

AN ANALYSIS OF LONG TERM WEIGHT LOSS AND
EXERCISE PATTERNS IN INDIVIDUALS
ONE YEAR AFTER A VERY LOW
CALORIE DIET

By

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CHAPTER I

INTRODUCTION

Obesity is one of the leading health problems in America, affecting people of every age and sex. Data from the National Center for Health Statistics suggest that 30.6 million American adults are obese, and that an estimated 6-45% of American children are overweight (Salans, 1987). Obesity is associated with health problems such as hypertension, diabetes, stroke, osteoarthritis and some types of cancer. Long term obesity is also linked as a risk factor of heart disease (James, 1984). Additionally, obese individuals may suffer ridicule from family and peers, discrimination in school and the workplace, depression, poor self-image and other emotional problems.

Numerous approaches have been promoted as being the best method of achieving weight loss for overweight and obese individuals. Weight reduction programs are advertised daily on television, radio, and in newspapers. In addition, magazines marketed to women frequently carry a new and different weight loss program in their monthly issues.

Despite the large number of weight loss programs available to obese individuals, successful treatment of this problem is very difficult. It is currently estimated that only 20% of the obese individuals who successfully lose

weight maintain that weight loss for longer than 5 years (Salans, 1987).

One diet in particular has received a lot of attention by the media after the successful participation by a popular television personality. This individual reported that she had lost over 60 pounds while on a medically supervised very low calorie diet and one year later, she reported maintaining 74% of her weight loss.

This weight reduction program is a hospital based treatment program that helps obese patients lose and maintain the weight loss. This 26 week program is comprehensive, focusing on many aspects of being overweight, including the physical, social and emotional dimensions. The participants in this program are on a medically supervised, very low calorie diet. They also participate in weekly group sessions that emphasize behavior modification, nutrition education and exercise. There is an especially strong emphasis on exercise. The participants are strongly encouraged to adopt a regular, aerobic exercise program, they receive 5 educational lectures on exercise, and if they desire, an individual consult with a physical therapist.

The trend for weight reduction programs is to include exercise and group support because these have been identified as potential contributors to successful long term weight loss maintenance.

Many obese individuals joke about the fact that they lose and gain the same pounds over and over. In fact, the diet industry is very lucrative because diet services are sold to

the same people, to lose the same pounds, over and over. The diet industry markets to Americans who are overweight and generated approximately 33 billions dollars in 1989 (Miller, Springen & Buckley, 1989). This demonstrates how difficult weight loss maintenance actually is for millions of people, regardless of which weight loss program and why it is important to increase the long term success of weight loss maintenance.

Statement of the Problem

The purpose of this study was to examine the weight loss maintenance and exercise patterns of participants one year following a very low calorie diet.

Importance of the Study

Significant health risks are associated with obesity and obesity is recognized as a difficult problem to treat. Many factors are known to contribute to the poor long term management of obesity such as: poor eating habits, emotions, socioeconomic factors, genetics and lack of exercise. It is important to begin to identify variables, such as regular exercise, associated with long term maintenance of weight loss.

Hypotheses

This study focused on the following research hypotheses:

1. There is no significant difference between men and women in maintaining weight loss for 1 year following a very low calorie diet.
2. There is no significant difference in maintaining weight loss for 1 year following a very low calorie diet between men and women who exercise regularly.
3. There is no significant difference in maintaining weight loss for 1 year following a very low calorie diet between men and women who do not exercise regularly.
4. There is no significant difference in maintaining weight loss for 1 year following a very low calorie diet between individuals who exercise regularly and those who do not exercise regularly.

Limitations

The results of this study were limited by:

1. The subjects will be self reporting exercise patterns, exercise intensity, and weight loss maintenance.

Delimitations

The study was delimited to:

1. The population of this study were individuals who chose to enroll in a medically supervised very low calorie diet program in a Midwest hospital before August 1988.

Assumptions

It is assumed that:

1. The responses to the self report questionnaire were accurate.
2. The participants of the weight loss program followed the diet as prescribed for the maintenance phase of 1 year.

Definition of Terms

Conceptual Definitions

Obesity. Body Mass Index greater than or equal to 27 or approximately 30% above ideal body weight (Salans, 1987).

Reduced-Obese. Obese individuals who have reduced to their ideal weight (Leibel, et al, 1983).

Very low calorie diet. A diet powder with daily intake of 400-800 Kcal and 70 grams of protein (Sandoz, 1989).

Functional Definitions

Exercise. Any physical activity considered aerobic by Cooper (1982).

Regular Exercise. An aerobic activity of 30 minutes duration performed at least 3 times per week.

Weight Reduction Program Completion. Completion of the 26 week program, or at least completion of the 12 week modified fast.

CHAPTER II

REVIEW OF LITERATURE

Obesity

Obesity refers to an excess of body fat which usually results in a significant risk to health and longevity. Most people define obesity in terms of height and body weight. Both men and women are considered obese if their weight exceeds 20% of the standard height-weight tables established by the Metropolitan Life Insurance Company in 1983 (Wadden, 1985). These tables are based on heights and corresponding weights associated with the lowest mortality rate among insured adults, and these tables can be helpful in determining the need for treatment.

Obesity reflects a positive energy balance, an excess intake of calories as compared to the energy expended. Consequently, increasing energy expenditure through exercise and decreasing energy intake by dieting has been basis for the treatment of obesity.

Energy Expenditure

It is estimated that physical activity accounts for approximately 20% of the daily energy expenditure for most adults (Jung & James, 1980). This includes exercise programs, activities of daily living and work

responsibilities. It has been suggested that obese adults are less active than non-obese adults, thus their energy expenditure is lower contributing to their obesity. Studies of obese adult populations have shown that the physical activity of obese individuals may be less than that of the non-obese (Salans, 1987). These studies do not suggest that inactivity caused the obesity, but that the physical inactivity was a consequence of the obesity and therefore, may perpetuate the condition.

Regular exercise alone was found to decrease body weight and body fat in obese and normal weight individuals, but the decline is slow. Epstein & Wing, (1982) reviewed the literature for articles reporting the effects of aerobic exercise on weight loss. Using a quantitative, meta-analysis procedure, these authors reviewed 13 studies on males, totaling 37 groups and 3 studies on females, totaling 4 groups. Of these 41 groups, 12 were identified as no-exercise control groups and 25 as exercise groups. Weight losses from exercise alone averaged 0.3 pounds per week for obese subjects and 0.11 pounds per week for normal weight individuals.

Another source of energy expenditure in humans is the resting metabolic rate. This includes the energy cost of protein synthesis, the mechanical work of the heart and the osmotic processes which are necessary to maintain homeostasis. This energy accounts for 55-60% of an individual's daily energy cost (Jung, 1980). Because of the large proportion of energy expenditure contributed by the resting metabolic rate, it was speculated that the resting metabolic rate would be

lower in obese individuals, suggesting a metabolic deficiency as a cause for obesity.

Ravussin, Burnand, Schutz, & Jequier (1982) examined the 24-hour energy expenditure in 30 subjects, 16 women and 14 men, aged 20 - 46 years. These 30 subjects were divided into 3 groups: 10 control subjects (103% ideal body weight); 6 moderately obese subjects (129% ideal body weight); and 14 obese subjects (170% ideal body weight). Energy expenditure was measured in an airtight respiration chamber for 24 hours and was significantly greater, 10043 kJ/day (± 363) for the obese subjects as compared to 8439 kJ/day (± 432) for the normal weight subjects. These authors stated that 92% of this greater energy expenditure was accounted for by the resting metabolic rate. The fact that obese individuals have a higher metabolic rate is linked to the increased body surface area and lean body mass associated with obesity. For most obese subjects, this elevated metabolic rate and dieting results in significant weight loss early in a weight loss program. However, the rate of weight loss decreases over time, and the resting metabolic rate may be responsible for this change.

Ravussin, Burnand, Schutz & Jequier (1985) examined the resting metabolic rate of seven obese subjects, 5 women and 2 men, between the age of 23-46 years, before and during a protein supplemented low calorie diet. After 10-16 weeks of dieting, the resting metabolic rate decreased from an average of 7262 kJ/day (± 583) to 6591 kJ/day (± 547), or 9.0% (± 2.9). This decrease in the metabolic rate was the same percentage as the average loss of lean body mass. The

researchers concluded that the reduction of the resting metabolic rate during weight reduction is mainly due to the decrease in the lean body tissue.

Warwick & Garrow (1981) studied 3 obese women, ages 14-34 years, for 13 weeks while on an 800 kcal/day diet. These women acted as their own control by alternating exercise or no exercise on a bicycle ergometer for 3-4 week periods. The fasting metabolic rate was measured bi-weekly for these women and it decreased over the 3-4 week period despite the exercise. The results of these studies indicate that individuals who are decreasing their energy intake to lose weight are also undergoing decreases in energy expenditure which undermine their efforts. This may be a reason why caloric restriction alone becomes less efficient for long term weight loss success (Grand, 1981). The other concern is whether this decline in resting energy expenditure is a permanent decline.

Leibel and Hirsch, (1983) examined the diminished energy requirements of reduced-obese patients. Twenty-six reduced-obese subjects were compared to a control group of 26 subjects of the same age and gender, who had never been obese. The chief finding of this study was the sharp decrease in the weight-maintenance energy requirements that occur with some former obese patients. The obese subjects in this study had lost an average of 56.4 kg but still weighed an average of 40 kg more than the control group. Despite weighing more than the control group, the reduced-obese subjects showed a 28% reduction in kcal/square meter of body surface needed to

maintain their present weight as compared to the control group. Their data indicated that dieting decreases the metabolic rate and these changes in the metabolic rate may be long lasting for some subjects, and will increase the tendency to regain the weight. This decrease in the metabolic rate is an important factor that will make long term weight loss maintenance more difficult for overweight individuals.

The decrease in energy expenditure during dieting has spawned the search for methods to reverse this decline. Some researchers suggest that regular exercise may reverse this decline in the resting metabolic rate. In one study, (Donahoe, Lin, Kirschenbaum, & Keesey, 1984) 10 overweight women, ages 22-55 years, participated in a treatment program consisting of 3 phases; baseline, diet only, and diet and exercise. Diet alone caused the resting metabolic rate per kg of body weight to decrease by 4.4%. However, subjects who exercised aerobically for 1 hour, twice weekly reversed the diet-induced decline and reset the resting metabolic rate per kilogram of body weight to its pre-dieting baseline value. These authors suggest that this change in the resting metabolic rate could occur for two reasons: exercise may increase lean body mass or exercise may change the metabolic activity of the existing lean body mass.

Data from Stern, Schultz, and Mole (1980) also support the theory that exercise can prevent the diet-induced resting metabolic rate decline. In this study the subjects were fed a 500 kcal diet for 28 days and the resting metabolic rate decreased as expected. After 2 weeks, these same subjects

added 20 minutes of exercise to their treatment and the resting metabolic rate increased to the pre-diet level. In contrast, studies by Henson, Poole, Donahoe & Heber, (1987) and Lennon, Nagle, Stratman, Shrago, & Dennis, (1984) found that aerobic exercise training did not return the depressed resting metabolic rate to pre-diet levels.

Henson, et al (1987) studied 7 moderately obese women during 9 weeks of caloric restriction (800 kcal/day). During weeks 4-6, the subjects exercised on a bicycle 30 minutes/day for 5 days/week. During the initial 3 weeks of dieting alone, the resting metabolic rate decreased an average of 13% which parallels other studies. However, the next 3 weeks of diet plus exercise failed to show any significant increase in the resting metabolic rate.

Lennon, et al (1984) reported similar conclusions. They studied 38 men and 40 women between the ages of 20-49 years, who were 15-35% overweight. They were divided into 3 groups and all followed the same diet exchange plan. The control group followed no exercise program. One group exercised aerobically 30 minutes daily, and the last group exercised every other day with the intensity determined by an exercise prescription. Only the women who followed the exercise prescription showed a significant increase in resting metabolic rate over the control group. Otherwise, there were no significant differences in total weight loss among the groups.

Dieting Alone

Attempts to control excess energy intake or over eating have included hypnosis, gastric by-pass surgery, gastric stapling, and jaw wiring, but the dietary approach has gained the most attention. There are many different types of diets promoted as successful treatments for obesity. These diets include total fasting, eating specific food combinations such as grapefruit and eggs, eating high protein foods or foods with high protein/high fat content. Weight loss from these diets is achieved by a reduction of energy intake mainly through the elimination of food choices (Weinsier, Wadden, Ritenbaugh, Harrison, Johnson, & Wilmore, 1984). Another popular treatment for obesity is the medically supervised, protein sparing, very low calorie diet. This diet provides 400-800 kcal/day and is considered a modified fast.

Fasting as a treatment for obesity has been used for more than 40 years. Very fast weight losses were achieved but several fasting-related deaths were reported. Several of the deaths appeared to be a result of myocardial protein degradation, a loss of heart muscle due to the conversion of muscle into glucose by gluconeogenesis (Wadden, 1985).

Very low calorie diets were designed to produce the same fast rate of weight loss as fasting, but also to preserve lean body tissue. This was accomplished by adding 70 grams of complete protein to the dietary intake. Although these individuals are consuming only 400-800 kcal/day and are at risk for medical problems, improvements in the quality of the

protein, and closer medical supervision are responsible for the absence of fatalities (Wadden, 1985).

Effects of Very Low Calorie Diets and Exercise

According to the American Medical Association's Council on Scientific Affairs of Chicago (1987), exercise can be an effective part of the comprehensive treatment of obesity if it increases energy expenditure, promotes fat loss, is safe, and promotes increases in activity levels within the individual's lifestyle. The hope is that exercise will accelerate the rate of weight loss.

Phinney, LaGrange, O'Connell, & Danforth (1988) studied the combined effects of a very low calorie diet, 720 kcal/day and exercise, 7 hours/week on 12 overweight women, ages 22-39 years, for 5 weeks. The diet group lost an average of 6.9 kg (± 0.7) over the 5 weeks and compared to the diet and exercise group that lost 6.5 kg (± 0.7) kg. These data suggest that exercise was not instrumental in accelerating weight loss for these individuals.

VanDale, Saria, Schoffelen, & Hoor (1987) studied 12 obese women, ages 19-48 years, who were divided into a diet and a diet-exercise group. The diet was 780-810 kcal/day and the exercise totaled 4 hours/weekly at 60% VO_2 max. The average weight loss after 12 weeks was 12.2 kg for the diet group and 13.2 kg for the diet-exercise group. Again, the data suggest that exercise and diet combined produced no significantly greater weight loss than diet alone.

In contrast, Hagan, Upton, Wong, & Whittam (1986) found

that dieting and exercise produced a greater weight loss than dieting alone. Forty-eight male and 48 female subjects, average age of 36 years and 120-140% of their ideal weight were assigned to 4 groups: diet alone, diet-exercise, exercise alone, and sedentary-control group. The diet group ingested 1200 kcal/day. The diet-exercise group consumed the same amount and exercised 30 minutes, 5 days/week. The exercise group participated in the exercise program but continued their normal eating habits. The sedentary-control group maintained normal eating habits and did not exercise. In both the diet and diet-exercise groups of men and women, there was a significant decrease in body weight. In the men, the body weight decreased 9.1% for the diet group and 11.4% for the diet-exercise group. While in the women, the body weight decreased 7.8% for the diet group and 10.4% for the diet-exercise group.

Long Term Weight Loss

Considering its scope and seriousness, successful treatment of obesity is a major concern in America. Americans will spend an estimated \$33 billion on diets and diet related products in 1989. Unfortunately, 95% of the individuals who lose weight, will regain at least as much as they shed (Miller, Springen, Buckley, & Williams 1989).

Despite all the treatment approaches, obesity is remarkably resistant to treatment especially with regard to long term successful maintenance of the weight loss. Weight regain after a very low calorie diet is no exception.

Andersen, Stockholm, Backer, & Quaade (1987) followed 30 women, 21-60 years of age, 5 years post a very low calorie diet. The median maximum weight loss for the group was 22.0 kg but after 5 years, only 5 of the 30 women had not returned to their pre-diet weight.

Sikand, Kondo, Foreyt, Jones & Gotto (1988) attempted a follow-up study 2 years after 30 obese women, ages 21-60 years, were treated with a very-low-calorie-diet and exercise training. The women were divided into 2 groups: Group I subjects were considered non-exercisers and Group II subjects participated in a structured aerobic exercise 2 times a week plus were encouraged to exercise more. The treatment program lasted 4 months and Group II subjects (n=11) lost an average of 21.8 kg; Group I subjects (n= 10) lost an average of 17.5 kg. After 2 years, 15 of the 21 women who completed the program were contacted: Group II (n = 7) regained 58.2% of the weight lost compared to Group I (n = 8) which regained 95.8% of the weight lost. The results indicated a lesser weight regain among subjects who diet and exercise as opposed to the diet alone subjects. And yet, this study illustrates that maintenance of weight loss is very difficult despite regular exercise.

Wadden and Stunkard (1986) did a 1 year follow up study on 50 subjects completing an obesity treatment program of diet alone (N=15), behavior therapy alone (N=16), and diet plus behavior therapy (N=19). The mean weight losses at the end of the treatment was 14 kg, 14.3 kg, and 19.3 kg respectively. Subjects in the diet group regained 66% of their weight loss.

Those subjects who received behavior therapy alone, regained 33% of their weight loss possibly supporting the theory that slow, steady weight loss is preferable to a quick loss. The combined treatment group regained only 33% of their weight as well. The authors feel this is encouraging but suggest further efforts must be made to improve long term weight loss maintenance.

Stalonas, Perri, & Kerzner (1984) did a 5 year follow up of a behavioral weight control program. Thirty-six of the original 44 subjects were contacted: 30 women and 6 men averaging 31 years of age, 183 pounds body weight, and 40.2% above their ideal body weight. Most of the subjects (n = 30) had regained a large portion of the weight lost. The average subject had gained 12 pounds, and actually weighed 1.5 pounds more than before treatment. Results from 9 subjects that received both an exercise and management component to the basic treatment program, reported maintaining 66% of their weight loss over 5 years.

In another study, (Graham, Taylor, Horell & Siegel, 1983) 60 of the original 138 participants in a behavioral weight loss program were followed for 4.5 years post treatment. Of the 60 respondents, 46 were female, 14 were male and their average age was 46 years. The study reported 58% of the subjects adhered to some of the basic behavior-program skills and 21% of these were considered physically active. Clients (n = 4) who were both active and adhering lost significantly more weight from the pre-diet level, (4.91 kg) and they maintained losses (4.86 kg) better than all groups combined.

Colvin and Olson, (1983) looked at long term success of weight loss in a different manner. They solicited individuals from the community who reported losing 20% of their body weight and had been successful at maintaining the weight loss over 2 years. Forty-one women responded and four factors characterized most of the respondents. These women had reached their goal weights, had improved their eating habits, no longer stayed at home during the day, and they exercised on regular basis.

Jeffery, Bjornson-Benson, Rosenthal, Lindquist, Kurth & Jonnson (1984) looked specifically at 81 men, average age 53 years, over a 2 year period of time. Those men who reported being more active (n = 24) had maintained a 20.8 pound weight loss compared to the 8.8 pound weight loss from those subjects (n = 57) who were not active. These authors were surprised to report no differential effect of regular exercise, alone, on weight maintenance. Those individuals who exercised regularly lost more weight initially, but regained similar amounts of weight as the non-exercisers.

Reviewing the literature indicates how difficult it is to treat obesity and maintain a long lasting solution. Significant weight loss can be achieved through a very low calorie diet program but maintenance of weight loss continues to elude the majority of overweight individuals.

According to the Council on Scientific Affairs (1988) a treatment program for obesity must include changes in eating and exercise behaviors to be successful. Unfortunately, few long term studies of this kind have been reported. In order

to successfully treat obese individuals it is important to identify behaviors, such as regular exercise, associated with successful long term maintenance of weight loss.

CHAPTER III

METHODS AND PROCEDURES

The purpose of this study was to examine the weight loss maintenance and exercise patterns of subjects one year following a very low calorie diet.

Selection of the Subjects

The population for this study were 160 women and 40 men between the ages of 18-72 years. An estimated 176 individuals were believed contacted by mail and 53 people responded, although 2 declined to participate. The subjects for this study included 40 women and 11 men between 32-65 years with a mean age of 43.2, who completed a hospital-based very low calorie weight reduction program, one year ago. Former records on subjects were obtained to include height and weight. Subjects signed a consent form prior to participation in the treatment program (Appendix A). The subjects were mailed a cover letter (Appendix B), a consent to participate form (Appendix C) and a blank page questionnaire (Appendix D). They were provided with a self-addressed stamped envelope to return the completed questionnaire. The second call for subjects was a note mailed to those who had not responded as a reminder that they could still participate. Each

questionnaire was identified by Social Security number only to assure confidentiality of the subjects.

Instrument

The questionnaire was developed to assess the following information: present activity level; exercise habits to include intensity, frequency, and duration since completing the weight reduction program; weight loss and weight loss maintenance (Appendix D).

A short pilot study was performed to check the reliability of the instrument. Eighteen junior college students, 16 women and 2 men, between the ages of 18-37 years, completed the questionnaire. The subjects received the second administration of the questionnaire 2 weeks later. The Pearson correlation coefficient for the responses to pre-program weight was .99. The Pearson correlation coefficient for the responses to post-program weight was .99.

Content validity was supported by a committee of experts in the area of health and fitness.

Data Collection

Each subjects weight was collected at entry into the program, at exit from the program and 1 year post completion of the program, from the self-reported weights on the questionnaire. The weight at entry into the program was collected from the subject's medical record.

Each respondents' self-reported exercise patterns were examined as to the type, duration and frequency of the

exercise. Seasonal variances, intensity and the self-evaluated activity level (Appendix D) were also considered. Dr. Kenneth Cooper's guidelines for regular aerobic exercise were used to categorize the subjects as either regular exercisers or non-exercisers.

Gender was identified by the Social Security number.

Statistical Analysis

Each subject's personal information was recorded and entered into the computer. This information included the subject's assigned number, gender, weight loss, weight loss maintained and exercise patterns. A 2 x 2 x 3 analysis of variance was used to determine if these subjects had maintained their weight loss 1 year after the diet and if significant differences existed in the weight loss maintenance between men and women and exercisers and non-exercisers. The statistical level of significance was .05 to accept or reject the hypotheses.

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study was to examine the weight loss maintenance and exercise patterns of participants one year following a very low calorie diet. A questionnaire was developed to determine the weight loss of each respondent as a result of the diet and the amount of weight loss maintained over one year. In addition, each respondent reported their exercise patterns over the past year. The analyses of data in this chapter represent the responses from forty women and eleven men who participated in the weight loss program.

Results

A 2 x 2 repeated measures analysis of variance was performed on the two points in time (pre-program weight versus post-program weight) considering gender. Table I shows the mean scores and standard deviations of males and females.

TABLE I

MEAN SCORES AND STANDARD DEVIATIONS OF MALES AND FEMALES WITH REGARD TO INITIAL WEIGHT (PRE-WEIGHT) AND WEIGHT AT COMPLETION OF THE WEIGHT LOSS PROGRAM (POST-WEIGHT)

	MALES	FEMALES
PRE-WEIGHT	277.4 ± 46.37	211.0 ± 40.95
POST-WEIGHT	204.8 ± 26.94	157.9 ± 30.81

As can be seen in Table I, the men in this study lost a mean weight of 72.6 pounds and the women lost a mean weight of 53.1 pounds as a result of a very low calorie diet.

A 2 x 2 repeated measures analysis of variance was performed on the two points in time (post-program versus one year follow-up) considering gender. Table II shows the mean scores and standard deviations for males and females.

TABLE II

MEAN SCORES AND STANDARD DEVIATIONS OF MALES AND FEMALES WITH REGARD TO WEIGHT AT COMPLETION OF THE WEIGHT LOSS PROGRAM (POST-WEIGHT) AND WEIGHT 1 YEAR AFTER (FOLLOW-UP WEIGHT)

	MALES	FEMALES
POST-WEIGHT	204.8 ± 26.94	157.9 ± 30.81
FOLLOW-UP WEIGHT	224.9 ± 47.48	170.9 ± 33.59

Table II indicates that the men in this study gained a

mean weight of 20.1 pounds and the women gained a mean weight of 13 pounds during the first year following a very low calorie diet.

A 2 x 2 analysis of variance was used to determine if significant differences existed in the weight of subjects after a very low calorie diet and at 1 year follow up, considering gender.

TABLE III

2 x 2 ANALYSIS OF VARIANCE FOR POST-WEIGHT AND FOLLOW-UP WEIGHT

SOURCE	SS	df	MS	F
GENDER (G)	43897.4	1	43897.4	*22.13
ERROR	97217.6	49	1984.0	
TIME (T)	4723.6	1	4723.6	*17.01
G X T	216.9	1	216.9	0.78
ERROR	13604.5	49	277.6	

* significant at .01 level

As can be seen in Table III, both men and women gained a significant amount of weight at 1 year follow-up and yet there was no significant difference found between the men and women for weight gain.

A 2 x 2 repeated measures analysis of variance was performed on the two points of time (post-program weight versus one year follow-up weight), considering gender of participants classified as exercisers. Table IV shows the mean scores and standard deviations for males and females.

TABLE IV

MEAN SCORES AND STANDARD DEVIATIONS OF MALES AND FEMALES WHO EXERCISE WITH REGARD TO POST-PROGRAM WEIGHT (POST-WEIGHT) AND WEIGHT 1 YEAR AFTER (FOLLOW-UP WEIGHT)

	MALES	FEMALES
POST-WEIGHT	213.67 + 30.83	160.72 + 33.58
FOLLOW-UP WEIGHT	213.67 + 21.50	169.97 + 35.63

Table IV indicates that in this study, the men who self-reported regular aerobic exercise reported no weight gain and the women who self-reported regular aerobic exercise gained a mean weight of 9.25 pounds during the first year following a very low calorie diet.

A 2 x 2 repeated measures analysis of variance was performed on the two points of time (post-program versus one year follow-up), considering gender of participants classified as non-exercisers. After examining the means and standard deviations of the four groups, the standard deviation of the

non-exercising males was very high as compared to the other three groups. Therefore, one subject was dropped from further analysis so that homogeneity of variance could be assumed. Table V shows the mean scores and standard deviations for males and females.

TABLE V

MEAN SCORES AND STANDARD DEVIATIONS OF MALES AND FEMALES WHO DID NOT EXERCISE WITH REGARD TO POST-PROGRAM WEIGHT (POST-WEIGHT) AND WEIGHT 1 YEAR AFTER (FOLLOW-UP WEIGHT)

	MALES	FEMALES
POST-WEIGHT	187.75 ± 14.59	150.54 ± 21.46
FOLLOW-UP WEIGHT	210.50 ± 31.58	173.45 ± 28.92

As can be seen in Table V, the men who did not exercise regularly gained a mean weight of 22.8 pounds and the women who did not exercise regularly gained a mean weight of 22.9 pounds during the first year following a very low calorie diet. (These mean weights for the male subjects are prior to dropping one male subject from further analysis.)

A 2 x 2 x 3 repeated measure analysis of variance was used to determine if significant differences existed in the weight of subjects after a very low calorie diet and at 1 year follow-up considering gender and self-reported exercise patterns.

TABLE VI

2 x 2 x 3 ANALYSIS OF VARIANCE FOR POST-PROGRAM WEIGHT
AND 1 YEAR FOLLOW-UP WEIGHT OF PARTICIPANTS CLASSIFIED AS
EXERCISERS AND NON-EXERCISERS

Source	SS	df	MS	F
GENDER (G)	26938.65	1	26938.65	*14.54
EXERCISE (E)	1180.41	1	1180.41	0.64
G X E	462.57	1	462.57	0.25
ERROR	85202.14	46	1852.22	
TIME (T)	2780.20	1	2780.20	*22.86
T X G	81.51	1	81.51	0.67
T X E	1223.35	1	1223.35	*10.06
T X G X E	76.09	1	76.09	0.63
ERROR	5594.48	46	121.62	

* significant at .01 level.

Table VI indicates that both men and women gained a significant amount of weight over one year following a very low calorie diet but there were no significant differences attributable to gender. This table also shows a significant difference related to the interaction of exercise/no exercise and post/follow-up weight. In order to establish which means were significantly different, a Newman-Keuls Multiple Range Test was performed. It is important to note that only 10 of the 11 male subjects were used for this post hoc test due to the extreme weight gain of one subject as compared to the other male subjects in this study.

TABLE VII

NEWMAN-KEULS MULTIPLE RANGE TEST COMPARING THE MEANS FOR EXERCISERS/NON-EXERCISERS AND POST WEIGHT/FOLLOW-UP WEIGHT

	EXERCISER	NON-EXERCISER
POST-WEIGHT	169.79 (n=35)	160.46 (n=15)
FOLLOW-UP WEIGHT	177.46 (n=35)	183.33 (n=15)

Using the results of the Newman-Kuels post hoc test in Table VII, it was determined that both exercisers and non-exercisers gained significant amounts of weight after one year and that there was no significant difference in the weight gain for exercisers as compared to non-exercisers.

Discussion

One hundred and seventy-six participants of a weight reduction program were asked to participate in a study examining long term weight loss maintenance and regular exercise patterns 1 year following a very low calorie diet. Fifty-one respondents agreed to participate, 2 declined and the other 123 individuals did not respond. The actual percentage of program participants who responded to the study was 30%. It is possible that those participants who were maintaining their weight loss were more likely to respond to this study than those individuals who were gaining weight.

Of the 51 respondents, 40 were women and 11 were men. The women lost a mean weight of 53.1 pounds and the men lost a

mean weight of 72.6 pounds while participating in the weight reduction program. Although weight loss as a result of a very low calorie diet was not a focus of this study, it was important to establish the amount of weight lost by the subjects as a point of reference for long term weight loss maintenance. This study analyzed the weight loss maintenance of these subjects for one year following the completion of the weight loss program.

The data from the questionnaire illustrated that the subjects gained weight over the first year following the weight reduction program. The men in this study gained a mean weight of 20.1 pounds (± 47) and the women gained a mean weight of 13 pounds (± 34). If the mean weight gain over 1 year is considered as a percentage of the mean weight loss, the male subjects gained 27.7% and the female subjects gained 24.4%. There was no significant difference in weight gain attributed to gender.

This study confirms previous research findings which overwhelmingly state that significant weight loss in obese subjects is difficult to maintain (Stalonas et al., 1984; Andersen et al., 1987; Salans, 1987; Sikand, 1988 & Miller et al., 1989). However, the weight gains reported in this study are less than those reported in the literature. Sikand et al, (1988) reported that after 2 years, one group of women regained 95.8% of their weight loss. Miller et al, (1989) suggests that 95% of the American population will regain 100% of their weight loss.

The lower weight gain reported in this study could be

explained by three reasons. First, this follow-up weight measurement is only 1 year after completing the diet. It is likely that some of these subjects will continue to gain weight over the next several years. Secondly, the respondents to the questionnaire, as discussed earlier, may not accurately represent the population of program participants. The third reason is suggested by Wadden & Stunkard, (1986). These authors found that a combined treatment of a very-low-calorie diet and behavior therapy similar to the weight reduction program in this study resulted in the subjects regaining only 33% of their weight loss over 1 year. These authors felt that behavior therapy was important in establishing new behaviors conducive to more successful weight loss maintenance.

Further analysis of the data was performed to determine if exercise contributed to greater weight loss maintenance. The subjects in this study were grouped by gender, and as exercisers or non-exercisers, based on their self-reported exercise habits and intensity.

Thirty-six of the women and nine of the men reported that they walked, cycled or participated in some type of aerobic exercise for 30 minutes duration and at least 3 times a week. After reviewing the respondents' questionnaire, 29 of the women (73%) and 6 of the men (55%) were classified as exercisers.

However, just as Jeffery et al., (1984) illustrated, this study failed to show significant differences in weight loss maintenance between subjects who exercised regularly and those

who did not. These results are disappointing considering the benefits of regular aerobic exercise on energy expenditure. Energy expenditure is increased due to the metabolic demand of the exercising muscles but in addition, aerobic exercise can increase the resting metabolic rate for several hours after the exercise session and thus further increase the total energy expenditure.

Of the 35 subjects classified as regular exercisers, 22 of them reported variances in their exercise patterns as a result of weather or illness. It is possible that despite the reported patterns of aerobic exercise, many of these exercisers may have actually been too inconsistent with their exercise program to produce a significantly higher energy expenditure or contribute to their weight loss maintenance.

It is also possible that the small, unequal group sizes compared in this study may have reduced the likelihood of significant differences being found between exercisers and non-exercisers.

In summary, it appears that the participants of a very low calorie weight reduction program had difficulty maintaining their weight loss throughout the first year following the program. Exercise, although considered an important factor for successful long term maintenance of weight loss by the Council on Scientific Affairs, (1988), did not prove to be a contributing factor in long term weight loss maintenance in this study. However, despite the lack of statistical significance in regard to exercise and weight loss maintenance, it is important to note that the men and women

who exercised gained only 4.5% of their post-program weight as compared to the non-exercisers who gained 14.3% of their post-program weight.

CHAPTER V

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Long term management of obesity continues to plague millions of overweight individuals. Low calorie diets are very effective for weight reduction but most individuals are unable to sustain their weight loss.

The primary purpose of this study was to examine the weight loss maintenance and exercise patterns of participants one year following a very low calorie diet.

A total of 51 subjects who had completed a weight reduction program responded to a questionnaire in regard to their weight (pre-program, post-program and at 1 year follow-up) and aerobic exercise patterns. The subjects were divided by gender and as exercisers or non-exercisers.

The statistical procedure used to analyze the data for exercise patterns and gender was a 2 x 2 x 3 repeated measures analysis of variance.

Findings

The data collected in this study were analyzed and lead to the following findings:

1. H_0 There is no significant difference between men and women in maintaining weight loss for 1 year following a very low calorie diet. Hypothesis one was accepted as no

significant difference was found between men and women in maintaining weight loss for 1 year following a very low calorie diet.

2. H_0 There is no significant difference in maintaining weight loss for 1 year following a very low calorie diet between men and women who exercise regularly. Hypothesis two was accepted as there was no significant difference in weight loss maintenance found between men and women who exercise regularly.

3. H_0 There is no significant difference in maintaining weight loss for 1 year following a very low calorie diet between men and women who do not exercise regularly. Hypothesis three was accepted as there was no significant difference in weight loss maintenance found between men and women who do not exercise regularly.

4. H_0 There is no significant difference in maintaining weight loss for 1 year following a very low calorie diet between individuals who exercise regularly and those who do not exercise regularly. Hypothesis four was accepted as there was no significant difference in maintaining weight loss found for individuals who exercise regularly and those who do not exercise regularly.

Conclusions

The following conclusions were drawn from this study:

1. Men and women are equally likely to regain a large percentage of the body weight lost as a result of a very low calorie diet over the following year.
2. Regular aerobic exercise did not influence long term weight loss maintenance for men or women.

Recommendations

The subjects who completed the questionnaire were asked to report their exercise patterns for the past year and to comment on seasonal variances. The credibility of the self-reported exercise utilized in this study is suspect and recommendations for future studies might be to have the subjects keep a daily exercise diary. This would assure the appropriate classification of exerciser versus non-exerciser.

A second recommendation is to change the design of the study from exercise/ no-exercise groups to groups of varying exercise parameters such as the number of days per week or the number of minutes per session. By comparing several exercise levels, there may be tighter control on the effect of exercise.

Lastly, this researcher recommends this study be done again with a larger number of subjects.

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APPENDIXES

APPENDIX A

PROGRAM CONSENT FORM

PATIENT CONSENT FORM

1. I hereby authorize and direct Dr. Tobie Bresloff and the Hillcrest Optifast Program staff and such assistants as may be selected by her, to administer and treat me, _____, with the supplemental fasting diet described in the attached Statement of Information and/or a modified program thereof.
2. I understand that the purpose of my participation in the program is to be treated for obesity and its associated medical complications.
3. I have been advised by Dr. Bresloff of the reasonably know risks and consequences associated with this treatment, and also of the reasonable known risks and consequences of foregoing this treatment. The reasonably known risks and consequences associated with this treatment that I have been told of are set forth in the attached Statement of Information.
4. I am advised that no guarantees can be made concerning the expected results of the procedures described above in the attached State of Information.
5. I hereby acknowledge that a) the above described information has been disclosed to me; b) the information on the attached Statement of Information has been disclosed to me; and c) all questions which I asked about the treatment described have been answered in a satisfactory manner.
6. I understand that I am free to discontinue participation in the program at any time, either verbally or in writing, without fear of prejudice in other treatment that I may receive by the staff at Hillcrest Medical Center.
7. I understand that this consent is in effect throughout my participation in the Hillcrest Optifast Program.
8. I understand that should the results of my treatment or any aspect of it be published in medical or scientific journals, I will not be referred to individually.
9. I understand that clothed photographs may be taken periodically to assess my progress in the program, but will only be viewed by program staff, unless I am otherwise notified.
10. I understand that the program consists of 12 weeks of supplemented fasting, 6 weeks of refeeding, seven weeks of stabilization, and four months of maintenance.

- 11. I understand that I am liable for my fees not reimbursed by a third party, as well as, for additional laboratory tests, medical team consultations, EKG's or product beyond the typical protocol, deemed necessary for my medical care.
- 12. I understand that, because of significant risks, non-compliance of the program protocol is grounds for dismissal without rebate of previously paid funds. I further understand that Hillcrest Optifast Program staff and Dr. Bresloff are not my primary care physicians, and that I will be referred to my primary care physician for non-fasting related problems or upon my separation, for an reason, from the program.
- 13. I have read and understand this consent. All blanks were filled in prior to my signature.

Patient Signature: _____ Date: _____

Hillcrest Optifast Staff: _____ Time: _____

APPENDIX B

COVER LETTER TO SUBJECTS

November 10, 1989

Dear Optifast Program Participant:

My name is Suzanne Reese and I am the physical therapist at the Hillcrest Optifast Program. I am currently working on my Masters Degree at Oklahoma State University. I am attempting to understand whether exercise is important in maintaining weight loss. I am asking you to help me with this study by completing the informed consent form and answering the following questionnaire. Your responses will be seen by me only, and results of the questionnaire will be reported in group format. **Your responses will remain confidential.**

If you have questions, please call

Suzanne Reese
Work: 587-6561 ext. 189
Home: 742-0823

Thank you in advance for your participation in this study.

Suzanne Reese, P.T.
Exercise Consultant, Hillcrest Optifast Program

APPENDIX C

INFORMED CONSENT

OKLAHOMA STATE UNIVERSITY
Exercise and Weight Loss Study for Masters Thesis

INFORMED CONSENT FORM

The purpose of this questionnaire is to investigate exercise patterns and long term weight loss in Optifast^R Program participants 1 year post completion of the Optifast^R Program. The questionnaire will ask you to report your exercise habits, activity level and weight loss as a result of the Optifast^R program.

The questionnaire will be identified by your Social Security Number only.

"I may contact Dr. Mac McCrory at telephone number (405) 744-7260 should I wish further information about the research. I may also contact Terry Macuila, University Research Services, 001 Life Sciences East, Oklahoma State University, Stillwater, OK 74078; Telephone: (405) 744-5700."

The information which is obtained will be treated as privileged and confidential and will not be released or revealed to anyone without your expressed written consent. Information will, however, be treated in an aggregate manner to provide group information.

"I have read and fully understand the consent form. I sign it freely and voluntarily."

Subject's Signature _____ Date _____

Witness _____

APPENDIX D

QUESTIONNAIRE

PERSONAL EXERCISE DIARY Social Security # _____

Have you exercised since completing the Optifast Program?
 _____yes _____no

If yes, please complete the following diary of your exercise program from the time you stopped going to the Hillcrest Optifast Program to the present. Please describe the type of activity (i.e. jogging, cycling, swimming), the minutes per session, and the number of times per week.

Type _____	Times/Week _____	Minutes _____
Type _____	Times/Week _____	Minutes _____
Type _____	Times/Week _____	Minutes _____

Were there any seasonal variances in your exercise program (fall, winter, spring, summer) If yes, please comment.

Do you typically exercise hard enough to (please check all that apply)

increase heart rate	_____
maintain Target heart rate	_____
increase breathing rate	_____
break a sweat	_____

What was your weight when you started the Optifast Program? _____

What was your weight when you finished the Optifast Program? _____

What is your weight now? _____

Please describe your activity level by circling one of these levels. Descriptions of each level are included.

No activity Light Moderate Maximal

No activity -person sits rather than stands; drives rather than walks; spectates rather than participates.

Light -person takes stairs rather than elevators; parks and walks; takes short exercise breaks; reduces reliance on labor saving devices.

Moderate-person begins a low intensity regular exercise program; in addition to increased daily activities; exercises aerobically 3-5 times per week.

Maximal -person engages in regular aerobic activity in the target heart rate range.

Would you like a copy of the results of this study? Yes ___ No ___

VITA

Suzanne B. Reese

Candidate for the Degree of

Master of Science

Thesis: AN ANALYSIS OF LONG TERM WEIGHT LOSS AND EXERCISE PATTERNS IN INDIVIDUALS ONE YEAR AFTER A VERY LOW CALORIE DIET

Major Field: Health, Physical Education and Recreation

Biographical:

Personal Data: Born in St. Louis, Missouri, on October 19, 1955, the daughter of Bernard and Wilda Bergjans.

Education: Graduated from Fort Zumwalt High School, O'Fallon, Missouri, in May 1974; received Bachelor of Science Degree in Physical Therapy from the University of Missouri at Columbia in May, 1978; completed requirements for the Master of Science degree at Oklahoma State University in May, 1990.

Professional Experience: Physical Therapist and Instructor, University of Missouri Hospital and Clinics, September, 1978 to October, 1981; Physical Therapist and Clinical Supervisor, Hillcrest Medical Center, December, 1981 to February, 1988; Senior Physical Therapist, Tulsa Regional Medical Center, April, 1988 to January, 1989; Instructor, Physical Therapist Assistant Program, Tulsa Junior College, January, 1989 to the present.