

# A Combination of Exercise with a Mini Medicine Ball and Diet with a Meal Replacement Shake as a Synergistic Program to Increases Fitness and Produces Weight Loss

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## **ABSTRACT**

Obesity is a major health problem in the United States and continues in epidemic proportions. Diet, without exercise, results in a loss of lean body mass. Exercise without diet causes a slower reduction in weight than with a diet. Exercise with diet causes a 24 hour increase in metabolism that aids in weight loss. The present study examined 123 subjects over a 1 month period in a single blinded randomized design to evaluate a new exercise and dietary restriction program. The subjects drank a nutritional supplement shake for lunch and dinner and ate a healthy breakfast for the third meal. One group of 60 subjects was the control group and a second group of 63 combined the diet with one hour of exercise 6 days a week with an aerobic exercise video with a 1kg mini medicine ball. The diet was 1500 calories per day for men and 1300 calories a day for women. The study lasted one month with progress measurements made at the start, after 3 days, 10 days, and 30 days. The results of the study showed that even at 3 days, there was a reduction in body weight and fat in these subjects. After the first 3 days, the average weight loss was 1.5 kg with a body fat loss of 1.7%. By the last day, the average weight loss was 4.5+/- 2.2kg with a body fat loss of 2.8%. Subjects lost as much as 19.5kg in the month and 12.2cm at their waist. These losses were significant ( $p < 0.01$ ). Core muscle strength and cardiovascular fitness also significantly increased during the month.

## **INTRODUCTION**

The world health organization has called diabetes and obesity an epidemic that will lead to major health costs around the world. For this reason, there has been an increased emphasis on dietary programs with diets ranging from high carbohydrate to high lipid to high protein diets<sup>1,2,4</sup>. This is especially true in children where cardio-respiratory damage can be reduced by exercise<sup>5</sup>. Diet and exercise can have dramatic improvements in reversing damage from cancer<sup>6</sup>,

kidney disease and diabetes<sup>7, 8</sup>. Diet and exercise, in fact, have been shown to reduce all cause mortality figures<sup>9</sup>.

DiETING alone without a lifestyle change results in weight loss and immediate weight gain after the diet is finished<sup>10, 11</sup>. Further with restrictive, basal metabolism is reduced making it harder to lose weight<sup>12-14</sup>. 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>15</sup>. Regular exercise after weight loss has been shown to increase the metabolic drive to allow weight<sup>16</sup> to be maintained easier.

Therefore, a more effective means of losing weight is to combine exercise with appropriate dieting. Exercise, in itself, tones muscle<sup>17-20</sup>. Further, the energy expenditure associated with exercise also helps promote weight loss<sup>17, 18, 21</sup>. Exercise not only increases energy expenditure and increases toning but can reduce systemic glucose levels<sup>22</sup>, reduce adipose tissue<sup>23</sup>, and reduce blood triglycerides and glucose<sup>24</sup>. A further advantage of exercise is that, while a diet alone reduces basal metabolism, exercise during dieting actually increases the basal metabolic rate and thus, post exercise energy expenditure enhancing additional weight loss is greater than could be achieved by either dieting or exercise alone<sup>25-27</sup>. This shift in metabolism associated with exercise and diet together has been shown to be beneficial in preventing some pathology such as diabetes<sup>28, 29</sup>.

In the present investigation, an exercise program was tested with a meal replacement shake. The exercise program used a mini weighted ball with a video program that has been tested in this lab before and found to produce good aerobic training and weight loss<sup>19</sup>. The diet involved the shake taken for lunch and dinner and subjects ate a healthy breakfast and healthy snacks between meals. Girth, weight, body tone and cardiovascular markers were used to assess the efficacy of this new exercise and diet combined program.

*Table 1- Demographics of Subjects at start of study*

		age (years)	height (cm)	weight (kg)	BMI	% body fat
<b>controls</b>	<b>mean</b>	38.2	169.1	86.2	28.7	35.2
	<b>SD</b>	12.1	10.3	18.3	6.4	12.3
<b>Exercise</b>	<b>mean</b>	42.5	168.0	91.6	32.5	38.0
	<b>SD</b>	12.3	9.3	22.1	6.0	7.5

**Subjects**

One hundred twenty three male and female subjects in the age range 21 to 69 years old for control subjects (n=60) and 21-67 years old for the exercise group (n=63) were recruited over a wide range of body masses. Subjects were free of cardiovascular and neurological disease. There were no differences in the average age between the groups as shown in Table 1 along with subject demographics. All subjects signed a consent form and all procedures were approved by the Human Review Committee of Azusa Pacific University.

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



**METHODS**

**Measurement of Core Strength-** Strength was measured with a modified abdominal 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 side bending left and right. Force was measured on 2 occasions with 1 minute between each measurement. The strength of each 3 second contraction was recorded on a BioPac MP 100 system (Goleta, CA) and the greatest strength in each direction was recorded as the maximum strength. After the subject gripped the device, strength was zeroed before the measurement was made to allow for the weight of the hands.

**Compliance-** For the exercise group, a compliance scale was used. Subjects were asked to complete log sheets on a daily basis for compliance for both the diet and exercise programs and log any food that they ate that was not on the diet and the date. The point scale was: 1 point each day maximum for exercise and 1 point each day maximum for diet compliance.

**Diet-** The diet consisted of a drink for 2 meals a day and a suggested diet for the third meal (breakfast). The daily composition of the diet for men and women, including the 2 meals with drinks was:

**WOMEN**

- Days 1-3 (and Days 28-30) 1100 kcal
- 110g carb (40%)
- 83g protein (30%)
- 37g fat (30%)
- Sat fat < 8.5g (7% total kcal)

Sodium < 2,000g/day  
Sodium Chloride < 4 g

Days 4-27 1300 kcal  
130g carb (40%)  
98g protein (30%)  
43g fat (30%)  
<10 g sat (7% total kcal)  
Sodium < 2,000g/day  
Sodium Chloride < 4 g

## MEN

Days 1-3 (and Days 28-30) 1,300 kcal  
130g carb (40%)  
98g protein (30%)  
43g fat (30%)  
<10 g sat (7% total kcal)  
Sodium < 2,000g/day  
Sodium Chloride < 4 g

Days 4-27 1,500 kcal  
150g carb (40%)  
113g protein (30%)  
50g fat (30%)  
<12g Sat Fat (7%)  
Sodium < 2,000g/day  
Sodium Chloride < 4 g

The drink for the meal replacement at lunch and dinner was a powder. The powder mix was mixed with skim milk, and the powder mix came in premeasured packets. Milk contribution was 90 calories, of which 8 grams were protein, 12 grams of carbohydrates, and 0 grams of fat. The powder mix was: 160 calories, of which 11 grams were protein, 13 grams were carbohydrates and 8 grams of fat. Thus the total for meal replacement for lunch and dinner was (milk + powder): 250 calories, of which 19 grams was protein, 25 grams carbohydrates and 8 grams of fat. The powder mix contained crystalline fructose, whey protein, vegetable oil powder, inulin fiber, and flavoring and was vanilla or chocolate in taste. The

breakfast each day came from a healthy food menu (i.e. lean proteins, veggies and fruit), so that the overall nutritional content provides a 40% carbohydrates, 30% protein, and 30% fat, a mixed diet.

**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).

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

**Girth Measurement-** Girth measurements were made by a measuring tape with a tensionometer that applied 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 trochanter, and half of the distance between the greater trochanter and the top of the patella.

**Video Exercises-** “Melt It Off” video- An 8” mini medicine ball was provided for the studies. The ball is 8” in diameter and weighed approximately 1 kg pounds. There were three videos provided: a “High Calorie Melt It Off” video, a “Cardio Burn and Sculpt” video and a “Sizzlin Abs” video. The “High Calorie Melt It Off” video was 60 minutes long with one short workout called “Melt in 10 for ten minutes”. The 3 videos consisted of pushups, squats, one leg pushups, lunges, trunk side bending, trunk rotation, squats, jumps, cycling with the legs while lying on one side, abdominal crunches, and backward – forward stepping. The “Cardio Burn and Sculpt” video was 38 minutes and consisted of jogging in place, squats, lunges, pushups, shoulder exercises, and arms curls. The “Sizzlin Abs” video was 15 minutes long and consisted of abdominal exercises such as curls and other core stability exercises. Videos were arranged so that the duration of the workout was one hour and the video were alternated to do these 6 days a week; the 7th day was

Figure 2- Exercise schedule in the “Melt It Off” group



rest. The workout schedule is shown in Figure 2.

### PROCEDURES

This study was a single blinded randomized design. At the onset of the study, each subject was randomly assigned to a group and demographic data was obtained. Data included age, height, weight, BMI, resting heart rate, blood pressure. 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 also measured as described in the methods section. All measures were obtained at baseline, 3 days, 10 days and 30 days at the completion of the study. The technicians making the measurements were blinded as to which group the subjects belonged to.

### Results

#### Control subjects

For the control subjects (n=60), only study measurements were taken. These subjects were integrated with the other group to validate the reliability and accuracy of measurements taken. They did not change their eating habits or exercise habits over the exercise period (ANOVA  $p > 0.05$ ). Table 2 shows the change in weight, BMI and body fat from the beginning to the end of the study. Essentially no change was noted for each time point in the study for the controls. There was no significant differences observed in any of these 3 parameters ( $p > 0.05$ ).

Table 3 shows similar findings for the girth measurements. Girth started at 105.2+/-16.1, 112.2+/- 12.2 and 53.7+/- 4.9

**Table 2** Change in demographics in control group over 1 month

	weight (kg)	BMI	% body fat
mean	0.4	0.1	-0.6
sd	0.3	0.2	0.7

**Table 3** Change in girth in control group over 1 month

	Average umbilicus	hips	thigh
mean	-0.7	0.4	0.4
sd	0.2	0.1	0.1

**Table 4-** Change in strength in control group over 1 month

	rectus strength	oblique strength left	oblique strength right
mean	-0.2	1.0	0.9
sd	0.1	0.1	0.4

**Table 5-** Initial girths for the 3 areas measured

	Av. umbilicus	hips	thigh
mean	107.9	113.1	57.1
Standard Deviation	12.1	9.1	4.3

cm for the waist, hips and thighs respectively at the onset of the studies. There was no statistical difference in the girth measurements in the control group at 3 days, 10 days or 30 days when comparing data in these subjects ( $p > 0.05$  ANOVA).

Likewise, heart rate, blood pressure and strength did not change over the one month period. The change in strength data is shown in Table 4. Strength started at  $16.9 \pm 6.4$ ,  $13.2 \pm 4.4$  and  $15.2 \pm 4.17$  kg for the rectus abdominus, left and right obliques respectively. There was no change at any measurement period (ANOVA  $p > 0.05$ ).

### Exercise group

**Compliance data-** For the diet, the average compliance averaged  $82.5 \pm 21.2\%$  (Figure 3). For the exercise, average compliance was  $61.3 \pm 21.4\%$ . On basis of the 3 and 10 and 30 day periods, the compliance is shown in Figure 3. As shown in this figure, compliance decreased slightly each week. After the study was started, the H1N1 epidemic started in the University community impacting the compliance.

### Demographics

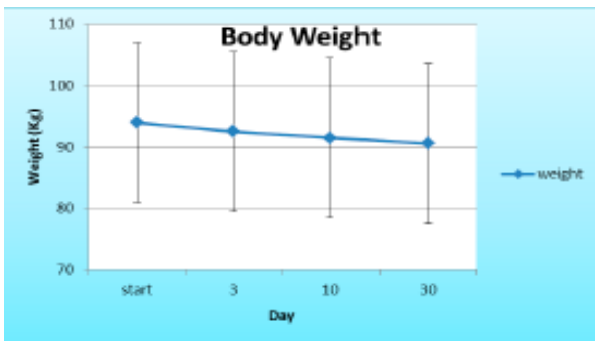
The weight change during the month for the exercise group is shown in Figure 4. At each measurement period, there was a progressive loss in body weight. After the first 3 days, the average weight loss was  $1.5 \pm 0.7$  kg with a body fat loss of 1.7%. Subjects lost as much as 6.6 kg. By the 10th day, the average weight loss was  $2.6 \pm 0.8$  kg with a body fat loss of 2.7%. Subjects lost as much as 8.1 kg. By the last day, the average weight loss was  $4.5 \pm 2.2$  kg with a body fat loss of 2.9%. Subjects lost as much as 19.5 kg. However, as stated above, many of the subjects could not exercise or diet due to the outbreak of the H1N1 flu. Girth followed a similar pattern. The initial data is shown in Table 5.

During the month, for all 3 areas, girth was reduced. For example, for the umbilicus, girth was reduced by  $4.3 \pm 1.2$  cm. The final girths are shown in Table 6. As a basis for comparison, Figure 5 shows the change in girth at the waist throughout the month. At 3 days, subjects lost as much as 5.1 cm, at 10 days subjects lost as much as 8.2 cm and at 30 days, subjects lost as much as 12.2 cm.

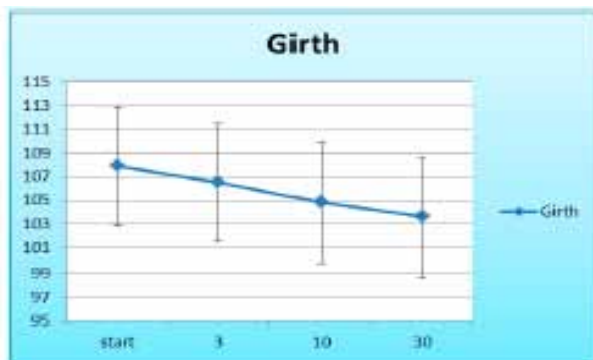
**Figure 3- Compliance in the exercise group**



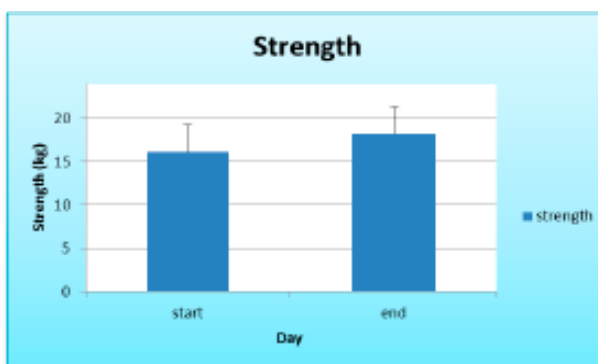
**Figure 4- Average weight change during the month**



**Figure 5- Girth at the waist during the month**



**Figure 6- Change in Rectus Abdominus strength during the month**



The strength of the rectus abdominus, and the right and left obliques increased during the month. For example, the increase in rectus abdominus strength over the 1 month period is shown in Figure 6. As illustrated here, there was a significant increase in strength throughout the 1 month period ( $p < 0.01$ ) for the subjects in this group. The left and right obliques increased from  $15.2 \pm 5.3$  and  $14.6 \pm 4.9$  kg at the start to  $17.1 \pm 4.2$  and  $16.9 \pm 5.1$  kg respectively. The heart rate and blood pressure reductions were statistically significant throughout the month ( $p < 0.05$ ).

### DISCUSSION

Almost every country in the world is facing obesity today and an epidemic increase in diabetes<sup>9,30,31</sup>. For this reason, public health organizations all over the world have been working to reduce obesity, the leading cause of diabetes<sup>30</sup> by utilizing exercise and diet programs<sup>7,8</sup>. The best programs involve both exercise and diet since exercise can increase metabolism for 24 hours post exercise and lead to better and safer weight loss<sup>17,20,21</sup>. It also increases self-image by reducing the flabbiness that can result from diet alone<sup>15</sup>.

Of the diet programs, the best is with a mixed diet with equal proportions of carbohydrates, proteins and fats<sup>21</sup>. Normally, this would reduce basal metabolism and make weight loss harder<sup>14</sup> but with exercise, basal metabolism is increased<sup>16</sup> and the drive to regain weight is reduced<sup>16</sup>. In the present investigation subject compliance was good, averaging over 70% for both the diet and exercise programs, but not as high

	Av. umbilicus	hips	thigh
mean	103.6	109.2	56.2
sd	9.4	9.2	6.1

as that reported previously<sup>19</sup>. Compliance looked almost random with some subjects complying well all month and others not complying at some times and complying well at other times. But the H1N1 started in the University community during the study and some people were sick at different times negatively impacting weight loss and compliance data. Thus, in a comparable study<sup>19</sup> which had similar exercise regimens and caloric restrictions but did not incorporate a meal replacement shake, compliance and weight loss were higher than that reported here. Had compliance been higher in the present study, then overall results for weight loss and girth loss would clearly have been higher. The results reported in this study are therefore conservatively low.

Normally with other programs, weight loss is fast in the first few days due to shifting of water in the body and then slows down. Here the subjects continually lost weight and girth. The loss in girth here amounted to several pant and dress sizes throughout the month. This helps reinforce this program since people are more satisfied if they see progress that can be measured. For example, subjects lost as much as 19.5 Kg in the month and this amounted to 12.2 cm in their waist. This amounted to several pant sizes. This is a sizable weight loss for a modest caloric deficit diet. Subjects were satisfied and didn't feel hungry and yet lost a great deal of weight.

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