COMPARISON OF MODERATE- AND LOW- FAT REDUCED ENERGY DIETS ON WEIGHT LOSS AND BODY COMPOSITION IN POST-MENOPAUSAL WOMEN WITH ANDROID OBESITY

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF SCIENCE

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

DEPARTMENT OF NUTRITION AND FOOD SCIENCES

COLLEGE OF HEALTH SCIENCES

BY

HOLLY A. McILHERAN

DENTON, TEXAS

DECEMBER 1993

ACKNOWLEDGEMENTS

I would like to acknowledge my Committee members, Carmen Roman-Shriver, Ph.D., and George Liepa, Ph.D., who assisted and guided me during the preparation of this thesis, and to Betty Alford, Ph.D., Chair, without whose patience and encouragement this would have never been possible. A special thanks to the Nutrition Department secretaries, Carol Johnson and Sandy Graham, for being supportive and patient. A special thank you to Dr. Gench for her assistance with the statistical analyses.

ABSTRACT

COMPARISON OF MODERATE- AND LOW- FAT REDUCED ENERGY DIETS ON WEIGHT LOSS AND BODY COMPOSITION IN POST-MENOPAUSAL WOMEN WITH ANDROID OBESITY

HOLLY A. McILHERAN
DECEMBER, 1993

The purpose of this study was to determine if manipulation of fat content of a 1200 kcal weight reduction diet had an effect on total weight loss and fat distribution as measured by body mass index (BMI) and waist-to-hip ratio (WHR). Twenty-eight abdominally obese, postmenopausal females consumed either a 1200 kcal moderate fat diet consisting of 30 to 32% of total calories from fat (MFD; N = 16), or a 1200 kcal low fat diet with 20 to 22% of calories supplied from fat (LFD; N = 12). Prior to weight loss, all subjects had a BMI $\geq$27 and WHR $\geq$0.80.

Regardless of diet, all subjects experienced significant decreases in body weight, BMI, and WHR. No significant differences were found in amount of weight lost, or changes in body mass index or waist-to-

hip ratio when the two groups were compared.

The data suggests that for postmenopausal females with android obesity, a low fat diet (20 to 22%) is not of greater benefit than a higher fat diet (30 to 32%) during weight reduction. Weight loss and changes in adiposity are related to caloric restriction rather than to the fat content of the diet.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Obesity is a major health problem in America, with approximately 25 to 30% of the population being overweight, and over 65 million Americans attempting to diet (1,2). Obesity has been associated with an increased probability of developing degenerative diseases such as coronary heart disease, hypertension, diabetes mellitus, and cancer (3-5). Obese individuals may exhibit decreased glucose tolerance (6) and blood lipid abnormalities (3,4). According to Brownell and Wadden (7), women who were 5% overweight were 30% more likely than individuals of average weight to develop heart disease, and those who were more than 30% overweight were 300% more likely to develop this condition. Weight reduction should be encouraged for obese individuals so as to improve overall health by decreasing health risk factors.

Obesity is the accumulation of excess body fat and occurs when a positive energy balance develops, that is, when energy intake is greater than energy expenditure. Excess energy intake, whether from fat, carbohydrate, or protein, can be converted to and stored as body fat. Dietary fat, however, requires less energy (3 kcal/ 100gm) to be converted to triglyceride than does carbohydrate (23 kcal/ 100gm) (8). Animal studies have also shown that mice appear to utilize energy from dietary fat more efficiently than dietary carbohydrate during growth, and dietary fat is more efficiently deposited in fat cells than is dietary carbohydrate (9).

WEIGHT REDUCTION

Most reducing diets that severely restrict caloric intake, or focus on one particular food group or a single macronutrient will generally not be successful (1,10). Weight loss diets should meet nutrient needs, allow for individual food preferences, minimize hunger, and be conducive to the improvement of overall health (1). Reviews of literature about weight loss provide consistent recommendations for conservative treatments (1,2,10).

LOW FAT DIETS

Low fat diets have recently gained popularity because of public interest in reducing saturated fat and cholesterol intake. These diets limit fat intake to approximately 20% of calories (11). The amount and type of fat in the diet has been shown to have an effect on blood lipid concentrations (12), and has been correlated with health risks such as heart disease and cancer. Prewitt et. al. (11) observed decreases in total body weight and fat weight, and increases in lean body mass with subjects fed a low-fat diet, regardless of adjustments in energy intake to maintain weight. Diets with modified low-fat intake have been intensively studied to determine their effect on blood lipid concentrations, but few studies have examined the effect of low-fat diets on body composition and changes in body weight.

The purpose of this study was to determine the effect of different amounts of fat in a 1200 kcal weight reduction diet on weight loss and changes in adiposity in postmenopausal women.

OBJECTIVES:

1. Compare total weight loss of subjects on a moderate-fat diet (MFD; 30-32% of calories from fat) to weight loss of subjects on a low- fat diet (LFD; 20-22% kcal from fat).

2. Compare changes in body mass index (BMI) between MFD subjects and LFD subjects.
3. Compare changes in waist-to-hip ratio (WHR) between subjects in the MFD group and subjects in the LFD group.

HYPOTHESES

The null hypotheses tested are stated as follows:

1) There is no difference in total weight lost between subjects fed a moderate- fat diet and subjects fed a low- fat diet;
2) There is no significant difference in decreases in body mass index between subjects in the MFD group and subjects in the LFD group;
3) No difference in WHR will exist between the two groups.

CHAPTER 2

REVIEW OF LITERATURE

Obesity is defined as a condition of the body in which abnormal amounts of adipose tissue accumulate. Obesity has been cited as a health risk factor that increases the chance of developing diseases such as coronary heart disease, diabetes mellitus, hypertension, and cancer (3-5). Mansen et al (3) examined the influence of obesity on the risk of coronary heart disease in a cohort study that involved 115,886 U.S. women ages 30- 55, who were free of diagnosed coronary disease, stroke, or cancer. During the eight years of observation, 605 incident cases of coronary heart disease were reported. After adjustments for age and smoking, the risk of both non-fatal myocardial infarction and fatal coronary disease among women in the heaviest Quetelet- index category ($\geq$29) was over three times higher than those in the leanest category. Coronary heart disease rate was significantly higher (by 80 percent) for mildly to moderately overweight women (Quetelet index 25-28.9). According to Brownell and Wadden (7), even women who are slightly overweight (5% above optimal body weight) were 30%

more likely than their leaner peers to develop heart disease. Women who were 30% or more overweight were an alarming 300% more likely to develop similar complications. Obesity has also been associated with decreases in glucose tolerance (6) and blood lipid abnormalities (3,4). The serious health risk factors which have been associated with obesity underscore the importance of weight reduction for obese individuals.

Measurements of obesity can be estimated by various methods, two of which are: Body mass index (BMI or Quetelet index) and waist-to-hip ratio. Body mass index is calculated as ({ body weight in kilograms} divided by {(height in meters)^2}), and is highly correlated with other estimates of body fatness (13). This method minimizes the effect of height, and has been useful for descriptive or evaluative purposes. The National Institute for Health (NIH) recommends BMI as a helpful measure to determine the presence of obesity and the need for treatment (13). BMI is also widely accepted by national and federal agencies as a standard in measuring body fatness.

Waist and hip circumferences are also highly correlated with body composition. Johnston et al. (14) compared skinfold measurements (triceps skinfold, at the midpoint of the flexed arm; thorax skinfold, over the 10th rib with the subject supine and knees raised; subscapular skinfold, at an oblique angle toward the midline; and abdominal skinfold) and body circumferences and their degree of correlation with body composition in 76 obese women before and after participation in weight reduction programs. There is little agreement in the literature on the optimal sites to be used in measuring obesity; particular sites were chosen by the research team because they provided reproducible indicators of the distribution of fatness in obese subjects (14). The body circumferences measured (waist, chest, arm, and iliac crest) were significantly better predictors of fatness in the same sample of obese women than were skinfold measurements. A separate validation sample of 136 men and women measured once yielded similar results. Waist-to-hip ratio (WHR) is calculated as (waist circumference divided by hip circumference), with a WHR >0.80 being an indicator of abdominal obesity in women.

Obesity is the accumulation of excess body fat and occurs when a positive energy balance develops, that is, when energy intake is greater than energy expended. Any calories, whether from fat, carbohydrate, or protein, when eaten in excess of energy needs, can be converted to and stored as body fat. Dietary fat, however, requires less energy (3 kcal/ 100gm) to be stored as adipose than does carbohydrate (23 kcal/ 100gm) (8). Animal studies have shown that mice appear to utilize energy from dietary fat more efficiently than from carbohydrate during growth, and that dietary fat is more efficiently deposited in fat depots than is converted carbohydrate (9). This comparison should be viewed cautiously because other physiological processes are involved during weight gain as compared with weight loss. Research involving fat- modified diets and their effect on blood lipid values has received much attention, but few studies have been conducted to determine the effect of fat- modified diets on weight reduction and total body composition.

DIETARY FAT AND OBESITY

The amount and type of fat in the diet has been shown to be positively correlated to plasma lipid levels. Studies involving dietary fat intake and obesity have attempted to determine the relationship between fat intake and body composition. Berry et al. (15) used adipose tissue analysis to assess the quality of fat in the diet and its relationship to obesity as measured by body mass index (BMI) in 413 free- living, healthy American males, ages 20- 78, whose BMI ranged from 15- 49. Obese subjects had decreased amounts of unsaturated fat in their adipose tissue, but since adipose tissue composition allows only a qualitative estimate of fat intake, a distinction as to whether these subjects ate more saturated fat or less polyunsaturated fat or a combination of both was not possible.

Mela and Sacchetti (16) determined the sensory preferences for fat and the relationship between dietary intake and body composition. Thirty subjects kept a diet record for ten days and then underwent preference testing with fat- containing stimuli. Ten different foods, each prepared with 2 to 5 levels of fat, were tested. Although no significant relationship was found between dietary fat intake and adiposity measures such as percent body fat, results revealed a consistent positive correlation between overall fat preference and measures of adiposity in a group of normal-weight individuals.

Poor adherence to low- fat diets is a problem in dietary lipid management and weight reduction because of people's preference for fat- containing foods and reluctance to give them up. Drewnowski et al (17) observed in humans a preference for sweetened, high- fat foods that may have implications for the development of dietary induced obesity. Fats provide texture, mouthfeel, and flavor.

These sensory properties of fats. make the diet varied and rich (18). The availability and acceptance of new food and beverage products labeled low- and no- fat is increasing, given the popularity of fat modified products (19). Replacing high fat foods with fat modified products may prove to be beneficial in weight reduction diets.

WEIGHT REDUCTION

Body fatness can be measured using body mass index (BMI), with a score of >27 indicating obesity in women, or waist-to-hip ratio (WHR), with a score of >.80 indicating obesity (4,7). Statistics have shown that at least 25 to 30% of the total population in this country is overweight, despite billions of dollars having been spent on weight loss programs, pills, and potions (20).

Fisher and Lachance (21) determined the nutritional adequacy of eleven popular weight reducing diets. None of the eleven diets provided 100% of the U.S. Recommended Daily Allowances for the 13 vitamins and minerals studied. Fat content of the diets ranged from 10 to 72% of total calories from fat. Reducing diets that approach the basic four food groups in balanced amounts appear to have fewer marginal nutrient levels than diets that emphasize or severely limit any one food group.

Weight reduction is considered successful if the new lower weight can be maintained once lost, and there is no risk to overall health. Weight reduction diets should satisfy nutrient needs, meet individual preferences, minimize hunger, and be conducive to the improvement of overall health (22). Reducing diets also need to be socially acceptable and readily available to fit the average lifestyle. A wide variety of diets is currently available for weight reduction and management, although many of these are not nutritionally adequate or safe for the population.

VERY-LOW-CALORIE DIETS

Very-low-calorie diets (VLCD) generally provide less than 1,000 kcal/day, often produce rapid weight loss, and are therefore considered successful by the public (12,23). Caloric levels below 1,200 kcal/day usually do not supply adequate nutrients to be safe for extended periods (>3-4 weeks), and are not appropriate for children, pregnant or lactating women, or the elderly (24). For individuals with other clinical conditions, such as heart or kidney disease, cancer, hypertension, and insulin-dependent diabetes, higher caloric intake may be advised, due to the additional stress placed on the body by these conditions.

NOVELTY DIETS

Novelty diets that promote extreme restriction of macronutrients or emphasize one particular food group promote weight loss by causing a total reduction in food consumption, but are often based on unfounded scientific principles (22). These approaches are often too extreme to be compatible with everyday lifestyles, are not followed for long periods of time, and may cause health risks (20).

FORMULA DIETS

Formula diets are pre-packaged for convenience and relieve the consumer from making food choices or having to plan meals. Maintenance of weight after loss is generally temporary because no changes in life style have been made. Although formula diets may benefit one portion of the population, they are not recommended for general weight loss.

MODERATE CALORIC RESTRICTION

A more conservative weight reduction method with caloric intakes between 1,200 and 1,800 kcal/day can be nutritionally adequate while promoting desired weight loss. The modest restriction of calories produces slower weight loss, which may be discouraging to less motivated individuals and to those with large amounts of weight to lose (22).

LOW FAT DIETS

Low fat diets have gained popularity because of public interest in reducing saturated fat and cholesterol intake. These diets limit fat intake to approximately 20% of calories (11). The amount and type of fat in the diet has been shown to have an effect on blood lipid concentrations (12), and has been positively correlated with health risks such as heart disease and cancer. Diets with modified low-fat intake and their impact on blood lipid values have been intensively studied, but few studies have examined the impact of low-fat diets on total body composition and changes in overall body weight. Prewitt et al (11) conducted a study to compare the effects of a low-fat diet (LF; 20% of total calories from fat) on total body weight , lean body weight, and adiposity in 18 premenopausal women. The subjects were fed a control diet (HF; 37% kcal from fat) for four weeks followed by a LF diet for 20 weeks. Despite adjustments in energy intake to maintain weight, subjects exhibited a 2.8% decrease in total body weight, an 11.3% decrease in fat weight, and a 2.2% increase in lean body weight). In contrast, research conducted by Alford et al (5) involving 35 adult, sedentary, overweight women on a 10 week diet with variations in carbohydrate, protein, and fat content, showed no significant differences in weight loss between subjects.

SUMMARY

Obesity is a public health problem that contributes to life- threatening diseases and general deterioration of health and a reduction in lifespan. Weight reduction should be encouraged with the emphasis on improving overall health and decreasing health risk factors. Diets that severely restrict caloric intake, focus on one macronutrient, or cannot fit the average daily lifestyle are generally unsuccessful (22). Weight reduction diets should focus on making healthy changes in eating behaviors, such as reducing overall fat intake, as well as calories, instead of periodic restrictions of intake for short term weight losses. A reduction in fat intake has been shown to induce weight loss despite increases in energy intake to maintain weight (11), as well as decrease plasma lipid and cholesterol levels, which can increase general health and well-being. The improvement of general health and well- being should be the focus of any weight reduction diet.

CHAPTER 3

METHODOLOGY

This study utilized data from two studies conducted in a similar manner and with the same screening guidelines at Texas Woman's University on free living, postmenopausal women with abdominal obesity. Comparisons of results of two weight reduction studies (25,26,30) were made to determine differences in weight loss and changes in body fatness between two groups of women following a 1200 kcal diet with different proportions of fat.

Morton and Burnham (25,26) conducted a study involving 16 postmenopausal women with android obesity placed on 1200 kcal reduction diets for four weeks. Approval for this study was granted by the Human Subjects Review Committee of Texas Woman's University, Denton, Texas. Consent forms for each participant were also approved. Recruitment of participants was done through newspaper advertisements, fliers, and interpersonal communication. The first screening was conducted over the telephone to identify those women who met the basic inclusion criteria: post-menopausal, non-smokers, Caucasian, and obese. The next screening was held to calculate BMI (>27) and WHR (>0.80), and to have the participants sign consent and information forms. Twenty four women were initially selected for the study; sixteen women satisfactorily completed the study.

The composition of the diet plan (as % of total calories) was approximately 57-62% carbohydrate, 18% protein, and 20-25% fat. **Table 1** (Appendix A) presents a sample one-day meal plan. Weekly nutritional counseling sessions were held to address any questions or concerns the women had about the meal plan, the research study, and/or nutritional concerns. Subjects were weighed using a beam balance scale before the start of the study and on a weekly basis thereafter until completion of the study. Height without shoes was measured using a stadiometer at the beginning of the study. Body mass index was calculated at the beginning and the end of the study.

Waist and hip circumferences were measured with a flexible measuring tape at the beginning of the study and then on a weekly basis until the study was concluded. Waist circumference was measured at the widest part of the gluteal region while the participant was standing and breathing quietly. Android obesity was classified according to a WHR of greater than 0.80 (25,26). Waist circumference was used rather than skinfold measurements because it has been reported as the best predictor of upper-body fat patterning (27).

The second study, conducted by Valencia Browning (30), involved 20 women recruited through advertisement in the local Denton newspapers, and flyers distributed throughout Denton grocery stores. Inclusion criteria for the women were that they had to be post-menopausal, obese as measured by BMI (>27) and WHR (>0.80), non-diabetic, not suffering from cardiovascular disease, and not taking medications that would interfere with carbohydrate or lipid metabolism.

Respondents were screened by telephone regarding current weight, height, medications presently taking, any pre-existing disease status, and date since last menses. An extensive health questionnaire was mailed to each interested subject prior to the second screening to assess body mass index (BMI) and waist and hip circumferences (WHR). The health questionnaires were reviewed during the second screening, all possible risks and benefits were provided orally, and a written consent was obtained from each participant. Attendance at weekly meetings was also addressed and subjects informed as to the importance of adhering to the specified dietary regimen. The subjects were then placed on a 1200 kcal reduction diet for four weeks.

Body weight was measured at the beginning of the study and weekly thereafter using a beam balance scale. Height, waist and hip circumferences were assessed using a flexible measuring tape. WHR and BMI were calculated at the beginning of the study and at the end of the fourth week. Waist measurements were made between the last rib and the iliac crest above the umbilicus. Hip circumference was measured at the greatest girth of the hip area. Each subject was weighed and measured in light street clothes and without shoes.

Subjects were asked to keep daily food diaries of amounts of food eaten and preparation method. Food diaries were checked weekly for compliance using Minnesota Nutrient Data System (28). The weekly meetings also included nutritional counseling regarding diet, any physical complications, and/or intolerances to the diet.

Diets were designed for weight reduction for four weeks providing 1200-1250 kcal/day. The diet consisted of a seven day menu cycle using the ADA exchange system (29) and the Minnesota diet system (28). An example of a one-day meal plan for this diet is also shown in Table 1. The meals contained an average of 51-53% of calories from carbohydrate, 19% from protein, and 30-32% of calories from fat. Diet exchange forms, food diaries, and recipes with preparation instructions were provided each week. Subjects compliance to the diet was verified using the Minnesota NDS (28) which expressed diet intake in percentages and grams of all nutrients contained in those foods eaten. Diet analysis was compiled over three days to assess adherence to diet plan. In order for subjects to continue in the study and results included in the statistical analysis, ranges were set up that allowed for a 20% deviation from the established level of kcals, grams of carbohydrate, protein and fat (30).

Subjects included in the low fat diet group consumed an average diet consisting of 60-62% of calories from carbohydrate, 18% of calories from protein, and 20-22% of calories from fat. Subjects whose diets averaged more than 22% of calories from fat were eliminated from the statistical analysis. The subjects that were included in the moderate fat diet group consumed a diet consisting of 49-51% of calories supplied by carbohydrate, 19% supplied by protein, and 30-32% of calories supplied by fat for the four week study period. Subjects who consumed >32% of calories from fat were eliminated from the statistical analysis.

Paired t-tests were performed to analyze weight loss, and changes in body mass index and waist-to-hip ratio within groups using the BMDP Statistical Analysis Software (31).

To determine differences between groups in weight loss, and changes in body mass index and waist-to-hip ratio, an analysis of covariance was performed using the BMDP Statistical Analysis Software (31). The level of statistical significance for all tests was set at $p \leq 0.05$.

CHAPTER 4

RESULTS AND DISCUSSION

Abdominally obese, postmenopausal females consumed either a 1200 kcal moderate fat diet (MFD; 30% of calories from fat) or low fat diet (LFD; 20% of calories from fat) for a four week period. The women were similar in age and height. Changes in body weight and anthropometric measures are presented. All statistical values reported in the tables are means (± standard deviation). Characteristics of the women in both groups are presented in **Table 2**.

Paired t-tests were performed to analyze weight loss, and changes in body mass index and waist-to-hip ratio within groups. **Table 3** presents the results of this analysis.

The goal of weight loss was achieved in both the low fat diet (LFD) group and the moderate fat diet (MFD) groups. On the average, women in the MFD group were 9% heavier than those in the LFD group at the beginning of the study (86.06 vs 79.22 kg, respectively), and also had a greater standard deviation. The women in the MFD group had a mean weight loss of 3.75 kg during the four week study period, an average of 0.94 kg lost per week. The women in the LFD group lost an average of 2.64 kg in four weeks

Table 2. Characteristics of Women on Low and Moderate Fat Reduction Diets Prior to Weight Loss.

	LOW FAT DIET GROUP (N = 12)			MODERATE FAT DIET GROUP (N = 16)		
	MEAN	STD.DEV.	RANGE	MEAN	STD. DEV.	RANGE
AGE	57.00	9.35	(70-43)	53.81	8.85	(70-38)
HT	162.10	5.56	(168-150)	164.00	4.70	(170-158)
WT	79.22	7.93	(94.8-68)	86.06	13.63	(113-67)
BMI	30.49	2.32	(34.1-27)	32.16	4.29	(39-27)
WHR	.90	.07	(.99-.81)	.89	.04	(.98-.83)

AGE (yrs)
HT = height (cm)
WT = weight (kg)
BMI = body mass index (kg/m^2)
WHR = waist-to-hip ratio
RANGE = (Max - Min)

Table 3. Comparison of the effects of Weight Loss in Women within the Low and Moderate Fat Diet Groups.

	Pre	Post	Mean Diff.	S.D.	p-value
Low Fat Diet Group					
WT.	79.22	76.58	-2.64	1.33	0.0001*
BMI	30.49	29.31	-1.18	.839	0.0005*
WHR	0.898	0.868	-0.030	0.028	0.0042*
Moderate Fat Diet Group					
WT.	86.06	83.31	-2.75	2.57	0.0000*
BMI	32.16	30.66	-1.50	0.95	0.0000*
WHR	0.893	0.868	-0.025	0.014	0.0000*

WT. = Weight
BMI = Body Mass Index
WHR = Waist-to-Hip Ratio

* Statistically significant $p \leq 0.05$

(0.66 kg/week). The differences in weight losses between the groups were not significant (See **Table 4**). Current literature indicates that reduction diets of 1200 kcal/day generally promote weight loss at an average of 0.5 to 1.0 kg per week. The women in this study lost weight at a rate consistent with these findings.

Decreases in BMI were also achieved by the women in both diet groups. The heavier weight of the women in the MFD group is reflected by a greater BMI prior to weight loss (32.16 compared to 30.49 in the LFD group). Women in the MFD group experienced a decrease in BMI with a mean reduction of 1.50 ($p < 0.0001$). The women in the LFD group experienced a mean decrease in BMI of 1.18 ($p < 0.0001$). The decrease in BMI between groups was not statistically significant ($p = 0.232$; See **Table 5**).

Waist-to-Hip ratio also decreased during the study period. The MFD group experienced an overall decrease in WHR of 0.025 ($p < 0.0001$), and the LFD group experienced a decrease in WHR of 0.030 ($p < 0.0001$). There was no statistical significance in WHR decreases between groups ($p = 0.571$; See **Table 6**).

One-way analysis of covariance was used to compare differences in weight, BMI, and WHR between the two groups.

No significant differences were found for the parameters of this study.

During the course of this study, the LFD group lost an average of 2.64 kg, a -3.34% loss of body weight, and the MFD group lost 3.75 kg, a -4.36% loss. **Figure 1** indicates the relationship between initial and final weight for both groups.

Figure 2 illustrates the decrease in BMI for the LFD group to be 1.18 (-3.87%), and a decrease of 1.50 (-6.41%) for the MFD group. Although the MFD group had a greater percentage decrease in BMI, it was not large enough to show a statistical significance. **Figure 3** indicates the decrease in WHR for the LFD group to be 0.030 (-3.34%) and a decrease of 0.025 (-2.80%) for the MFD group. No statistically significant differences were found.

A recent study conducted by van der Kooy et al. (32) gave evidence that WHR may be a poor predictor of changes in visceral fat stores in obese men and women. Seventy-eight subjects, 38 men and 40 premenopausal women between the ages of 25 and 51 years were selected for the weight loss study when their body mass index was between 28 and 38 (kg/m^2). The aim of the study was to investigate the effects of weight loss in obese men and women on three fat depots:

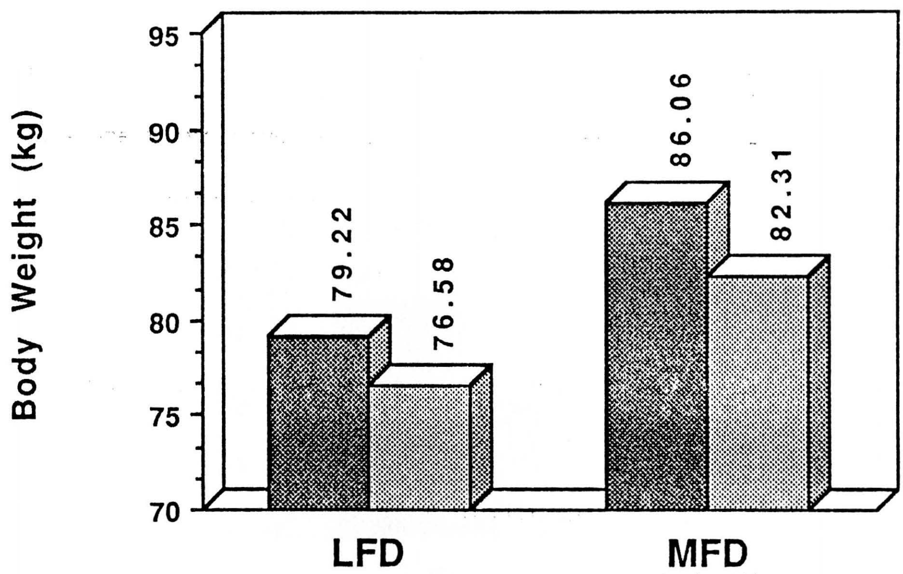

Figure 1. Relationship between initial and final Body Weight for Low Fat Diet (LFD) and Moderate Fat Diet (MFD) Groups.

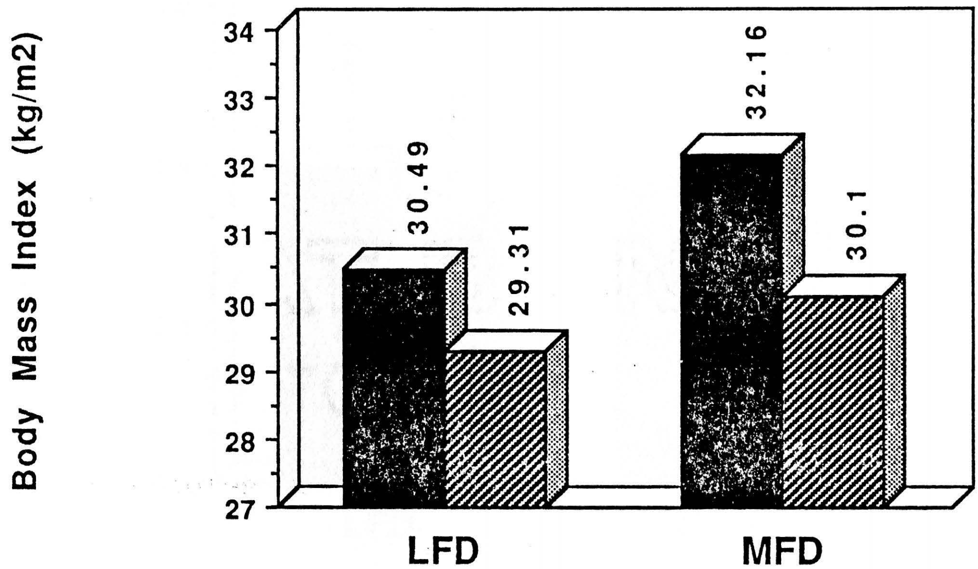

Figure 2. Relationship between initial and final Body Mass Index for Low Fat Diet (LFD) and Moderate Fat Diet (MFD) Groups.

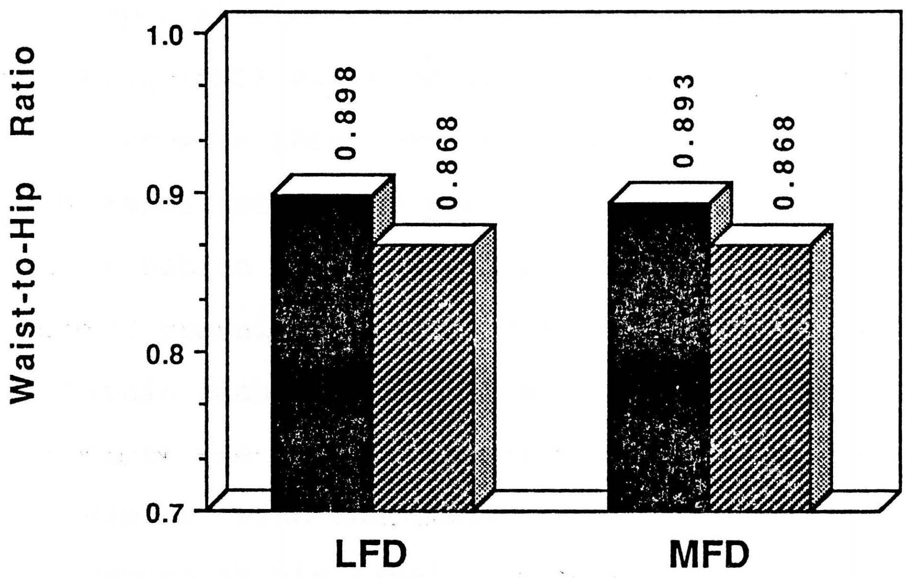

Figure 3. Relationship between initial and final Waist-to-Hip Ratio for Low Fat Diet (LFD) and Moderate Fat Diet (MFD) Groups.

visceral and subcutaneous abdominal depots, and the subcutaneous depot at the trochanter level. Magnetic resonance imaging (MRI) was used to estimate the changes in fat depots, which were then compared to changes in circumference measurements and the waist-to-hip ratio. Body- fat distribution was assessed by circumference measures and MRI scanning before and after weight loss treatment. Within each sex the percent change of the visceral fat depot was larger compared to the two subcutaneous depots, with the smallest decrease in subcutaneous depots at hip level. Despite a significant change in WHR with weight loss and a positive correlation between initial amount of visceral fat and WHR, the change in visceral fat showed no significant correlation with change in WHR in either sex. "The relative stability of the WHR after weight loss may be explained by: 1) the sites where waist and hip circumferences were measured; 2) a relatively small weight loss, < 10 kg; 3) an insufficient number of subjects to detect the relatively small changes in circumference measures and their ratio; and 4) the initial fat pattern of the study population". The authors concluded that changes in WHR are not appropriate for evaluation of changes in visceral fat, and more specific anthropometric measures need to be developed for this purpose.

All subjects included in this research, regardless of diet, experienced significant decreases in total body weight, BMI, and WHR measurements. The percentage of fat in the diet consumed by the women in this study does not seem to make a significant difference in amount of weight lost or in changes in measures of adiposity. The weight loss achieved by all subjects was the result of caloric restriction and not the effect of reduced or restricted fat intake.

Certain variables must be considered when analyzing these data. First, the study only covered a four week period. Larger changes in weight lost and in body measurements may be found if the subjects followed the diet plan for a longer period of time. Second, the subjects involved with this research were free living, and did stray from the prescribed diets. Researchers may have more control over calorie and fat intake with subjects on a formula diet or with those receiving prepared meals.

This study indicates that there is no statistically significant effect derived in an overweight adult female population from the manipulation of the percentage of fat in a 1200 kcal diet. Weight loss results from a reduction of caloric intake in proportion to requirements. The composition of the diet appears to be of less importance than the caloric level. Both groups lost weight and showed decreases in BMI and WHR.

CHAPTER 5

SUMMARY AND CONCLUSIONS

The overall objective of this study was to determine the effect of manipulation of fat content in a 1200 kcalorie reduction diet on total weight loss and changes in the distribution of adiposity in postmenopausal women. Twenty eight subjects were assigned to one of two groups according to percent of calories from fat in the diet. The low fat diet group (LFD; N = 12) consumed a diet consisting of 20 to 22% of calories from fat. The moderate fat diet group (MFD; N = 16) consumed a diet consisting of 30 to 32% of total calories from fat. The study period lasted four weeks.

The women in both diet groups were similar in age and height. The MFD group had a slightly higher body weight prior to weight loss, but was not statistically different from the LFD group. Total caloric intake of both groups, regardless of diet, was 1200 to 1250 kcalories/day. The diets were similar in protein content, and carbohydrate varied according to fat content.

Regardless of the diet consumed, significant decreases in body weight, body mass index, and waist-to-hip ratio were experienced in all subjects in both groups during the four week study period. Body weight decreased significantly within the LFD group ($p < 0.0001$), and within the MFD group ($p < 0.0001$). No significant differences were found when weight loss of the LFD group was compared to weight loss of the MFD group ($p = 0.40$).

Both diet groups experienced significant decreases in body mass index within groups (LFD $p < 0.0005$; MFD $p < 0.0001$). When decreases in BMI of the low fat group were compared to decreases in BMI of the moderate fat group, no statistical significance was found ($p = 0.232$).

The LFD group experienced a significant decrease in waist-to-hip ratio ($p < 0.0042$), as did the MFD group ($p < 0.0001$). No statistical significance was found when decreases in WHR were compared between groups ($p = 0.571$).

Comparisons of the two studies showed that weight loss, BMI, and WHR were not significantly different between the group consuming a LFD and the group on a MFD; therefore the null hypothesis is accepted. It appears that weight loss and changes in adiposity are dependent on caloric restriction rather than the manipulation of the fat content of the diet.

The effect of the fat content of the diet still needs to be pursued. A longer study period may allow for more substantial changes in weight loss and greater changes in adiposity. More time would also allow for the weight loss to decrease to the point where the women would no longer be obese. Greater weight loss and/or movement to the nonobese state may be necessary for a change to occur that can be measured by waist-to-hip ratio or body mass index.

Future research may achieve improved results with more precise control over dietary intake of the subjects. Liquid formula diets with set caloric levels and fat content may control confounding variables associated with free-living subjects. Also, meals prepared on-site and consumed by the subjects on-site may provide increased compliance to diet prescription.

Based on this research, further studies utilizing this population should include a longer study period, and liquid formula diets or on-site meal preparation and consumption in order to obtain better control of subjects' intake and to decrease any confounding variables.

BIBLIOGRAPHY

1. Rock CL, Coulston AM. Weight-control approaches: A review by the California Dietetic Association. *J Am Diet Assoc*. 1988;88:44-48.

2. Cooper Institute for Aerobics Research and Kellogg's. *Issues in Weight Control*. Battle Creek, MI: Kellogg Company; 1992.

3. Mansen JE, Colditz GA, Stampfer MJ, Willett WC, Rosner B, Monson RR, Speizer FE, Hennekens CH. *N Engl J Med*. 1990;322:882-889.

4. Brownell KD. The psychology and physiology of obesity: Implications for screening and treatment. *J Am Diet Assoc*. 1984;84:406-414.

5. Alford BB, Blankenship AC, Hagen RD. The effects of variation in carbohydrate, protein and fat content of diet upon weight loss, blood values, and nutrient intake of adult obese women. *J Am Diet Assoc*. 1990;90:534-540.

6. Busby MJ, Bellantoni MF, Tobin JD, Muller DC, Kafonek SD, Blackman MR, Andres R. Glucose tolerance in women: The effects of age, body composition, and sex hormones. *J Am Geriatr Soc*. 1992;40:497-502.

7. Brownell KD, Wadden TA. The heterogenity of obesity: Fitting the treatment to individuals. *Behav Therapy*. 1991;22:153-166.

8. Danforth E. Diet and obesity. *Am J Clin Nutr*. 1985;41:1132-1145

9. Donato KA. Efficiency and utilization of various energy sources for growth. *Am J Clin Nutr*. 1987;45:164-167.

10. Stevens VJ, Rossner J, Greenlick M, Stevens N, Frankel HM, Craddick S. Freedon from fat: A contemporary multi-component weight loss program for the general population of obese adults. *J Am Diet Assoc*. 1989;89:1254-1258.

11. Prewitt TE, Scheisser D, Bowen PE, Aye P, Dolecek TA, Langenberg P, Cole T, Brace L. Changes in body weight, body composition, and energy intake in women fed high- and low- fat diets. *Am J Clin Nutr*. 1991:54:304-310.

12. Norum KR. Dietary fat and blood lipids. *Nutr Rev.* 1992;50:30-37.

13. Health Implications of Obesity. Bethesda, Md: National Institutes of Health Consensus Development. *Ann Int Med.* 1985;103:147-151.

14. Johnston FE, Wadden TA, Stunkard AJ, Pena M, Wang J, Pierson RN, Van Itallie TB. Body fat deposition in adult obese women. Patterns of fat distribution. *Am J Clin Nutr.* 1988;47:225-228.

15. Berry EM, Hirsch J, Most J, Thornton J. The role of dietary fat in human obesity. *Int J Obesity.* 1986;10:123-131.

16. Mela DJ, Sacchetti DA. Sensory preferences for fats: Relationships with diet and body composition. *Am J Clin Nutr.* 1991;53:908-915.

17. Drewnoski A, Greenwood MR. Cream and sugar: Human preferences for high fat foods. *Physiol Behav.* 1983; 30:629-633.

18. Drewnowski A. Sensory properties of fats and fat replacements. *Nutr Rev.* 1992;50:17-20.

19. Lyle BJ, McMahon KE, Kreutler PA. Assessing the potential dietary impact of replacing dietary fat with other macronutrients. *J Nutr.* 1992;122:211-216.

20. Weinsier RL, Wadden TA, Ritenbaugh C, Harrison GG, Johnson FS, Wilmore JH. Recommended therapeutic guidelines for professional weight control programs. *Am J Clin Nutr.* 1984;40:865-872.

21. Fisher MC, Lachance PA. Nutrition evaluation of published weight- reducing diets. *J Am Diet Assoc.* 1985;85:450-454.

22. Rock CL, Coulston AM. Weight-control approaches: A review by the California Dietetic Association. *J Am Diet Assoc.* 1988;88:44-48.

23. Wing RR, Marcus MD, Salata R, Epstein LH, Miaskiewiez S, Blair EH. Effects of a very-low-calorie diet on long-term glycemic control in obese type II diabetic subjects. *Arch Inter Med.* 1991;151:1334-1340.

24. Burgess NS. Effect of a very-low-calorie diet on body composition and resting metabolic rate in obese men and women. *J Am Diet Assoc*. 1991;91:430-434.

25. Morton LA. *The Effects of High and Low Glycemic Index Reduction Diets on Postmenopausal Android Obese Caucasian Women*. Denton, Tx: Texas Woman's University; 1992. Thesis.

26. Burnham CE. *The Effect of Low and High Glycemic Index 1,200 Kcalorie Diets on Carbohydrate Metabolism in Post-menopausal Women with Abdominal Obesity*. Denton, Tx: Texas Woman's University; 1991. Thesis.

27. Johnston FE, Wadden TA, Stunkard AJ, Pena M, Wang J, Pierson RN, Van Itallie TB. Body fat deposition in adult obese women. I Patterns of fat distribution. *Am J Clin Nutr*. 1988;47:225-228.

28. Nutrition Coordinating Center, University of Minnesota; 1991. *Minnesota Nutrient Data System*. Minneapolis,MN: Price K, Stevens M ed.

29. American Diabetic Association and American Dietetic Association. *Exchange Lists for Meal Planning*. Chicago, Il: ADA, Inc;1988.

30. Browning V. *Influence of Dietary Treatment on the Abdominally Obese Postmenopausal Women*. Denton, Tx: Texas Woman's University; 1992. Dissertation.

31. Dixon, Ed. *Biomedical Data Program Statistical Software*. Berkley: University of California Press, 1990.

32. van der Kooy K, Leenan R, Seidell JC, Deurenberg P, Droop A Bakker CJ. Waist-hip ratio is a poor predictor of changes in visceral fat. *Am J Clin Nutr*. 1993;57:327-333.

APPENDIX A

ONE DAY MEAL PLAN

TABLE 1 One Day Meal Plan for Low and Moderate Fat Diet Groups

LOW FAT DIET MEAL PLAN	MODERATE FAT DIET MEAL PLAN
BREAKFAST	
1/2 cup oatmeal 1 cup skim milk 1/2 grapefruit 1 slice pumpernickel bread 1 tbsp. diet margarine	1 slice pumpernickel 1 cup 2% milk 1 tsp. margarine 1 pear
LUNCH	
1 Tbsp. natural peanut butter 1 Tbsp. diet jelly 2 slices pumpernickel bread	1 cup kidney beans 2 oz. cheese 1/2 cup broccoli cooked 1/2 cup 2% milk 2 tsp. olive oil
SUPPER	
2 oz. chicken strips 1-1/2 cup cooked pasta 1 cup fresh broccoli 1 Tbsp. diet margarine 1 Tbsp. lemon juice 1 tsp. olive oil 1 garlic clove 1 cup skim milk	1 oz. diced ham 1 cup barley 1 cup fresh zucchini 1 large tomato 1 tbsp. olive oil
SNACK	
1/2 cup apple juice	1/2 cup 2% milk

APPENDIX B

DESCRIPTIVE STATISTICS

Table 4. Descriptive Statistics on Weight.

GROUP	PRETEST MEAN ±S.D.	POSTTEST MEAN ±S.D.	ADJUSTED POSTTEST MEANS
LOW FAT DIET	79.22 ±7.91	76.58 ±7.47	80.26
MODERATE FAT DIET	86.06 ±13.63	82.31 ±13.09	79.55

Analysis of Covariance Summary Table

SOURCE	DF	SS	MS	F	P- VALUE
GROUP	1	3.12	3.12	0.73	0.40
ERROR	25	106.33	4.25		

DF = Degrees of Freedom
SS = Sums of Squares
MS = Mean Squared
F = F-Value

* $p < 0.05$

Table 5. Descriptive Statistics on Body Mass Index.

GROUP	PRETEST MEAN ±S.D.	POSTTEST MEAN ±S.D.	ADJUSTED POSTTEST MEANS
LOW FAT DIET	30.49 ±2.32	29.31 ±2.80	30.27
MODERATE FAT DIET	32.16 ±4.29	30.09 ±4.80	29.37

Analysis of Covariance Summary Table

SOURCE	DF	SS	MS	F	P- VALUE
GROUP	1	5.29	5.29	1.50	.232
ERROR	25	88.11	3.52		

DF = Degrees of Freedom
SS = Sums of Squares
MS = Mean Squared
F = F-Value

* $p < 0.05$

Table 6. Descriptive Statistics on Waist-to-Hip Ratio.

GROUP	PRETEST MEAN ±S.D.	POSTTEST MEAN ±S.D.	ADJUSTED POSTTEST MEANS
LOW FAT DIET	.898 ±0.07	.868 ±0.07	.866
MODERATE FAT DIET	.893 ±0.04	.868 ±0.05	.870

Analysis of Covariance Summary Table

SOURCE	DF	SS	MS	F	P- VALUE
GROUP	1	0.000	0.000	.330	0.571
ERROR	25	0.012	0.001		

DF = Degrees of Freedom
SS = Sums of Squares
MS = Mean Squared
F = F-Value

* $p < 0.05$