 1/2 c seedless grapes 8-12 oz water
Snack	1 c plain yogurt 8-12 oz water	1/2 orange 8-12 oz water	3 frozen pineapples slices 8-12 oz water	Large handful leafy spinach 8-12 oz water	1 c plain yogurt 8-12 oz water	1/2 orange 8-12 oz water	3 frozen pineapple slices 8-12 oz water

ior student in the Doctor of Physical Therapy Program, performed all of the measurements.

DIET

The diet program was a low-fat, low-

sodium diet. The total caloric intake averaged 1213 calories per day. The diet menu is listed in Table 2, and the caloric composition is provided in Table 3.

Briefly, the diet was a low-fat (12% fat) diet with a balance of protein and carbo-

Table 3. Composition of Diet

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	% Diet
Fats (g)	29	34	29	37	35	28	33	12
Carbohydrates (g)	91	196	138	100	175	134	72	49
Protein (g)	124	103	90	74	113	90	131	39
Kcal total	1182	1448	1152	994	1424	1138	1152	
Average calories/day								1213

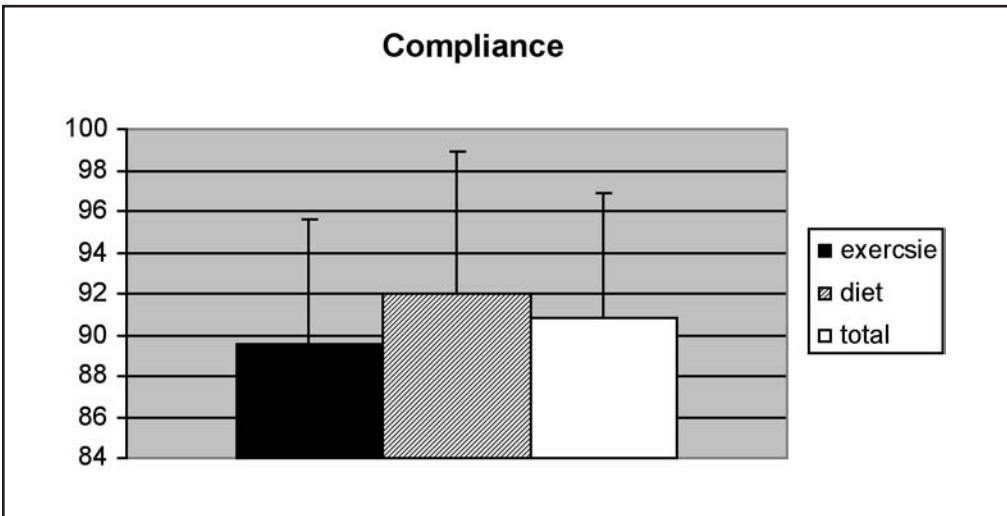


Figure 3. Compliance of the subjects.

hydrates as shown in Table 3. The caloric composition of the diet was determined from the United States Department of Agriculture tables as published at <http://USDA.com>. To avoid hunger, 3 snacks were provided between meals at additional times each day.

BLOOD PRESSURE

Blood pressure was measured by auscultation of the left arm. An automatic blood pressure cuff was used on the wrist (Omron Hem 621, Bannockburn, IL)

HEART RATE

Heart rate was determined by counting the radial pulse over a 15-second period and multiplying by 4.

BODY FAT CONTENT

Body fat content was measured by an impedance plethysmograph (RJL systems, Clinton Twp, MI).

VIDEO AND CROSS CRUNCH EXERCISE

The video that was used in the exercise sessions was the *Fat Burning Cardio* video produced by Savvier LP. *Fat Burning Cardio* is a 30-minute aerobic exercise video that consists of upper and lower body aerobic exercise with in-place jogging, walking, hopping, squats, and jazzercise with upper body movement. The tape had two segments. On alternate days, the additional 15-minute segment of the video was followed. For the Cross Crunch exercise, subjects bent

Table 4. Workout Sequence

Monday (Day 1)	Tuesday (Day 2)	Wednesday (Day 3)	Thursday (Day 4)	Friday (Day 5)	Saturday (Day 6)	Sunday (Day 7)
Cardio aerobic video	Cardio aerobic video	Cardio aerobic video	Cardio aerobic video	Cardio aerobic video	Cardio aerobic video	Rest day
Ab exercise video	Strength video	Ab exercise	Strength video	Ab exercise		

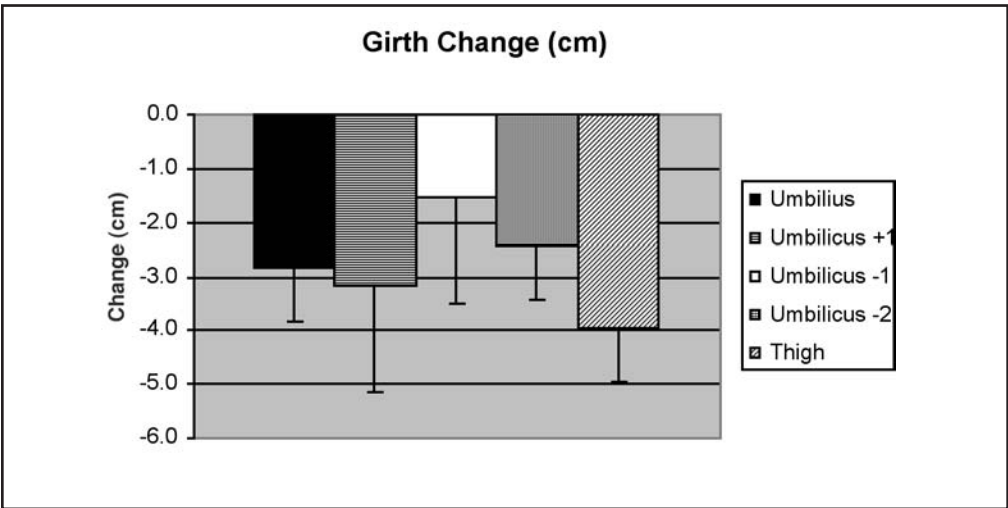


Figure 4. Girth changes at the waist and thigh in subjects following the diet and exercise program.

against the heaviest resistance band for 12 compressions to the left side and 12 compressions to the right side. This comprised about 1.5 minutes of abdominal exercise.

PROCEDURES

Experimental subjects engaged in a 1-week exercise and diet program. Measurements were taken before the program was started and after 1 week to assess the effectiveness of the diet and exercise program. All measurements were taken by personnel who were unaware of which group the participants were in, thus providing a single-blinded design. Measurements are listed below:

- (1) Measurement of muscle strength
- (2) Body fat and lean body mass
- (3) Girth measured at the waist and

thigh

- (4) Body weight
- (5) Heart rate and blood pressure
- (6) Cholesterol and triglycerides in the blood.

Subjects exercised as described under the Methods section and followed the diet shown in Tables 2 and 3 for 1 week. Subjects were encouraged to follow the exercise and diet program. The total workout time varied from 30 to 40 minutes per day. The workout program is shown in Table 4.

DATA ANALYSIS

Statistical analysis involved the calculations of means, standard deviations, analysis of variance (ANOVA), and t tests. The level of significance was $P < 0.05$.

Table 5. Girth in Control Subjects

	Umb	Loss Umb	Thigh	Loss Thigh	Umb +1	Loss +1	Umb -1	Loss -1	Umb -2	Loss -2
Girth	98.01	-0.09	63.56	-0.48	107.70	-0.11	109.09	-0.20	111.11	-0.28
SD	15.71	0.56	7.47	0.61	11.78	2.22	12.35	1.57	11.84	0.72
t value		0.43		0.32		0.81		0.53		0.16

Umb = umbilicus; umb +1 = umbilicus +1 inch; umb -1 = umbilicus -1 inch; umb -2 = umbilicus -2 inches.

Table 6. Girth loss in experimental subjects

	Umb	Loss umb	Thigh	Loss thigh	Umb+1	Loss +1	Umb -1	Loss -1	Umb -2	Loss-2
Girth	92.5	-2.8	57.8	-4.0	92.3	-3.2	96.3	-1.5	98.7	-2.4
SD	11.2	1.5	6.5	2.9	13.1	2.4	12.7	2.4	12.3	3.0
t value		0.00		0.00		0.00		0.02		0.05

Umb = umbilicus; umb +1 = umbilicus +1 inch; umb -1 = umbilicus -1 inch; umb -2 = umbilicus -2 inches.

RESULTS

Compliance

Compliance data for the diet and exercise program are shown in Figure 3. Seven of the subjects dropped out of the study because of personal reasons. Their data were excluded from the database. For the rest of the group, as can be seen in Figure 3, compliance for the program was $90.9\% \pm 11.3\%$. Figure 3 shows the breakdown of compliance for exercise and diet alone.

STRENGTH

For the control subjects, average strength on the left side was 76.6 ± 20.5 kg and 90.5 ± 28.4 kg at baseline measurement. The average strength difference between the first and second measurements was -1.0 ± 2.7 kg for the left side and -0.05 ± 2.7 kg for the right side; these differences were not significant.

Prior to the diet and exercise program, the strength of the experimental group for left flexion was 87.4 ± 19.2 kg and the average strength of the right flexion was 83.4 ± 20.3 kg. After the 1-week training period, strength increased by 9.3 ± 3.0 kg for right and 6.8 ± 7.2 kg for left flexion, a significant increase in strength ($P < 0.01$).

GIRTH

For the control subjects, the girth showed no significant difference from the before and after 1 week measurements as shown in Table 5 with the associated t values. However, for the subjects in the diet and exercise group, results were different.

As shown in Table 6 and Figure 4, the girth at the umbilicus, umbilicus +1 inch, minus 1, and minus 2 inches, and at the thigh all decreased significantly after the 1-week diet and exercise program ($P < 0.01$). At the waist, the average girth loss was 2.9 ± 1.4 cm (1.1 0.55 inches). This is equivalent to a loss of one pants or dress size in most people.

WEIGHT LOSS

From the starting weight shown in Table 1, subjects in the control group showed no statistical change in weight from the first to the second week. However, for the experimental group, as shown in Figure 5, there was a 2.4 ± 0.7 kg (5.3 ± 1.5 lb) loss in weight, which was significant ($P < 0.01$).

CARDIOVASCULAR FITNESS

For the control subjects, the average systolic blood pressure was 125.8 ± 11.6 mm Hg while the diastolic was 81.2 ± 7.1

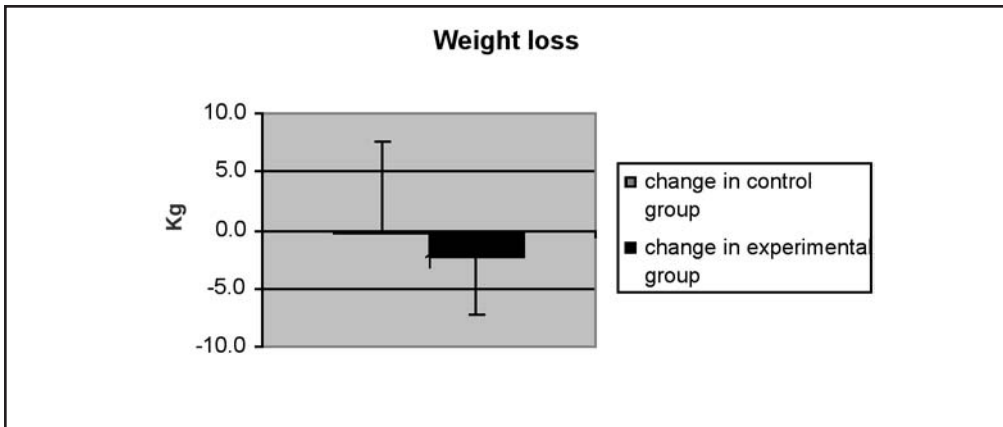


Figure 5. Weight loss in control and diet groups over 1 week.

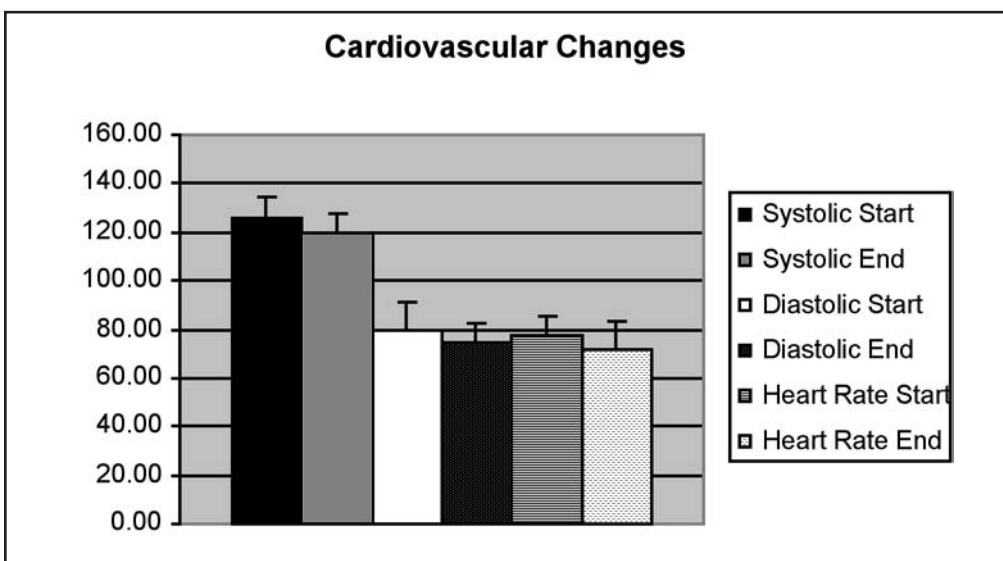


Figure 6. Heart rate and blood pressure changes in the experimental group before and after the 1-week diet and exercise program.

mm Hg at the first measurement. The starting average heart rate was 77.4 ± 7.5 beats per minute. There was no significant difference between the first and the second set of measurements. For the experimental group, as shown in Figure 6, there was a significant reduction in systolic and diastolic blood pressure and heart rate ($P < 0.05$). Blood pressure and heart rate were reduced by 6.3 ± 5.1 systolic/ 4.9 ± 3.8 diastolic mm Hg and 6.1 ± 7.2 beats per minute, respectively.

BLOOD CHEMISTRY

For the control group, the total cholesterol started at 219 ± 53 , LDL at 146.6 ± 42.3 , and triglycerides at 150.1 ± 32.5 . There was no significant change in the second value versus the first value. For the experimental group, as shown in Figure 7, there was a significant reduction in all 3 indicators of heart disease ($P < 0.01$).

DISCUSSION

Aerobic exercise is a common form of

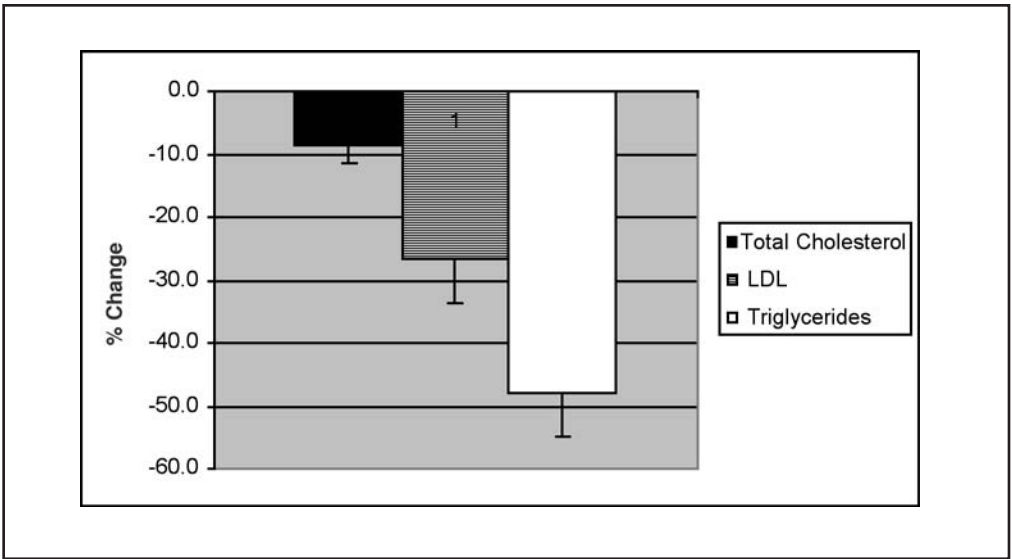


Figure 7. Blood chemistry before and after weight loss in the diet group.

exercise used in physical training.^{22,23} It is usually assumed that aerobic training is accomplished by steady continuous work that requires high energy use.^{22,23} However, recent studies show that considerable muscle activity during aerobic training can be achieved with simple abdominal exercise machines^{24,25} or following exercise videos,⁵⁻⁷ and this results in good aerobic and anaerobic training. But the key to exercise is making it short enough in duration, but at the same time intense enough, so that there is good subject compliance⁷ and training. In this investigation, compliance averaged $90.9\% \pm 11.3\%$, a very good compliance for this group of subjects. Thus, the intensity and duration of this exercise and diet program were effective. Although the subjects were compliant, the program itself must also provide good benefits for the subjects.

In the present investigation, a 1-week exercise and diet program caused a dramatic reduction in blood pressure, cardiac work (heart rate x blood pressure), and abdominal fat. Aside from the psychological advantage of losing weight and feeling fit (this study showed a loss

of 1 clothing size in a week); the long-term health benefits of such a program would be to reduce the health care risks of diabetes, heart attack, and stroke. Furthermore, dieting has many psychological benefits.^{9,10} From a psychological standpoint, a 1-week diet and fitness program that can produce results is important because it encourages compliance with the program. The diet used here had a high compliance rate, showing its acceptance. Furthermore, the exercise program is a program that can be continued for life and involves less than 1 hour a day to complete. These types of combined aerobic and anaerobic programs provide good long-term training benefits and risk reduction of heart disease. Thus, the 2 together should promote fitness and health with long-term use.

The best testament to the physiological benefits of this program are increased cardiovascular fitness as assessed by blood pressure and heart rate reductions at rest as well as reduced stress on the heart. In recent studies, a reduction in blood pressure alone by only 2.5 mm Hg reduced the risk of

heart attack and stroke by 12%.²⁶ Here, heart rate and blood pressure reductions would be associated with at least a 10% reduction in heart attack in just the first week of the program. Furthermore, abdominal body fat has been shown to be an important determinant of people developing diabetes.^{27,28} When people have both high blood pressure and high abdominal fat, the risk of heart attack and stroke rises considerably.^{26,27}

Abdominal and lower back strength is important in preventing lower back soft-tissue injuries during lifting tasks.^{16,17} Iwai et al showed that muscle strength was directly related to disability level and lower back pain in young individuals such as collegiate wrestlers.²⁹ Paraspinal and abdominal muscle dysfunction first leads to abnormal muscle activity during exercise,³⁰ and later to reduced muscle strength and eventual back injury.³¹ Here, the increase in abdominal strength should lead to less back pain and fewer back injuries for people using this equipment.

CONCLUSION

A 1200 calorie per day diet and abdominal exercise program were well accepted by the experimental group. Compliance for the program was over 90%. Muscle strength, with a combination aerobic and anaerobic exercise program for the abdominal muscles, increased significantly. For the experimental group, after 1 week, abdominal strength increased by about 10%. The weight loss and change in abdominal circumference were equal, after 1 week, to approximately a clothing size. In summary, the diet and exercise program used here, which requires minimal time each day, provides a safe workout and diet for people to use. Since the abdominal workout can be accomplished from a chair, the program is good for older people and poorly conditioned people who may not be able to

lie on the floor. The program can be appropriate for a wide variety of people who need to lose weight and increased fitness.

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