

# Cardiovascular and Fitness Benefits of a One-Month Home Exercise and Weight Loss Program

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## ABSTRACT

Nine male and 13 female subjects (age range, 22 to 53 years) participated in a one-month weight loss program that combined diet with aerobic exercise and isokinetic exercise on a 6 Second Abs abdominal machine. Nineteen of the research subjects completed the study. Considering the diet was less than 1500 calories per day, the subjects who completed the studies average compliance rate was excellent; the average compliance rate was 92.6% for exercise and 93.3% for diet. Thus, the combined compliance rate for the diet and exercise program averaged 92.9%. The average person on the diet reduced their weight by  $6.2\% \pm 2.1\%$ . This translated to a change in body mass index of  $1.7\% \pm 0.9\%$ . There were numerous benefits to the diet and exercise program. First, for the total group, there was a 6% reduction ( $8.6 \text{ mmHg} \pm 11 \text{ mmHg}$ ) in systolic

blood pressure, a 2.8% reduction in heart rate, a reduction of 24.2 mg % cholesterol, 52.3 mg % triglyceride, and a reduction of 4.2 mg % LDL from the beginning to the end of the program. These increases in cardiovascular fitness were associated with an over 400% increase in the 6 Second Abs machine workload by the subjects. The subjects used the 6 Second Abs machine at home.  $\text{VO}_2$  max of the abdominal muscles nearly doubled and muscle thickness increased by about 5.8%. Thus, a diet and 30 minute a day exercise program proved quite valuable in increasing the overall health and fitness of these subjects.

## INTRODUCTION

Numerous books and articles have been written on various types of diet and exercise programs. While it is universally agreed that diet and exercise programs are good for general health, there is no agreement on the best diet or the best type of exercise program. Diets that are especially low in fat can cause

**Table 1.** Demographics

	Age years	Height cm	Weight 1 kg	Weight 2 kg	Change kg	% Change in Weight	BMI start	BMI end	Change in BMI
Group mean	30.4	168.5	85.1	79.8	-5.3	-6.2	29.7	28.0	-1.7
Group SD	8.5	9.6	18.6	17.8	1.9	2.1	4.8	4.8	0.9
Male mean	32.0	175.2	96.8	91.2	-5.7	-6.0	31.5	29.9	-1.8
Male SD	4.3	8.3	14.7	15.0	1.7	1.9	5.0	5.3	0.9
Female mean	29.0	163.0	75.5	70.6	-5.0	-6.4	28.1	26.5	-1.6
Female SD	10.9	6.8	16.1	14.6	2.1	2.3	4.3	3.9	0.9

**Figure 1.** Subject using 6 Second Abs machine.**Figure 2.** Subject during VO<sub>2</sub> measurements.

an increase in thermogenesis, which increases the caloric expenditure of the body.<sup>1</sup> This increase in thermogenesis is amplified by concurrent exercise, not only during exercise but throughout the day.<sup>2-4</sup> Therefore, there is a substantial advantage to combining both types of programs for weight loss.

The combination of a weight loss and exercise program also has many general benefits to overall health. Lack of exercise, for example, leads to obesity, an increase in plasma triglycerides, borderline high glucose levels, and a rise in LDL lipids that can lead to heart disease.<sup>5</sup> Further, obesity, in turn, causes an increase in inflammatory cytokines and C reactive protein, which can then lead to the early onset of type 2 diabetes.<sup>6,7</sup>

Even without the development of

type 2 diabetes, increased inflammatory cytokines are linked to the production of superoxides, which damage tissue.<sup>8</sup> Therefore, even if someone does not develop diabetes, endothelial damage can still occur secondary to obesity. This in turn, leads to damage to the autonomic nervous system.<sup>8</sup>

Although diet alone is helpful in reducing body weight, exercise can directly reverse some of the damage associated with impaired nitric oxide production from long-term exposure to the inflammatory cytokines in obesity.<sup>9</sup> Obviously, exercise must be of a certain minimal duration to have long-term effects on the body.<sup>10-12</sup> In a recent study, we examined the combination of a low-fat mixed carbohydrate protein diet and a 30 to 35 minute a day exercise

**Table 2.** Menu for the First Week of the Diet

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Breakfast	1 scrambled egg; 1 scrambled egg with yolk; 1/2 banana; 8-12 oz water	1/2 orange; 1/2 cup chicken; 8-12 oz water	1 cup plain yogurt; 1/2 banana; 3 frozen pineapple slices; 1 tsp coconut extract; 8-12 oz water	1 scrambled egg; 1 scrambled egg with yolk; 1/2 banana; 8-12 oz water	1/2 orange; 1/2 cup chicken; water	1 cup plain yogurt; 1/2 banana; 3 frozen pineapple slices; 1 tsp coconut extract; water	1 scrambled egg; 1 scrambled egg with yolk; 1/2 banana; 8-12 oz water
Snack	1 yogurt 8-12 oz water	1 large apple; 8-12 oz water	1 orange; 8-12 oz water	1 yogurt; 8-12 oz water	1 apple; 8-12 oz water	1 orange; 8-12 oz water	1 yogurt; 8-12 oz water
Lunch	3/4 cup pasta; 1/4 cup chicken breast; 1/4 apple; 5 tbs salsa; 8-12 oz water	1/2 cup cooked broccoli; 1/2 bag dry baked Ramen Noodles, boiled; 1/2 bag crunched up 1/2 cup snow peas; 1 orange; 3 thin slices of turkey meat; 1 tsp lite 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 cup angel hair pasta; 1 tbs peanut butter for pasta; 1/2 cup broccoli; 1/4 apple; 8-12 oz water	1/2 cup cooked broccoli; 1/2 bag dry baked Ramen noodles, boiled 1/2 bag crunched up; 1/2 cup snow peas; 1 orange; 3 thin slices of turkey meat; 1 tsp lite 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 cup pasta; 1/4 cup chicken breast; 1/4 apple; 5 tbs salsa; 8-12 oz water
Snack	1 cup 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 cup strawberries; 8-12 oz water	1 orange; 8-12 oz water;	1 cup straw-berries; 8-12 oz water
Dinner	3 oz chicken breast; 1/2 cup grapes; 1/2 cup strawberries; 1/4 cup celery; 1/2 cup pineapple slices; 1 tbs ranch dressing; 8-12 oz water	1 cup spinach leaves; 2 tangerines; 4 almonds; 4 thin slices of peppered turkey meat; 1/2 cup cooked broccoli; 1 tsp lite sesame seed dressing or vinaigrette; 8-12 oz water	1/4 lb ground turkey; 3 mushrooms; 1 cup celery; 2 tbs Jamaican jerk seasoning; 1 cup spinach; 2 tsp lite vinaigrette; 8-12 oz water.	3 oz chicken breast; 1/2 cup cooked broccoli; 3 cooked asparagus; 1 slice sharp cheddar cheese; 1/2 cup seedless grapes; 8-12 oz water	1 cup spinach leaves; 2 tangerines; 4 almonds; 4 thin slices of peppered turkey meat; 1/2 cup cooked broccoli; 1 tsp lite sesame seed dressing or vinaigrette; 8-12 oz water	1/4 lb ground turkey; 3 mushrooms; 1 cup celery; 2 tbs Jamaican jerk seasoning; 1 cup spinach; 2 tsp lite vinaigrette; 8-12 oz water	3 oz chicken breast; 1/2 cup cooked broccoli; 3 cooked asparagus; 1 slice sharp cheddar cheese; 1/2 cup seedless grapes; 8-12 oz water
Snack	1 cup plain yogurt; 8-12 oz water	1/2 orange; 8-12 oz water	3 frozen pineapple slices	Large handful leafy spinach; 8-12 oz water	1 cup plain yogurt; 8-12 oz water	1/2 orange; 8-12 oz water	3 frozen pineapple slices

program, sustained for one week, on weight loss and cardiovascular indicators (ie, blood pressure).<sup>13</sup> We found that the combination of aerobic and anaerobic exercise programs and abdominal exercise with a 1200 calorie per day diet can cause a dramatic reduction in weight, girth, and blood pressure in just one week. However, this study raised the following additional ques-

tions: 1) What would the compliance in a 1-month program be? 2) How much would body girth measurements change if the study were sustained for 1 month? 3) What long-term benefits in cholesterol and triglycerides would be seen in a 1-month program? and, 4) What changes would be seen in overall muscle fitness? Therefore, the present investigation was conducted to do a more sys-

**Table 3.** Menu for the Second Week of the Diet

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Breakfast	6 egg whites; 1 slice whole wheat toast; 2 links vegetarian sausage	1 cup cooked oatmeal; 1/2 cup skim milk	3/4 cup raisin bran; 1/2 cup skim milk	1 1/2 cups plain yogurt; 1 banana; 1/4 cup ff granola	6 egg whites; 1 slice whole wheat toast; 2 links vegetarian sausage	1 cup cooked oatmeal; 1/2 cup skim milk	3/4 cup raisin bran; 1/2 cup skim milk
Snack	1 orange	2 stalks celery; 5 tbs fat-free bean dip	2 oz low-fat cheese	1 hard boiled egg; 5 baby carrots	1 orange	2 stalks celery; 5 tbs fat-free bean dip	2 oz low-fat cheese
Lunch	Healthy burrito: 1 whole wheat tortilla; 1/2 cup black beans; 1/2 cup fresh salsa; 2 oz low-fat cheese; Tabasco to taste	High-fiber pasta: 1 cup cooked whole wheat pasta; 1/2 cup low-fat marinara sauce; 4 oz ground turkey; 1 cup cooked spinach	Chicken kabob, Place on a skewer: 4 oz chicken, cut; 1 small green pepper, cut; 5 cherry tomatoes; 3 large mushrooms	Pizza: 1 slice cheese pizza; Top with 1/2 cup each steamed broccoli and mushrooms	Healthy burrito: 1 whole wheat tortilla; 1/2 cup black beans; 1/2 cup fresh salsa; 2 oz low-fat cheese; Tabasco to taste	High-fiber pasta: 1 cup cooked whole wheat pasta; 1/2 cup ff marinara sauce, 4 oz ground turkey, 1 cup cooked spinach	<i>Lunch:</i> Chicken kabob: Place on a skewer: 4 oz chicken, cut; 1 small green pepper, cut; 5 cherry tomatoes; 3 large mushrooms
Snack	1 apple	1/2 cup 1% fat cottage cheese; 5 baby carrots	1 orange	2 stalks celery; 5 tbs fat-free bean dip	1 apple	1/2 cup 1% fat cottage cheese; 5 baby carrots	1 orange
Dinner	Chicken teriyaki, sauté in non-stick pan; 5 oz chicken breast cut in strips; 1 cup broccoli; 5 large mushrooms; 2 tbs Lite teriyaki marinade	Tuna salad: 2 cups mixed greens; 4 cherry tomatoes; 3 large mushrooms; 4 slices cucumber; 1 can drained light tuna in water; 1 tbs fat-free dressing	Soup and salad: Soup: 2 cups low-fat, low-salt, tomato vegetable soup (ie, Healthy Valley); Add 1/2 cup frozen vegetables  Egg salad, chop together: 1 hard boiled egg; 6 egg whites	Chicken caesar: 3 cups chopped romaine lettuce; 4 cherry tomatoes; 5 oz baked chicken; 2 tbs fat-free dressing; 2 tbs fat-free parmesan	Chicken teriyaki, sauté in non-stick pan: 5 oz chicken breast cut in strips; 1 cup broccoli; 5 large mushrooms; 2 tbs Lite teriyaki marinade	Tuna salad: 2 cups mixed greens; 4 cherry tomatoes; 3 large mushrooms; 4 slices cucumber; 1 can drained light tuna in water; 1 tbs fat-free dressing	Soup and salad: Soup: 2 cups low-fat, low-salt, tomato vegetable soup (ie, Healthy Valley); Add 1/2 cup frozen vegetables  Egg salad, chop together: 1 hard boiled egg; 6 egg whites 2 tbs fat-free mayo; 2 tbs fat-free mayo; Place on 5 leaves romaine or mixed greens
Snack	Spinach salad 2 cups raw spinach; 1 tbs fat-free dressing	1 orange	1 apple	1 apple	Spinach salad 2 cups raw spinach; 1 tbs fat-free dressing	1 orange	1 apple

tematic study of the effects of such a program over a 1-month period on overall health.

## SUBJECTS

The subjects in the study were 9 males and 13 females; ages, heights, and weights are listed in Table 1, along with the appropriate standard deviations. Before being accepted into the study, all individuals had to have a body mass

index of at least 15 and be capable of losing at least 8 kg. All experimental methods and procedures were approved by the Institutional Review Board at Azusa Pacific University. All experimental procedures, risks, and benefits were explained in detail to all subjects. Each subject acknowledged voluntary participation by signing an informed consent statement.

The average age of the subjects was

**Table 4.** Menu for the Third Week of the Diet

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Breakfast	Breakfast burrito: 4 egg whites; 1/4 cup salsa; Wrap in whole wheat tortilla	3/4 cup raisin bran; 1/2 cup skim milk; 3 egg whites	1 cup oatmeal; 1/2 cup skim milk	Omelet: 4 egg whites; 2 oz low-fat cheese; 1 tbs each of chopped onion & green pepper; 2 vegetarian sausage links	Breakfast burrito: 4 egg whites; 1/4 cup salsa; Wrap in whole wheat tortilla	3/4 cup raisin bran; 1/2 cup skim milk; 3 egg whites	1 cup oatmeal; 1/2 cup skim milk
Snack	1 vanilla non-fat yogurt	10 strawberries; 1/2 cup 1% fat cottage cheese	1 orange	10 strawberries; 1 cup 1% fat cottage cheese	1 vanilla non-fat yogurt	10 strawberries; 1/2 cup 1% fat cottage cheese	1 orange
Lunch	Chef salad: 2 oz low-fat cheese; 3 oz lean ham; 2 cups mixed greens; 1 tbs fat-free dressing; 4 WASA crackers	Veggie burger: 1 veggie burger; 1 whole wheat pita; 5 leaves romaine lettuce; 1 tsp Dijon mustard	Tuna salad: 2 cups mixed greens; 4 cherry tomatoes; 3 large mushrooms; 4 slices cucumber; 1 can drained light tuna in water; 1 tbs fat-free dressing	Ham sandwich: 1 whole wheat pita; 3 oz lean ham; 1 tsp Dijon mustard; 5 leaves romaine	Chef salad: 2 oz low-fat cheese; 3 oz lean ham; 2 cups mixed greens; 1 tbs fat-free dressing; 4 WASA crackers	Veggie burger: 1 veggie burger; 1 whole wheat pita; 5 leaves romaine lettuce; 1 tsp Dijon	Tuna salad: 2 cups mixed greens; 4 cherry tomatoes; 3 large mushrooms; 4 slices cucumber; 1 can drained light tuna in water; 1 tbs fat-free dressing
Snack	1 apple	1 orange	10 strawberries; 2 oz low-fat cheese	2 tbs low-fat peanut butter; 1 apple	1 apple	1 orange	10 strawberries; 2 oz low-fat cheese
Dinner	Faux fried chicken: Sprinkle 4 oz chicken breast with 2 tbs bread-crumbs and bake; 1 cup broccoli	Chicken kabob (grill or bake): Place on skewer: 5 oz chicken, cut; 1 small green pepper, cut; 5 cherry tomatoes; 3 large mushrooms	Soup and salad 2 cups low-fat, low-salt, bean and vegetable soup (ie, Healthy Valley); Add 1/2 cup frozen vegetables  Egg salad: 1 boiled egg, chopped; 6 egg whites; Mix with 2 tbs fat-free mayo; Place on 5 leaves of romaine lettuce	Seafood skewer: Place 10 medium shrimp on skewer; Cover with 2 tbs Lite teriyaki marinade and broil; 1 cup steamed zucchini; 8 slices cucumber; 1 tbs fat-free dressing	Faux fried chicken: Sprinkle 4 oz chicken breast with 2 tbs bread-crumbs and bake; 1 cup broccoli	Chicken kabob (grill or bake): Place on skewer: 5 oz chicken, cut; 1 small green pepper, cut; 5 cherry tomatoes; 3 large mushrooms	Soup and salad 2 cups low-fat, low-salt, bean vegetable soup (ie, Healthy Valley); Add 1/2 cup frozen vegetables Egg salad: 1 boiled egg, chopped; 6 egg whites; Mix with 2 tbs fat-free mayo; Place on 5 leaves of romaine lettuce
Snack	1 oz low-fat cheese; 1 carrot	1 baked apple with cinnamon	1/2 cup grapes	1 orange	1 oz low-fat cheese; 1 carrot	1 baked apple with cinnamon	1/2 cup grapes

30.4 years  $\pm$  8.5 years. There was no statistical difference between the age of the male and female subjects. However, the average height of the group was 168.5 cm  $\pm$  9.6 cm, and was greater in the male subjects (175.2 cm  $\pm$  8.3 cm) when compared to the female subjects (163.0 cm  $\pm$  6.8 cm) ( $P < 0.05$ ). The average weight of the group before the diet was 85.1 kg  $\pm$

18.6 kg with an average weight loss of 5.3  $\pm$  1.9 kg after the diet. This weight loss amounted to a reduction of 6.2% of body weight. While the men lost more weight than women (Table 1), the percent change in body weight was actually higher in the women than the men, averaging 6.4%  $\pm$  2.3% in the women and 6.0%  $\pm$  1.9% in the men. The average

**Table 5.** Menu for the Fourth Week of the Diet

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Breakfast	1 cup oatmeal; 1/2 cup skim milk	Omelet: 4 egg whites; 2 oz low-fat cheese;	3/4 cup raisin bran; 1/2 cup skim milk	1 1/2 cups plain yogurt; 1 banana; 1/4 cup fat-free granola	1 cup oatmeal; 1/2 cup skim milk	Omelet: 4 egg whites; 2 oz low-fat cheese;	3/4 cup raisin bran; 1/2 cup skim milk
		1 tbs each chopped onion & green pepper				1 tbs each chopped onion & green pepper	
Snack	1 cup 1% fat cottage cheese	1 cup cantaloupe	1 apple; 1/2 cup 1% fat cottage cheese	1 hard boiled egg	1 cup 1% fat cottage cheese	1 cup cantaloupe	1 apple; 1/2 cup 1% fat cottage cheese
Lunch	Seafood pasta: 1 cup whole wheat pasta; 1/2 cup marinara; 5 medium shrimp; 2 cups tossed salad with 1 tbs fat-free dressing	Turkey burger: 5 oz lean, ground turkey; 1 whole wheat pita; 2 slices tomato; 1 tsp Dijon mustard	Peanut butter sandwich: 2 tbs low-fat peanut butter; 1 whole wheat pita; 1 cup Cantaloupe	Veggie burger: 1 veggie burger; 2 oz low-fat cheese; 2 slices tomato; 1 tsp Dijon mustard; 1/2 whole wheat pita	Seafood pasta: 1 cup whole wheat pasta; 1/2 cup marinara; 5 medium shrimp; 2 cups tossed salad with 1 tbs fat-free dressing	Turkey burger: 5 oz lean, ground turkey; 1 whole wheat pita; 2 slices tomato; 1 tsp Dijon mustard	Lunch: Peanut butter sandwich: 2 tbs low-fat peanut butter; 1 whole wheat pita; 1 cup cantaloupe
Snack	2 stalks celery; 5 tbs low-fat bean dip	1 non-fat vanilla yogurt	2 stalks celery; 5 tbs low-fat bean dip	1 cup cantaloupe	2 stalks celery; 5 tbs low- fat bean dip	1 non-fat vanilla yogurt	2 stalks celery; 5 tbs low-fat bean dip
Dinner	Chicken teriyaki, sauté in non- stick pan: 5 oz chicken breast cut in strips; 1 cup broccoli; 5 large mushrooms; 2 tbs Lite teriyaki marinade	Flounder florentine: Wrap 5 oz piece flounder or sole around; 1/2 cup cooked spinach; Top with 2 tbs breadcrumbs and bake	Chicken caesar: 3 cups chopped romaine lettuce; 4 cherry tomatoes; 5 oz baked chicken; 2 tbs fat-free dressing; 2 tbs fat-free Parmesan	Ham dinner: 5 oz lean baked ham; 1 cup spinach; 2 cups tossed salad; 1 tbs fat-free dressing	Chicken teriyaki, sauté in non-stick pan: 5 oz chicken breast cut in strips; 1 cup broccoli; 5 large mushrooms; 2 tbs Lite teriyaki marinade	Flounder florentine: Wrap 5 oz piece flounder or sole around; 1/2 cup cooked spinach; Top with 2 tbs breadcrumbs and bake	Chicken caesar: 3 cups chopped tomaine lettuce; 4 cherry tomatoes; 5 oz baked chicken; 2 tbs fat-free dressing; 2 tbs fat-free Parmesan
Snack	1 tangerine	1 baked apple with cinnamon	1 tangerine	1 apple	1 tangerine	1 baked apple with cinnamon	1 tangerine

loss in body weight in both groups amounted to change in body mass index (BMI) of 1.7 units  $\pm$  .9 units.

## METHODS

### 6 Second Abs Machine

The 6 Second Abs machine is a commercial exercise device (Savvier LP, Carlsbad, Calif). It consists of a rectangular plastic frame with rubber bands on the inside to adjust resistance.

Resistance can be increased in a number of different stages so that it becomes increasingly more difficult to compress the rectangle (Figure 1). As the machine is compressed to the first, second, and third click position, there is a linear increase in load. The upper part of the rectangle is placed under the subject's arms (under the triceps muscles, bilaterally) or held in the subject's arms

against the chest, while the base of the rectangle is placed on top of the middle of the quadriceps muscles. Both the upper and lower rectangles of the machine are padded.

### Diet

The diet consisted of a low-fat, low-sodium diet. The total calories averaged about 1300 calories per day. The diet is listed in Tables 2, 3, 4, and 5. A stringent diet of an average 1200 calories per day was followed in the first week (Table 2) and then the diets for the second week (Table 3), third week (Table 4) and fourth week (Table 5) were more relaxed. It was a low-fat diet (12% fat) with a balance of protein and carbohydrates. To avoid hunger, 3 snacks were provided between meals each day. The composition of the first week of the diet

**Table 6.** Composition of Diet in the First Week

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	% Diet
Fats (% of diet)	29	34	29	37	35	28	33	12
Carbohydrates (% of diet)	91	196	138	100	175	134	72	49
Protein (% of diet)	124	103	90	74	113	90	131	39
Cholesterol (mg/dL)	614	249	213	518	518	240	696	
Kcal	1182	1448	1152	994	1424	1138	1152	
Average calories/day								1213

is shown in Table 6.

### Blood Pressure

Blood pressure was measured by auscultation of the left arm. An automatic blood pressure cuff was used on the wrist. The arm was always placed so that the wrist was at heart level for blood pressure measurements.

### Heart Rate

Heart rate was determined by counting the radial pulse over a 10-second period and multiplying by 6.

### Girth Measurements

Girth measurements were made using a measuring tape with a tensometer that applied 3 grams of force during the measurements. A senior student in the doctor of physical therapy program made all measurements. The landmarks for girth measurements were done from anatomical markers such as the hip joint, and measurements were made by tape above and below these markers to assure reliability.

### Video Exercise

The “Fat Burning Carbo,” “Rock Hard Abs,” and “Total Body” videos used for the exercise sessions were produced by Savvier LP. The “Fat Burning Cardio” video provides 30-minutes of upper and lower body aerobic exercise that consisted of in place jogging, walking, hopping, squats, and jazzercise with upper body movement. The “Rock Hard Abs” video provided a 15-minute mixed aerobic and muscle strength-training workout with a

5-minute 6 Second Abs workout 3 times per week. The “Total Body” video called for 30 minutes of aerobics using circuit-training involving marching, working aerobically with elastic exercise bands for the upper and lower body, and kickboxing.

### Assessment of Compliance

Compliance with the program was assessed in 2 ways. First a 6-point scale was used to assess exercise compliance each week. The scale was as follows: 0 indicated did not exercise at all; 1, exercised 1 day of the 6 required; 2, exercised 2 days of the 6 required; 3, exercised 3 days of the 6 required; 4, exercised 4 days of the 6 required; 5, exercised 5 days of the 6 required; and 6, exercised all 6 days.

There was also a diet compliance scale as follows: 0 indicated did not follow the diet; 1, cheated 6 days; 2, cheated 5 days; 3, cheated 4 days; 4, cheated 3 days; 5, cheated 2 days; 6, cheated 1 day; and 7, did not cheat.

For the diet compliance scale, subjects were asked to date and log in any additional foods that they ate that were not on the diet.

### Measurement of Strength of the Abdominal Muscles

Isometric strength of the abdominal muscles was measured in the supine position. To accomplish this, the subjects laid down initially with the hips at a 90° angle. A cotton strap was placed around the chest and connected to an isometric

**Table 7.** Workout Sequence

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
"Total Body" video	Fat burning Cardio	"Total Body" video	Fat burning "Cardio	"Total Body" video	Fat burning "Cardio	Rest day
"Rock Hard Abs" Workout #1	Video" or Aerobic "Workout	"Rock Hard Abs" Workout #2	Video" or Aerobic Workout	"Rock Hard Abs" Workout #2	Video" or Aerobic Workout	

strain gage transducer. The strain gage was linear in the range of 0 to 200 kg of force. The output of the transducer was amplified with a strain gage conditioner amplifier with a gain of 1000. The display, a Westin 1971 panel meter, was calibrated in force in kilograms. A two arm Wheatstone Bridge was used in the strain gage amplifier with a sample and hold circuit such that subjects could observe their maximum effort, and the display held the maximum reading for each force measurement. In practice, strength was measured as the greatest of 3 maximal efforts with the subject trying to sit up from the supine position.

### **Oxygen Consumption, Ventilation, Carbon Dioxide Production and Respiratory Quotient**

A VO-2000 portable metabolic cart (Aerosport Inc., Minneapolis, Minn) was used to measure airflow and oxygen use. The analyzer is a battery operated metabolic cart containing a CO<sub>2</sub> infrared analyzer, a fuel cell based oxygen analyzer and a pneumotachometer. The analyzer was calibrated with the local barometric pressure and temperature at the beginning of each experiment. The analyzer then sampled expiratory gases through a mouthpiece. Since a mouthpiece was used, the subjects wore a nose clip. The gas was sampled breath by breath and all gas values were averaged over 3 breaths. Ventilation, oxygen consumption, and carbon dioxide production were then converted to standard pressure and temperatures (STPD) and stored in the memory of the analyzer

(Figure 2).

### **Blood Lactate**

An Accusport fingertip lactic acid analyzer measured blood lactate. The blood sample was taken from the subject's fingertip, warmed to 40°C for 5 minutes in warm water to assure a free arterial flow of blood. The sample size was 25 µL. The sample was taken 5 minutes after the subject stopped exercising.

### **Measurement of Body Fat Content**

Total body fat content was measured on a Norland DEXA. Dual x-ray absorptiometry was used to scan the entire body and measure lean body mass and total body fat content.

### **Measurement of Thickness of Abdominal Muscles**

High-resolution 2D ultrasound was used to measure the thickness of the abdominal muscles before and after weight loss.

### **Clinical Venous Chemistry**

Blood samples were drawn before and after weight loss and analyzed for electrolytes, cholesterol, triglycerides, and CBC count.

### **STATISTICAL ANALYSIS**

Statistical analysis involved the calculation of means, standard deviations, and paired and unpaired T tests. The level of significance was  $P < 0.05$ .

### **PROCEDURES**

Subjects were in a one-month weight loss and exercise program. Before and after the program, baseline measure-



**Table 8.** Cardiovascular Changes Before and After Weight Loss and Exercise Program\*

	Systolic BP				Diastolic BP				HR pre	HR post	Change
	pre	post	Change	%	pre	post	Change	%			
Group mean	135.6	127.1	-8.6	-6.0	87.3	84.5	-2.8	-2.8	76.0	73.1	-2.9
Group SD	10.5	10.6	11.0	7.6	8.6	9.5	9.0	10.1	11.8	12.8	9.9
Male mean	135.3	128.4	-6.9	-4.7	88.8	84.1	-4.7	-4.4	71.0	67.9	-3.1
Male SD	11.3	7.6	10.8	7.4	10.2	5.0	9.1	10.0	9.7	13.1	9.8
Female mean	135.8	125.9	-9.9	-7.2	86.0	84.8	-1.2	-1.5	80.0	77.4	-2.6
Female SD	10.3	12.8	11.5	8.0	7.2	12.2	9.1	10.5	12.3	11.4	10.5

\*BP indicates blood pressure; HR, heart rate; pre, before exercise and weight loss program; and post, after exercise and weight loss program.

ments were taken to assess the effectiveness of both the diet and the exercise program. The measurements taken before and after weight loss included body fat content, abdominal muscle strength, abdominal max Vo<sub>2</sub> using a modified Bruce protocol, abdominal muscle size, and girth of major areas of the body. A modified Bruce protocol was used for abdominal exercise in the supine position using the 6 Second Abs machine and the load was increased every two minutes by changing resistance bands. Load increments for the stages were 15, 25, 30, 40, 55, 70, 80, and 110 lbs. These were applied at 2-minute intervals until exhaustion. Thus, the test continued until the subject could no longer maintain the required power output. During the entire test, VO<sub>2</sub> was measured every 3 breaths, as well as ventilation and the respiratory quotient. Heart rate was measured every 30 seconds.

Lactates were measured before and after the exercise, as described above. During the 5-minute post-exercise period and for 5 minutes pre-exercise, the subjects placed a hand in a 9-inch glass bowl, three-quarters filled with 40°C to 45°C water to increase arterial blood flow to the fingertips for the blood samples.

Two 5-cc tubes of blood were drawn from all subjects to assess blood electrolytes, cholesterol, HDL, LDL, lipids, red cell count, white cell count, and triglycerides, both before and after the study.

Subjects entered a diet program shown in Tables 2, 3, 4, and 5. The first week of the diet was more stringent and involved a diet that averaged only 1207 calories per day. During the second, third, and fourth weeks, the diet was somewhat easier but still only averaged approximately 1400 calories per day as shown in Tables 2, 3, 4, and 5. In addition to the diet, during which all groceries were provided to maintain continuity, subjects were also provided with a 6 Second Abs machine and exercise videos. The total daily exercise schedule is shown in Table 7. Subjects were encouraged to stick with the exercise and diet program. The total workout time varied from 30 to 35 minutes per day. To exercise the abdominal muscles, subjects engaged in 4 bouts of 10 contractions of the abdominal muscles three times per week. This involved exercise with weight distributed equally on both thighs during abdominal exercise for 10 repetitions in each position. Abdominal exercise was performed in the seated position with the body turned at 45° to exercise the oblique muscles and lying on the floor with the feet against the wall to exercise the rectus abdominus muscles. The workload on the bands was adjusted based on measurement from VO<sub>2</sub> max, so that subjects could not maintain the entire workload of 40 contractions. If they could maintain the workload, then the strength of the bands was increased for the next experimental day. In this manner, then, the day-by-day workload was increased

**Table 9.** Girth Change\*

	Waist pre	Waist post	Change	%	1 inch pre	1 inch post	%	Change	Hip pre	Hip post	Change	%
Group mean	96.9	91.6	-5.2	-5.2	94.6	87.3	-7.2	-7.5	108.4	104.2	-4.2	-3.8
Group SD	14.0	12.6	5.2	5.5	13.7	12.7	3.8	4.0	7.3	6.9	3.3	2.9
Male mean	105.8	98.7	-7.1	-6.6	102.6	94.8	-7.7	-7.6	109.4	104.6	-4.8	-4.4
Male SD	12.0	11.1	5.2	4.2	11.0	11.3	2.0	2.0	7.8	7.8	4.3	3.8
Female mean	89.5	85.8	-3.7	-4.0	88.0	81.2	-6.8	-7.4	107.5	103.8	-3.7	-3.4
Female SD	11.2	11.0	4.9	6.3	12.4	10.6	4.9	5.2	7.2	6.5	2.3	2.0

\*Before (pre) and after (post) exercise and weight loss program. 1 inch indicates girth 1 inch above the umbilicus. All measurements are in cm.

on the abdominal muscles.

As stated above, all experimental procedures were repeated on 2 occasions, both before and after the one-month diet and exercise program.

## RESULTS

Results are shown in Figures 1 to 4 and Tables 8 to 11. The average body weight of the group before the weight loss program was 85.1 kg  $\pm$  18.5 kg. After one month, the average weight was reduced to 79.8 kg  $\pm$  17.8 kg. This was a loss of 5.3 kg  $\pm$  1.9 kg or a reduction of 6.22% in body weight. The women lost less weight than the men (5.0  $\pm$  2.1 kg for women and 5.7 kg  $\pm$  1.7 kg for men), but the women lost a greater percentage of their body weight (6.4%  $\pm$  2.3% compared to 6.0%  $\pm$  1.9% for the men) (Table 1). The reduction in weight loss associated with the diet was significant ( $P < 0.01$ ).

The weight loss was associated with a reduction in body mass index averaging 6.0%  $\pm$  3.1% for the men, and 5.6%  $\pm$  3% for the women. The total reduction in body mass index was 1.69 units  $\pm$  0.89 units for the entire group. This reduction was also statistically significant ( $P < 0.01$ ).

The changes in body mass index were paralleled by changes in body fat content. DEXA data showed an average reduction of body fat of 4.15%  $\pm$  3.64% for the group. Some members of the group had small changes in body fat, whereas others averaged as high as 10.34% loss in body fat. The average body fat change for women was 3.8%,

whereas for men it was 4.5%. The loss in body fat was significant in both groups ( $P < 0.01$ ). DEXA also showed that there was a loss in lean body mass. The average subject lost 4.13%  $\pm$  3.58% lean body mass. There was some variability from one subject to another, but the loss was significant ( $P < 0.05$ ).

These reductions in weight and body fat content are not surprising considering that there was a large reduction in girth in most parts of the body. For example, Table 9 shows changes in girth in the waist (measured one inch above the umbilicus in cm), and the hip for men, women, and the entire group. For example, for the group, there was a reduction in waist size of 5.2%  $\pm$  5.5%, whereas one inch above the waist, we recorded the greatest reduction, 7.2%  $\pm$  3.8%. For the hip, there was a reduction of 3.8%  $\pm$  2.9%. The changes were a reduction of 5.2 cm in waist size for the group, a reduction of 7.2 cm one inch above the waist, and 4.2 cm reduction at the hip. Whereas all the reductions in body girth listed above were significant ( $P < 0.01$ ), other significant girth changes included, a reduction of 0.95 cm or 3.0%  $\pm$  2.24% of the upper arm circumference for the group. For the men, the loss in the upper arm girth was 0.8 cm  $\pm$  0.9 cm, whereas for the women the loss was 1.0 cm  $\pm$  0.5 cm. In a similar manner, the girth of the forearm was reduced by 0.3 cm  $\pm$  .68 cm for the group. Measurement of the circumference of the wrist on about one third of the group showed a significant reduction in size, whereas for the rest of the group,

**Table 10.** Pulmonary Testing\*

	VO <sub>2</sub> pre	VO <sub>2</sub> post	Change	%	kg load pre	kg load post	Change	%	Ve pre	Ve post	Change
Group mean	0.27	0.53	0.26	143.22	15.59	24.12	8.26	58.09	5.86	9.11	3.25
Group SD	0.21	0.25	0.15	128.57	3.16	5.45	6.33	46.66	3.47	3.94	3.78
Male mean	0.24	0.53	0.28	136.77	15.74	24.98	8.57	61.68	7.17	10.16	2.99
Male SD	0.08	0.18	0.17	99.39	2.69	6.60	8.58	64.19	4.42	3.31	4.56
Female mean	0.30	0.54	0.24	148.49	15.46	23.41	8.01	55.17	4.80	8.26	3.46
Female SD	0.27	0.30	0.13	153.10	3.63	4.52	4.12	28.62	2.10	4.35	3.22

\*Before (pre) and after (post) exercise and weight loss program. All volumes for VO<sub>2</sub> and vent are liters per minute at standard temperature and pressure.

there was no change in the measurement of the wrist. Consistently, for the entire group, there was a large reduction in the circumference around the buttocks. For the group, for example, there was a loss of  $4.03 \text{ cm} \pm 2.73 \text{ cm}$ . This amounted to a  $3.68\% \pm 2.42\%$  reduction. This was significant ( $P < 0.01$ ). The reduction was the greatest among the men averaging  $5.0 \text{ cm} \pm 2.5 \text{ cm}$ ; the reduction for the women was  $3.2 \text{ cm} \pm 2.7 \text{ cm}$ . This amounted to buttocks reductions of 4.5% for the men and 3.0% for the women. Another area showing a reduction in girth was the thigh, which averaged  $2.1 \text{ cm} \pm 2.3 \text{ cm}$  for the group,  $3.2 \text{ cm}$  for men, and  $1.2 \text{ cm}$  for the women. This resulted in an average reduction in thigh size of 3.15% for the group. The largest reduction in thigh size was in the men, averaging 4.8%, and the average reduction in women was 1.8%.

These losses in weight and circumference are not surprising considering the high degree of subject compliance with the diet and exercise program. During the first week of the diet (Figure 3), diet compliance averaged  $6.78 \pm 0.55$  on a 7-point scale and exercise compliance averaged  $5.67 \pm 1.41$ , out of a 6-point scale. This computed to a total compliance of  $12.44 \pm 1.46$ . There was no statistical difference between the compliance of men and women ( $P > 0.05$ ). During the second, third, and fourth week of diet, compliance changed very little (Figure 3). Thus, for the entire diet period, the total diet compliance for the group was  $6.48 \pm 0.65$  and the total

exercise compliance for the group was  $5.6 \pm 0.94$ . The total overall compliance, diet and exercise combined, averaged 12.08 out of 13 for the group or a 92.9% compliance rate.

Women complied better with the diet averaging  $6.7 \pm 0.3$  out of 7, whereas the men had an average total compliance of  $6.3 \pm .9$  units. For the exercise, men averaged  $5.8 \pm 0.7$ , whereas for the women the average exercise compliance was  $5.4 \pm 1.1$ .

Although the men reported that their exercise compliance was better than that of the women, the women demonstrated greater improvement in terms of the workload used on the 6 Second Abs machine during the home exercise program. As shown in Figure 4, the total work (product of number of repetitions and load) on a given day increased by over 400% during the program for the group. The average final work product was  $401 \pm 131$  units for the group. However, at the end of the first week, as an example, the women averaged  $146 \pm 49$  units and men averaged  $200.8 \pm 110.7$  units, by the end of the fourth week the workload of the women was  $402 \pm 119$  units and the workload of the men was  $399 \pm 155$  units. Thus for the women, a greater gain in abdominal endurance was seen in these studies.

The change in total strength, calculated based on the strength at the beginning vs the strength at the end of the study, averaged  $35.3 \text{ kg} \pm 18.8 \text{ kg}$  for the men and  $22.7 \text{ kg} \pm 11.5 \text{ kg}$  for the women, these differences being signifi-

**Table 11.** Blood Chemistry\*

	Start Cholesterol (mg/dL)	End Cholesterol (mg/dL)	Change	Start Triglycerides (mg/dL)	End Triglycerides (mg/dL)	Change	End LDL (mg/dL)	Start LDL (mg/dL)	Change
Group mean	220.6	196.4	-24.2	145.7	93.4	-52.3	136.4	140.5	4.2
Group SD	51.0	42.6	26.3	91.5	35.1	85.5	26.6	17.1	25.5
Male mean	245.1	206.3	-38.8	190.1	103.1	-87.0	138.6	138.1	-0.4
Male SD	49.5	31.1	26.9	112.4	34.9	117.7	33.1	13.7	34.1
Female mean	200.5	188.2	-12.3	109.3	85.4	-23.9	134.5	142.5	7.9
Female SD	44.7	50.1	19.8	50.7	34.8	28.8	21.3	19.9	16.4

\*Before (start) and after (end) exercise and weight loss program.

cant ( $P<0.05$ ). At the beginning of the study, the average strength for the group was  $28.38 \text{ kg} \pm 16.11 \text{ kg}$ . At the end of the one-month period, the group strength had increased to  $59.8 \text{ kg} \pm 23.6 \text{ kg}$ , an increase of  $31.4 \text{ kg}$  or  $157\%$  of the baseline values. For the men, the strength increase was  $35.3 \text{ kg} \pm 18.8 \text{ kg}$  to  $71.8 \text{ kg} \pm 18.7 \text{ kg}$ , or a gain of  $174.6\%$ . For the women, the increase in strength from  $22.7 \text{ kg}$  increased to  $50.0 \text{ kg}$ , or an increase of  $144.2\%$ . These increases in strength were significant ( $P<0.01$ ). Thus, while the women were doing more work each day, the absolute change in muscle strength was less. The changes in work done and strength were all significant for both subgroups and the pooled data ( $P<0.01$ ). The implication then is that the women were pushing themselves harder than the men during the exercise bout. The abdominal muscle mass, when measured with ultrasound, increased on the average by  $5\%$  for the group.

Given all of these changes in fitness, it is not surprising that there was a positive change in cardiovascular indicators and blood chemistry. As shown in Table 8, systolic blood pressure was reduced by an average of  $6\%$  in the group, and the largest reduction in systolic blood pressure occurred in women. Diastolic blood pressure did not significantly change ( $P>0.05$ ), whereas heart rate showed a decrease of about  $3\%$  in the group, with the largest reduction occurring in men.

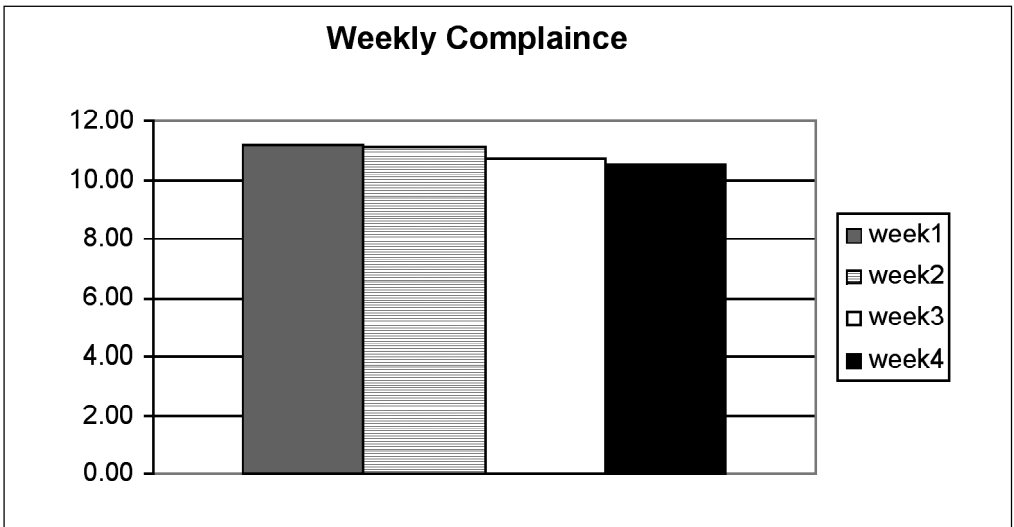
As shown in Table 10,  $\text{VO}_2$  for the group (including both men and women)

increased during the one-month period. This is paralleled by an increase in ventilation during the  $\text{VO}_2$  max testing as well. The increase in aerobic training is also reflected in lactic acid measurements. The lactate acid for the group averaged  $1 \pm 1.34$  units before training and  $0.61 \pm 1.13$  units after training. This difference was statistically significant ( $P<0.05$ ).

Finally, some of the most dramatic changes were in the blood measurements. Cholesterol decreased by  $24.2\%$  in the group (Table 11). The largest decrease was in men but women still showed a decrease of  $12\%$  in cholesterol. In a similar manner, triglycerides decreased by  $52.3\%$  with again, the largest decrease in men. Of the triglycerides, LDL cholesterol decreased by  $4.2$  units for the group. Blood glucose was reduced from  $98.7\% \pm 10.81$  units before the diet to  $93.75 \pm 13.0$  units after the diet, or a reduction of  $5.01\%$  for the group. This difference was statistically significant ( $P<0.05$ ). There was a small reduction in sodium ( $5.41 \pm 3.36$  units) throughout the diet, reflecting the low-sodium diet, whereas potassium and other electrolytes showed no significant changes. There was no significant change in red blood cell count or white blood cell count from the beginning to the end of the study. Hematocrit showed an increase of  $2.25\%$  during the study.

## DISCUSSION

In numerous studies, diet and exercise programs have been shown to increase



**Figure 3.** Diet compliance.

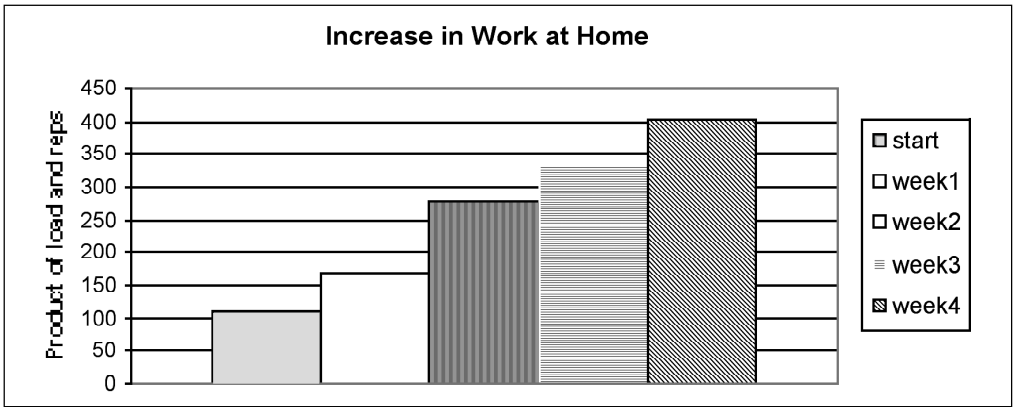
cardiovascular fitness and increase general health by lowering triglycerides, cholesterol, and other cardiovascular risk factors.<sup>1,5</sup> Certainly, a diet and exercise program is beneficial in reducing the potential for both cardiovascular disease and diabetes by increasing glucose uptake in muscle and energy expenditure in the body.<sup>14</sup> Whereas fasting reduces energy expenditure in the body,<sup>15</sup> a proper diet low in fat but high in carbohydrates and protein increases thermogenesis and adds to potential weight loss.<sup>2</sup> A secondary effect of a low-fat diet is a decrease plasma leptin, a hormone that is produced by adipose tissue to signal high stores of fat in these cells. When leptin is low, PPAR, a protein that activates DNA to produce enzymes in order to increase the use of carbohydrates as a fuel, is activated. Some of the genes that are thereby activated, lower tissue cytokines, reducing cardiovascular inflammation.<sup>11,12</sup> This has a dramatic effect in reducing heart disease, preventing diabetes, and reducing the symptoms of people who have diabetes.<sup>13,16</sup>

In a previous study, we have shown significant reductions in weight and

large increases in aerobic fitness, using a combination of aerobic exercise, abdominal exercise on a 6 Second Abs machine, and a diet program for one week.<sup>13</sup> The exercise, while being conducted only for one week, also caused significant increases in aerobic capacity and muscle strength. But questions remained to be answered regarding compliance, if the diet was extended to one month, and how the program would change blood chemistry and body fat content, if extended to one month.

Compliance was good in both the previous study and in the present investigation. In fact, compliance was better here than in the one-week study. Perhaps, the difference was that the previous study involved 75 people. To achieve this number, supervision was minimal and the selection process did not involve extensive interviews for motivation. In the present investigation, with a smaller group of subjects, the selection process for motivation was much more extensive and the results showed a group of highly motivated people that maintained both the diet and exercise program.

In the present investigation, there



**Figure 4.** Gain in work capacity at home.

were large losses in girth all over the body. The greater weight loss achieved here compared to the one-week study, published previously, was due to the longer duration of aerobic and abdominal exercise, which contributed to a more balanced weight loss across the entire body in both the male and female subjects. The majority of the loss in girth was due to losses in fat. However, the losses in girth would have probably been much greater if there was no increase in muscle mass. The exercise program did show an increase in muscle strength in the abdominal muscles. Since muscle mass increases body weight, the actual loss in body weight of the subjects would have been much greater if not for the increase in muscle mass. Thus the weight loss here was not 4 times that of the previous 1-week study, probably due partly to an increase in muscle mass in the abdominal area. This result is not surprising when an exercise program is added to a diet. Further, in the first few weeks of a diet, the weight loss is much more exaggerated than longer dietary programs.

The loss in girth in other areas seems, from DEXA data, to be due partly to a loss of fat and partly to a loss in lean body mass. The fact that exercise was aerobic and not isokinetic anaerobic

in nature for all but the abdominal muscles, does not help preserve the loss of lean body mass on a low-calorie diet. This is consistent with other diet and exercise programs.

However, even with the weight observed here, a more interesting observation was a decrease in overall cardiovascular and diabetes risk factors such as cholesterol, blood glucose, and triglycerides. Further, the reduction in blood pressure (systolic), in both groups of subjects, shows a reduction in stress on the heart. The reductions in blood pressure, triglycerides, and cholesterol are not merely additive, but are synergistic in reducing the risk of heart disease and stroke.

Considering abdominal exercise was only performed for 5 minutes per day, the increases in muscle strength, aerobic endurance, and muscle thickness of the abdominal muscles show the effectiveness of the 6 Second Abs machine and its part in providing a fast and efficient progress-resistant exercise program. With a large increase in the daily workload, almost a doubling in muscle strength, exercising for only 12 sessions (3 times per week for 4 weeks) showed rapid and significant improvements in tone of the abdominal area.

As pointed out previously, the

abdominal muscles are an important muscle group in preventing lower back injuries and pain as well as providing good posture<sup>17,6,7</sup>. Thus with the one week study and now the one month study, the 6 Second Abs machine was very effective in training abdominal muscles and might potentially reduce lower back pain, improve posture, and produce other gains.

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