

# The Effect of an Aerobic Dance and Diet Program on Cardiovascular Fitness, Body Composition, and Weight Loss in Women

Jerrold Petrofsky PhD JD  
Jennifer Batt\* BS  
Lee Berk DrPH  
Kelly Collins BS \*  
Tien-Ning Yang , BS\*  
Marshall LeMoine, BA\*  
Gurinder Bains MD  
Shashi Gunda MPT  
Chinna Raju MSPT  
Dhanaraj Vanarasa BPT  
Yumi Kim MPT  
Cristina Beard\*  
Katrina Broussard\* BA  
Jason Christensen\* BS  
Courtney Ellstrom  
Ingrid George\* AS  
Michael Holland\* BS  
Pratima Vallabhaneni BPT  
Jackie Brown\* BS

*Dept of Physical Therapy  
Loma Linda University  
Loma Linda, California*

*Dept of Physical Therapy\*  
Azusa Pacific University  
Azusa, California*

*Corresponding Author  
Dr. Jerrold Petrofsky  
Professor and Director of Research  
Department of Physical Therapy  
Loma Linda University  
Loma Linda California, 92350  
909 558 7274  
Email: jpetrofsky@llu.edu*

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## **ABSTRACT**

Sixty female subjects in the age range of 20 - 65 years participated in a series of experiments to determine the effectiveness of a 1-hour aerobic dance video used each day for a total of 10 days, combined with a dietary plan in promoting weight loss and increasing cardiovascular fitness. The experiment was a single-blinded, randomized design study, and subjects were randomly assigned into 1 of 2 groups. One group of sub-

jects participated in the exercise and diet program (30 subjects) and the other group served as controls, and participated in the measurements only (30 subjects). The diet consisted of 1,306 calories per day and was a balance between Carbohydrates, Fats and, Proteins.

For the control subjects (non-exercising), there was no difference in blood pressure, heart rate, girth, or body weight over the 10-day period. In contrast, for the group of subjects that exercised, at 7 days, the average weight loss was  $1.22 \pm 0.75$  kg, and the average loss in girth at the waist was  $1.74 \pm 3.0$  cm.

**Table 1- Demographics of subjects at start of experiment**

|                           | <b>Age (years)</b> | <b>Height(cm)</b> | <b>Weight (kg)</b> | <b>BMI</b> | <b>Body Fat</b> |
|---------------------------|--------------------|-------------------|--------------------|------------|-----------------|
| Mean                      | 41.6               | 163.2             | 77.4               | 29.0       | 41.5            |
| SD                        | 13.1               | 7.3               | 17.8               | 6.1        | 8.5             |
| Panel A- Exercise group   |                    |                   |                    |            |                 |
|                           | <b>Age (years)</b> | <b>Height(cm)</b> | <b>Weight (kg)</b> | <b>BMI</b> | <b>Body Fat</b> |
| Mean                      | 38.2               | 164.3             | 80.4               | 30.1       | 39.2%           |
| SD                        | 10.1               | 8.2               | 18.5               | 7.4        | 8.1             |
| Panel B- Control subjects |                    |                   |                    |            |                 |

The top 10% of the subjects reduced their weight by  $2.53 \pm 0.6$  kg and waist circumference by  $5.86 \pm 2.1$ cm. Heart rate and blood pressure decreased significantly at 7 days ( $p < 0.05$ ). By the 10<sup>th</sup> day, the average weight loss was  $2.1 \pm 0.61$  kg, average loss in body fat was  $3.0 \pm 1.1$  % of body weight, and the average reduction of girth at the waist was  $3.7 \pm 1.1$  cm. For the top 10% of the group, the weight loss was  $3.4 \pm 1.4$  kg at 10 days, and for the waist, the average reduction of girth was  $8.16 \pm 2.3$  cm. There was a 28.6% increase in the strength of the core muscles.

**INTRODUCTION**

Obesity is a major problem in the United States and worldwide.<sup>1,2,3,4,5,6</sup> For this reason, there has been an increased emphasis on dietary programs with diets ranging from high carbohydrate to high lipid to high protein.<sup>7,8,9</sup> However, diets in themselves suffer from 2 problems. First, people generally stay on the diet for the first few days and, without changing lifestyle, many diets result in weight loss followed by immediate weight gain.<sup>1,2</sup> Another challenge with dieting without exercise is that basal metabolism is reduced during many types of diets, thus, making it harder to lose weight.<sup>10,11</sup> Further, without exercise, weight loss results in flabbiness in the skin as fat is lost from the subcutaneous tissue and actually reduces body image, especially in women.<sup>12</sup>

A more effective means of losing

weight is to combine exercise with dieting. Exercise, in itself, tones muscle.<sup>13,14,15</sup> Further, the energy expenditure associated with exercise also helps promote weight loss.<sup>13,14,15</sup> Exercise not only increases energy expenditure and toning, but can alter systemic glucose levels,<sup>16</sup> reduce adipose tissue,<sup>17</sup> and reduce blood triglycerides and glucose.<sup>18</sup> A further advantage of exercise is that while a diet alone reduces basal metabolism, exercise during dieting actually increases basal metabolism and post-exercise energy expenditure. This results in additional weight loss greater than could be achieved by dieting or exercise alone.<sup>19,20,21</sup> This shift in metabolism associated with the combination of exercise and diet have been shown to be beneficial in preventing disease such as diabetes.<sup>22,23</sup>

In the present investigation, an aerobic dance video program specifically designed for women, was tested.<sup>17</sup> The program involved an aerobic dance and fitness video combined with a caloric restricted diet. Girth, body tone, and cardiovascular markers were used to assess the efficacy of this combined program.

**SUBJECTS**

Sixty female subjects in the age range of 20 to 65 years participated in the study. Subjects were recruited over a wide range of body masses and fitness levels. Subjects were free of cardiovascular disease or neurological injury at the time of

**Table 2- Diet Composition**

| Day  | Kcal    | Prot | Carb | Fat % | Sodium (mg) | Fat (g) | Sat (g) |
|------|---------|------|------|-------|-------------|---------|---------|
| 1    | 1,192   | 35%  | 39%  | 26%   | 1,160       | 36      | 6       |
| 2    | 1,147   | 36%  | 33%  | 31%   | 1,370       | 41      | 13      |
| 3    | 1,164   | 40%  | 45%  | 15%   | 1,265       | 20      | 6       |
| 4    | 1,345   | 37%  | 37%  | 26%   | 1,291       | 40      | 11      |
| 5    | 1,339   | 38%  | 31%  | 31%   | 1,537       | 47      | 12      |
| 6    | 1,379   | 38%  | 29%  | 33%   | 1,349       | 52      | 18      |
| 7    | 1,363   | 36%  | 36%  | 28%   | 1,422       | 43      | 11      |
| 8    | 1,376   | 37%  | 41%  | 22%   | 1,354       | 34      | 13      |
| 9    | 1,364   | 38%  | 40%  | 22%   | 1,528       | 34      | 11      |
| 10   | 1,367   | 40%  | 35%  | 25%   | 472         | 39      | 9       |
| Mean | 1,303.6 | 0.4  | 0.4  | 0.3   | 1,274.8     | 38.6    | 11.0    |
| SD   | 95.2    | 0.0  | 0.0  | 0.1   | 304.3       | 8.6     | 3.5     |

the experiment. Subjects were randomly allocated into either the control group or the exercise group. The general characteristics of the subjects are listed in Table 1. There was no statistical difference between the 2 groups. All subjects signed a consent form and all procedures were approved by the Human Review Committee of Azusa Pacific University.

## **METHODS**

### **Compliance**

For the experimental group, a compliance scale was used. Subjects were asked to complete log sheets on a daily basis for both the diet and exercise programs so that any additional food eaten was recorded.

#### *Diet compliance scale:*

If they did not deviate from a meal, they scored 1/3 of a point. Thus, for total compliance on a given day, the maximum score was 1.0. This score was added for the 10 days. If they were 100% complaint, the score was 10 points.

#### *Exercise compliance scale*

If they exercised the full 60 minutes, they scored 1 point for each day. If they worked out for 15 minutes, they scored 1/4 of a point. If they worked out 30 minutes, they were scored 1/2 of a point.

If they worked out for 45 minutes, they were scored 3/4 of a point. On the early part of the study, if they could not complete 1 hour due to fatigue, they still received 1 point.

### **Diet**

The diet was a mixture of carbohydrate, fat, and protein, and was low sodium. The average calories consumed were approximately 1,306 per subject. The diet involved a reduction in calories and glycemic index. The caloric balance of the diet is given in Table 2.

### **Blood Pressure**

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

### **Heart Rate**

Heart rate was determined by the radial pulse by the blood pressure cuff mentioned above.

### **Body Fat Content**

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

### **Girth Measurement**

Girth measurements were made by a

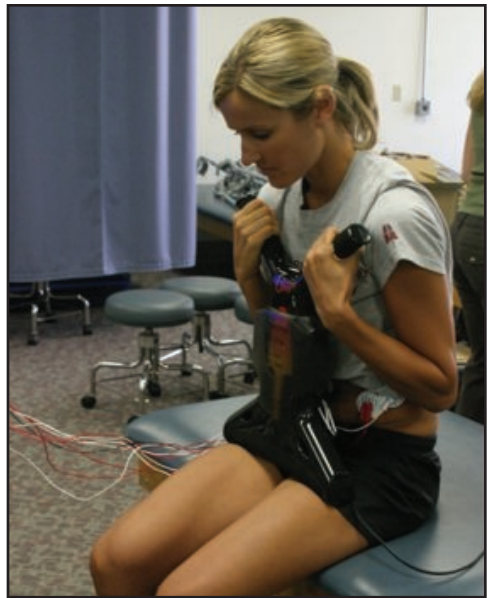
measuring tape with a tensionometer that applies 3 grams of force during the measurements (Vital signs model 67020, Country Technology, Gays Mills, WI.). To improve reliability, all measurements were made by the same investigator. Girth was measured at 2.5 cm above and 2.5 cm below the umbilicus, at the hip around the greater trochanters, and half of the distance between the greater trochanter to the top of the patella.

### **Measurement of Strength**

Strength was measured with a modified exercise device. The device consisted of an abdominal crunch machine with strain gages added to measure the compression force (Figure 1). Subjects were asked to compress the device with their abdominal muscles while sitting straight (rectus abdominus) or side bending left and right (obliques). 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 (Goleta, CA) and the greatest strength in each direction was recorded as the maximum strength.

### **Measurement of Aerobic Fitness**

Aerobic fitness was measured in two ways. First, resting heart rate and blood pressure was measured at the beginning of the study, and 7, and 10 days after the onset of the diet and exercise program. However, in a limited group of subjects, a treadmill stress test was also used. A treadmill stress test involved having subjects run for 5 minutes at a 3% grade, and at 3.5 mph. Heart rate and blood pressure were measured at the beginning and the end of the 5-minute period. Since the increase in heart rate during work is inversely proportional to aerobic fitness for a set work load, changes in aerobic fitness could be assessed by the change in heart rate. Further, 8 minutes after the exercise was completed, an arterialized



**Figure 1.** Subject demonstrating abdominal strength measurements through a forward crunch on an abdominal crunch machine

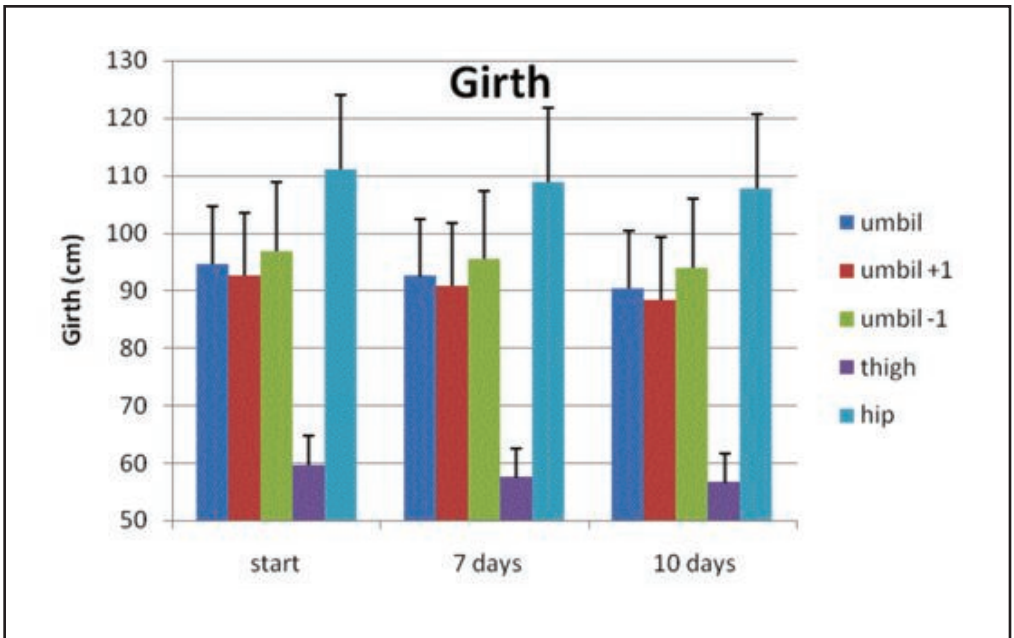
fingertip blood sample was taken and lactate was measured. The change in lactic acid after exercise is also proportional to the change in aerobic fitness.

### **VIDEO TAPE**

Two exercise videos were used. These were called the “Chair fitness” and “Booty Beat Dance.” Each tape involved a 1-hour DVD video produced by Flirty Girl Fitness and distributed by Savvier LP. They were designed to provide a 1-hour aerobic workout to music (Booty Beat) or provide a fitness core workout. Three different instructors on the video could be followed so that subjects could have a beginner, intermediate, or advanced workout. Subjects were encouraged to work out at the highest intensity they could for the 1-hour period. Only 1 video was used on a given day and the videos were alternated, starting with the “Booty Beat Dance” video the first day.

### **PROCEDURES**

This study was a single- blinded, ran-



**Figure 2.** This figure shows the average girth measured for the entire group of subjects from the umbilicus, 2.5 cm above and below the umbilicus, for the hip and thigh at the beginning of the study, after 7 days of exercise and diet, and at 10 days. All data is shown  $\pm$  the standard deviation.

domized design. The investigators taking the measurements were blinded as to if the subjects were in the control or active (exercise) group. At the onset of the study, demographic data was obtained for each subject including age, height, weight, BMI, resting heart rate, blood pressure, and total body fat% by impedance. Girth of the waist (at the umbilicus and 2.5 cm above and below the umbilicus) and thighs (half of the distance between the hip and knee) were measured as described in the methods section. All measures were obtained at baseline, 7 days, and 10 days after the start of the study. One group accomplished diet and exercise (exercise group) with exercise 7 days per week for 10 days, while the other group just participated in the measurements only (control group).

In a smaller randomly selected portion of the group, aerobic fitness was assessed by a treadmill stress test. Using the modified Bruce Protocol, the sub-

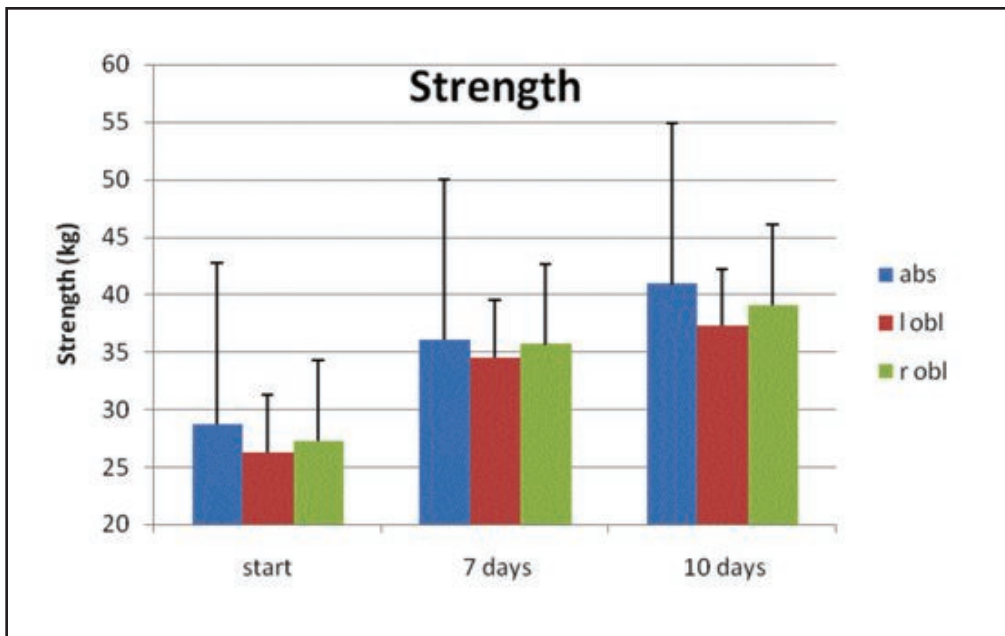
jects walked for 5 minutes and then ran at 3.5 mph at a 3% grade on the treadmill. After 5 minutes, subjects stopped and rested. At the beginning and end of the 6 minute period, heart rate was assessed as well as blood pressure. Further, 8 minutes after exercise ended, lactic acid was sampled from arterialized blood in the fingertip and the change in lactic acid was used to measure aerobic fitness.

## RESULTS

### Exercise Group

The compliance of the group that was exercising and dieting was high. After 7 days, the compliance of the diet was  $85.1 \pm 14.1\%$ , whereas for the exercise it was  $83.1 \pm 21.2\%$  of the total of the 100% possible compliance to both diet and exercise. After 10 days, the average compliance for the diet was  $82.3 \pm 18.2\%$  and for the exercise was  $82.98 \pm 19.4\%$ .

**Weight Loss-** At 7 and 10 days, there was a significant reduction in body



**Figure 3.** This figure shows the strength of the abdominal flexures (rectus abdominus muscles) and the right and left obliques muscles for the entire group of subjects measure at the onset of the study, and at 7 and 10 days into the exercise and diet program

weight ( $p < 0.01$ ), BMI and body fat in this group of subjects ( $p < 0.01$ ). The average loss of weight was  $1.22 \pm 0.75$  kg at 7 days and  $1.78 \pm 0.92$  kg at 10 days. For the top 20% of the subjects, the weight loss was  $2.25 \pm 0.6$  kg at 7 days and  $2.9 \pm 0.8$  kg at 10 days. For the top 10% of the group, the weight loss was  $2.53 \pm 0.6$  kg at 7 days and  $3.4 \pm 1.4$  kg at 10 days. The average subject, at 7 days, reduced BMI by  $0.46 \pm 2.8\%$ , a significant reduction in BMI ( $p < 0.01$ ). At 10 days, the reduction in BMI was  $1.7 \pm 5.6\%$ , a significant reduction ( $p < 0.01$ ). For the top 20% of the group, the loss in BMI was  $0.84 \pm 0.12$  and for the top 10% it was  $0.94 \pm 0.14$  BMI. At 10 days, the average loss in BMI was  $0.82 \pm 0.11$ . For the top 20% it averaged  $2.13 \pm 0.81$  and for the top 10%, it averaged  $3.21 \pm 1.21$ .

For the group, the average loss in body fat at 7 days was  $1.65 \pm 1.24\%$ , a significant loss ( $p < 0.01$ ). At 10 days, the average loss in body fat was  $2.21 \pm 1.46\%$ , a significant loss ( $p < 0.01$ ). For the top

20% of the subjects, at 7 days, the average loss of body fat was  $3.63 \pm 1.2\%$ , whereas for the top 10%, the average loss in body fat was  $4.2 \pm 1.3\%$ . At 10 days, the average loss in the top 20% of the subjects was  $4.33 \pm 1.4\%$  and for the top 10% it was  $5.2 \pm 1.8\%$ .

When the % loss in body fat was compared to the loss in weight, at 7 days, with a fat loss of  $1.65\%$ , the total weight loss in fat was  $1.27$  kg. Since the total weight loss was  $1.22$  kg, the loss was 100% fat. At 10 days, the loss in fat was  $1.71$  kg and loss in weight was  $1.78$  kg. Thus here also, the fat loss appeared to be all due to loss in body fat and not lean body mass.

### Girth

The changes of girth in the 5 locations measured in these experiments are shown in Figure 2. As shown in Figure 4, the average reduction for the group at 7 days was a reduction in girth at the waist of (averaging girth at the waist  $\pm$

2.5cm)  $1.74 \pm 3.03$  cm at 7 days and  $3.67 \pm 2.34$  cm at 10 days. These reductions were significant ( $p < 0.01$ ). For the top 20% of the group, the average reduction at the waist was  $4.47 \pm 1.3$  cm at 7 days and  $7.27 \pm 1.72$  cm at 10 days. For the top 10% of the group, the average reduction of girth in the waist was  $4.88 \pm 1.13$  cm at 7 days and  $8.16 \pm 2.3$  cm at 10 days.

### **Strength**

Figure 3 shows the change in strength in the exercise and diet group at the start and for 7 and 10 days. As shown in this figure, there was a continuous increase in strength in all three muscle groups examined, that is, the rectus abdominus, and right and left external obliques. This increase at 7 and 10 days compared to rest was significant ( $p < 0.01$ ). For the group, the average increase in strength for the rectus abdominus at 7 and 10 days was  $20.3 \pm 7.4\%$  and  $28.1 \pm 6.8\%$  respectively. For the right and left obliques, the increase in strength was  $23.5 \pm 7.1\%$  at 7 days and  $28.7 \pm 6.8\%$  at 10 days respectively.

### **Aerobic Fitness**

Figure 6 illustrates the changes in heart rate and blood pressure, both systolic and diastolic, for the entire study group at 7 and 10 days. As illustrated in this figure, the average heart rate and blood pressure all decreased comparing data to data 7 and 10 days into the study ( $p < 0.01$ ).

At 7 days, the average person reduced heart rate by  $10.0 \pm 13.4$  beats per minute, a significant reduction from rest ( $p < 0.01$ ). For the top 20% of the group, heart rate was reduced by  $29.8 \pm 11.4$  beats per minute, while for the top 10%, heart rate was reduced by  $33.3 \pm 14.1$  beats per minute. At 10 days, the average person reduced heart rate by  $13.6 \pm 14.3$  beats per minute, a significant reduction from rest ( $p < 0.01$ ). For

the top 20% of the group, heart rate was reduced by  $31.8 \pm 15.2$  beats per minute while for the top 10%, heart rate was reduced by  $33.6 \pm 17.7$  beats per minute.

For blood pressure, the average reduction in systolic blood pressure was  $3.26 \pm 8.11$  mmHg and for diastolic it was  $3.94 \pm 7.55$  mmHg at 7 days, both significant ( $p < 0.05$  and  $p < 0.01$  respectively). For the top 20% at 7 days, the reduction in systolic pressure was  $15.3 \pm 7.1$  mmHg and for the top 10% at 7 days, it was a reduction of  $18.7 \pm 9.1$  mmHg. For diastolic blood pressure, at 7 days, the average reduction for the group was  $3.94 \pm 7.55$  mmHg, a significant reduction ( $p < 0.01$ ). For the top 20% of the group, the average reduction was  $15.3 \pm 11.4$  mmHg, and for the top 10%, the reduction was  $20.7 \pm 9.7$  mmHg. At 10 days, the average reduction in blood pressure was  $4.37 \pm 7.49$  systolic and  $5.87 \pm 7.18$  diastolic. For the top 20% at 10 days, the reduction in systolic pressure was  $14.8 \pm 7.2$  mmHg and for the top 10% it was a reduction of  $20.3 \pm 5.1$  mmHg. For diastolic blood pressure, at 10 days, the average reduction for the group was  $5.87 \pm 7.18$  mmHg, a significant reduction ( $p < 0.01$ ). For the top 20% of the group, the average reduction was  $17.1 \pm 4.3$  mmHg and for the top 10%, the reduction was  $20.1 \pm 4.3$  mmHg.

For 11 subjects, a treadmill fitness test was done at the beginning, at 7 days, and at 10 days of the study. As was true of the entire group, the resting heart rate prior to exercise decreased from  $85.5 \pm 11.1$  beats per minute at the start to  $77.0 \pm 9.7$  and  $73.4 \pm 7.3$  beats per minute at 7 and 10 days respectively. The final heart rate at the end of the exercise, which started at  $120.7 \pm 7.4$  beats per minute at the start of the studies, reduced to  $115.3 \pm 6.4$  and  $109.2 \pm 11.1$  beats per minute at 7 and 10 days respectively. These reductions were significant ( $p < 0.01$ ).

Likewise, blood pressure was reduced from  $121.67 \pm 6.7/80.4 \pm 7.6$  mmHg at the start of the study at rest to  $114.0 \pm 7.8/75.8 \pm 7.2$  mmHg at day 10. At the peak of exercise, the blood pressure at the first day was  $142.5 \pm 11.2/73.1 \pm 7.8$  mmHg and by day 7 was reduced by  $8.86 \pm 1.4/1.2 \pm 0.8$  mmHg. At day 10, compared to day 1, peak blood pressure was reduced by  $17.05 \pm 7.1/1.91 \pm 0.4$  mmHg, a significant reduction in peak blood pressure due to the exercise. These changes at 7 and 10 days were significant (ANOVA  $p < 0.01$ ).

### Control Subjects

The average data for the control subjects is shown in Table 2 relating weight, girth, strength, aerobic fitness measures, blood pressure, and heart rate at the beginning, at 7 days, and at 10 days into the study. As shown in this table, there is no significant difference in this parameter at rest, 7, or 10 days ( $p > 0.05$ ).

### DISCUSSION

A major problem in the last 40 years has been a steady increase in obesity both in adults and children.<sup>24</sup> This increase in obesity, which secondarily has resulted in an increase in diabetes around the world, as well as cardiovascular disease, is a direct result of poor eating habits and lack of exercise.<sup>24,25,26</sup> When combined together, there has been a dramatic increase in adiposity, which predisposes the body to cardiovascular disease and diabetes.<sup>27</sup>

Because of this, numerous weight loss programs have been proposed.<sup>28</sup> Some of these involve dieting, whereas others involve exercise alone.<sup>29</sup> Diet programs such as Atkins and others vary the diet in both content and caloric composition in an attempt to trick metabolism and by increasing basal metabolism and reducing caloric intake, causing a reduction in body weight.<sup>30,31,32,33,34</sup> However, numerous studies have shown

that compliance for simple dietary programs is often poor. Many people go on diet programs and then come off the programs to gain even more weight than they even started with. Exercise programs are good except that caloric expenditure during exercise requires dozens of hours to lose even a pound of weight.<sup>35</sup>

One of the advantages of a diet and exercise program together is that although exercise in itself causes a small caloric expenditure during the exercise, it increases basal metabolism in an excess of 24 hours, which then alters the weight loss from the dietary program.<sup>36,37</sup> However, compliance for many of these programs is also sometimes poor particularly when the exercise modality is monotonous, such as treadmill running, which some participants consider boring. In the present investigation, the combined diet and exercise program was used. Here, however, an additional factor, psychological motivation by way of fun dance videos that contained current night club dance movements, was used. Because of a desire to excel at dancing, this exercise program is meant to inspire women to get fit and feel good. The high level of compliance in the program was best explained by exit interviews where subjects stated that they not only lost weight, but that the program was fun and that they looked forward to the video each day. Since a large number of muscle groups are involved in aerobic dancing, the program involved both muscle use for anaerobic training and cardiovascular training.<sup>38</sup> This program was designed to be used by all women, regardless of size, age, and fitness level, and therefore, was not restricted to only fit women. By emphasizing increasing fitness for the body to be more flattering, this type of program resulted in high compliance as seen in the present investigation, and is something that a woman can engage in for months or years



because of the long term benefit and psychosocial motivation.

Although there was a diet associated with the program, the dietary restriction was moderate (about 1,300 Calories), and included a balanced combination of proteins, carbohydrates, and fats that was healthy. It had a variety of food that the women in this study enjoyed as seen in the compliance data presented here. Thus, based on reductions in girth and increases in aerobic fitness, this dietary program proved an excellent way to lose and maintain weight and increase fitness. The significant loss in girth and weight in a short period such as 7 days provides motivation. A girth loss of 1.74 cm at 7 days translates to approximately 1 pants size. The program proved an excellent way to lose and maintain weight, improve body image, tone and strengthen, and increase fitness.

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