DISSERTATION

DEVELOPMENT AND EVALUATION OF A WEIGHT CONTROL PROGRAM FOR OBESE PREADOLESCENT CHILDREN

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY VIRGINIA A. HAMMARLUND ENTITLED DEVELOPMENT AND EVALUATION OF A WEIGHT CONTROL PROGRAM FOR OBESE PREADOLESCENT CHILDREN BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

DEVELOPMENT AND EVALUATION OF A WEIGHT CONTROL PROGRAM FOR OBESE PREADOLESCENT CHILDREN

Obesity is a common nutritional problem of American children. Health problems associated with childhood obesity and its continuation into adulthood underscore the need for effective weight control treatment for obese preadolescent children. The purpose of this study was to develop an effective weight control program that incorporated a structured low fat diet, regular exercise, behavior modification, family involvement and a fun learning environment. No weight control treatment for obese preadolescent children has incorporated these factors. The program was designed to teach obese preadolescent children methods to reduce their daily fat intake to between 25 and 30 percent of their total daily caloric intake.

Thirty-two obese preadolescent children were recruited from the Cheyenne, Wyoming, area with the assistance of local health care practitioners. Children were randomly assigned to the special intervention group or the standard care group. Children assigned to the special intervention

group participated in a newly designed ten week weight control program for obese preadolescent children.

Children in the special intervention group changed the nutrient quality but not the fat quantity of their diets. These children, as indicated on their program evaluations and confirmed by nutrient analysis increased their consumption of fruits, vegetables, dairy products and meat. They did not use low fat food substitutions that were emphasized in the program. Analysis of activity factors confirmed that children in the special intervention group had increased their level of physical activity at weeks 10 and 22.

Children in the standard care group received the nutritional counseling usually provided by a registered dietitian at the local medical clinic. Children in the standard care group exhibited a significant improvement ($P \leq 0.05$) in relative weight and BMI at weeks 10 and 22. Changes in dietary fat intake of children in the standard care group were associated with changes in their weight status indicators. The greater success of the standard care group was related to the level of family functioning and the type of individualized counseling provided as usual care. Results of this study suggest that obese preadolescent children from dysfunctional families could achieve a greater

level of weight control success with individualized care than with a group based program.

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INTRODUCTION

Obesity is a common nutritional problem in Western societies (Kluthe and Schubert, 1985). It is a risk factor for several diseases including hypertension, cardiovascular disease, noninsulin-dependent diabetes mellitus, gout, gallbladder disease and certain arthritic conditions of the spine, knee and hip. Obesity is also associated with an increased risk for cancer of the colon, rectum and prostate in men and an increased risk for cancer of the gallbladder, biliary passages, breast (postmenopausal), cervix, endometrium and ovaries in women (National Institutes of Health, 1985; Pi-Sunyer, 1991; Schapira, 1991).

Prevalence of obesity, particularly in the United States has steadily increased during the 20th century. American men and women appear to be more prone to obesity than their Canadian or British counterparts (Millar and Stephens, 1987). Similar trends exist between American children and children from other countries. A greater percentage of American children are obese compared to children from Britain, Sweden, Switzerland and Finland (Ginsberg-Fellner, 1981; Nuutinen, 1991). Among American children age 6 to 17 years, the prevalence of obesity increased from 16.7% in National Health Examination Survey, 1963-1970 to 24.5% in the second National Health and Nutrition Examination Survey, 1976-1980 (Gortmaker, 1987). During the same time period, the prevalence of superobesity among American children of this age group increased from 5.7% to 10.4% (Gortmaker, 1987).

Obesity is defined as a long term imbalance in the percentage of body fat (Bray, 1979). Measurements used to diagnose obesity include both laboratory and clinical methods. Although clinical methods are less direct than laboratory methods, clinical procedures offer the advantages of wider availability, less expense, simplicity and greater patient acceptance than laboratory techniques. Clinical methods are based on anthropometric measurements at various body sites.

The most common anthropometric measures used in the clinical setting include weight, height, relative weight, circumferences and skinfold thicknesses (Gray,1989). Triceps skinfold thicknesses at or above the 85th percentile for a specific age and sex group identifies children as obese (Seltzer and Mayer, 1965; Garn and Clark, 1976). Children who have triceps skinfold thicknesses greater than or equal to the 95th percentile for their age and sex group are considered to be superobese (Gortmaker, 1987).

Onset of obesity can be detected by the age of two years in girls and the age of three years in boys (Shapiro, 1984; Muramatsu, 1990). Persistence of the obese condition is as important to establish as the age of onset. Tracking or continuation of obesity from childhood into adulthood has been extensively studied since Abraham and Nordsieck's investigation (Abraham and Nordsieck, 1960). The percentage of children who remain obese into adulthood varies from 14% to 75% depending on the age of onset and the severity of the condition (Abraham and Nordsieck, 1960; Charney, 1976; Garn, 1985).

Health consequences experienced by obese children are similar to the health conditions encountered by obese adults. Health risks associated with childhood obesity include social, psychological and physiological problems. The latter are identified by a higher incidence of respiratory infections, a greater incidence of unusual orthopedic disorders, hyperinsulinemia, hypertension and hyperlipidemia. These health risks, particularly hyperlipidemia (Wynder, 1989) and hypertension (Julius, 1990) continue into adulthood along with the obese weight status.

Prevention is identified as the most desirable form of treatment for obesity. However, prevention can only be possible when the causes of obesity have been determined. Factors influencing energy balance have been studied in order to determine the causes of obesity. Recent evidence indicates that a high intake of dietary fat may accentuate the storage of excess calories in the body as fat (Salmon and Flatt, 1985; Flatt, 1987; Dreon, 1988; Romieu, 1988; Schutz, 1989; Sims, 1989). Dietary fat, even at excessive intakes, appears to be preferentially stored in adipose tissue rather than utilized as a fuel source (Dallosso and James, 1984; Flatt, 1985; Schutz, 1989). The increase in the prevalence of obesity in the U.S. population parallels the increase in the dietary fat content of the American diet (Bray, 1976; Select Committee on Nutrition and Human Needs, 1977; Kannel and Gordon, 1979). Percent of calories derived from fat rose from 27% of total caloric intake in 1910 to 44% of total caloric intake in 1984 (Daxum, 1986).

Lack of effective treatment combined with the health implications associated with an increasing prevalence of childhood obesity concern health care professionals. A review of weight loss programs previously and currently available to children, adolescents and adults revealed several factors that influenced the success of a weight loss treatment. These factors included family involvement (Kingsley and Shapiro, 1977; Brownell, 1983; Epstein, 1985 and 1990; Mellin, 1987; Wadden, 1990; Hart, 1990), a structured diet (Epstein, 1990), regular exercise (Becque, 1988; Amador, 1990; Reybrouck, 1990; Wood, 1991), behavior modification (Minderaa and Wit, 1983; Becque, 1988; Hills and Parker, 1988; Hoerr, 1988; Amador, 1990; Lavery, 1988; Epstein, 1990; Schlundt, 1990), a "fun" learning environment (Hoerr, 1988) and a low fat diet (Schlundt, 1990; Sheppard, 1991; Prewitt, 1991). No weight control program for children has incorporated all of these factors. Thus, the goal of the research project was to develop an effective weight control program for preadolescent children utilizing these factors.

The objectives of the present research included:

1. To develop a weight control program that incorporated a 25 to 30 % fat calorie diet and increased physical activity for obese preadolescent children.

2. To monitor the rate of weight gain, the relative weight and the percent of body fat in selected children after adherence to a weight control program.

3. To compare the effectiveness of the proposed weight control program for obese preadolescent children to standard care.

REVIEW OF LITERATURE

Prevalence of Obesity in American Children

Prevalence of obesity among American children increased 47% between the years of 1963 and 1980. In the 1963 to 1970 National Health Examination Survey (NHES), 16.7% of the children age 6 to 17 years in the United States were determined to be obese. Percentage of children from the same age group who were identified as obese rose to 24.5% in the second National Health and Nutrition Examination Survey (NHANES II) conducted between the years of 1976 and 1980.

Results of both surveys were based on the percentage of children whose triceps skinfold measurements fell at or above the 85th percentile for their age and sex group (Gortmaker, 1987). Standards used to define the 85th percentiles were obtained from NHES cycle two and three. Cycle two of NHES examined 7119 children age 6 to 11 years between the years of 1963 and 1965. Cycle three of NHES examined 6710 children age 12 to 17 years between the years of 1966 and 1970. In NHANES II, 3700 children between the ages of 6 and 17 years were examined. Values used as standards for the 85th percentiles identified not less than 15% of the population as obese. Thus, a slightly greater proportion of the samples were identified as obese.

More striking increases in the prevalence of obesity occurred among certain subgroups of the population. Although children of both sexes experienced increases in the prevalence of obesity, boys 6 to 11 years of age demonstrated a substantial increase of 61%. Among girls of this age group, the prevalence of obesity rose 46%. Adolescent females age 12 to 17 years also demonstrated a sizable increase in the prevalence of obesity. Between the years of 1966 to 1980, the prevalence of obesity among adolescent females increased 58%. More modest increases in the prevalence of obesity occurred among adolescent males (Table 1).

Differences in the prevalence of obesity were also observed among ethnic groups. An increase of 91% in the prevalence of obesity was recorded among black children age 6 to 11 years. A 51% increase in the prevalence of obesity was observed among white children of the same age group. Black adolescents experienced a 83% increase in the prevalence of obesity between the years of 1966 to 1980 compared to a 35% increase for white adolescents.

Prevalence of superobesity among children age 6 to 17 years in the United States nearly doubled between the years of 1963 to 1980. In the NHES, 1963-1970, 5.7% of the children surveyed were considered superobese compared to 10.4% of the children studied in the NHANES II, 1976-1980. Superobesity was defined as a triceps skinfold measurement

TABLE 1. Estimates of the Prevalence of Obesity in the United States from 1963 to 1980 by Age, Sex and Race in Children 6 to 17 Years of Age.*

6- to 11-Year-Olds

GROUP	NHES (1963-65)	NHANES II (1976-80)	% INCREASE
Boys	17.9	28.9	61
Girls	17.3	25.2	46
Blacks	8.8	16.8	91
Whites	19.1	28.0	51
Total	17.6	27.1	54

12- to-17-Year-Olds

GROUP	NHES (1966-70)	NHANES II (1976-80)	% INCREASE
Boys	15.5	18.3	18
Girls	16.1	25.5	58
Blacks	10.2	18.7	83
Whites	16.7	22.5	35
Total	15.8	21.9	39

*Source: Gortmaker SL, Dietz WH, Sorbol AM, Wehler CA. Increasing pediatric obesity in the United States. Am J Dis Child 141:535-40,1987. Reprinted with permission from The American Medical Association (Appendix A).

greater than or equal to the 95th percentile for a given age and sex group. Standards used to define the 95th percentiles were also obtained from NHES cycle two and three. Values used as standards for the 95th percentiles identified not less than 5% of the population as superobese. Thus, a slightly greater proportion of the samples were identified as superobese.

Greater increases in the prevalence of superobesity were observed among children age 6 to 11 years, adolescent females and black children. Boys 6 to 11 years of age experienced a 122% increase in the prevalence of superobesity. Girls of the same age group exhibited a 70% increase in the prevalence of superobesity. Black children 6 to 11 years of age demonstrated a staggering 196% increase in the prevalence of superobesity. In comparison, white children of the same age group experienced a 92% increase in the prevalence of superobesity. An 87% increase in the prevalence of superobesity was recorded among adolescent females. Prevalence of superobesity among black adolescents increased 86%, while the prevalence of superobesity among white adolescents increased 61%
(Table 2).

<u>Changes in Anthropometric Measurements of American Children</u>

Comparison of the mean values for weight, height and triceps skinfold measurements from both national surveys indicated that children age 6 to 17 years were becoming

TABLE 2. **Estimates of the Prevalence of Superobesity in the United States from 1963 to 1980 by Age, Sex and Race in Children 6 to 17 Years of Age.**[*]

6- to-11-Year Olds

GROUP	NHES (1963-65)	NHANES II (1976-80)	% INCREASE
Boys	5.8	12.9	122
Girls	6.1	10.4	70
Blacks	2.7	8.0	196
Whites	6.5	12.5	92
Total	5.9	11.7	98

12-to-17 Year Olds

GROUP	NHES (1966-70)	NHANES II (1976-80)	% INCREASE
Boys	5.2	7.3	41
Girls	5.8	10.8	87
Blacks	4.4	8.2	86
Whites	5.7	9.2	61
Total	5.5	9.0	64

[*]Source: Gortmaker SL, Dietz WH, Sorbol AM, Wehler CA. Increasing pediatric obesity in the United States. Am J Dis Child 141:535-40, 1987. Reprinted with permission from The American Medical Association (Appendix A).

fatter (Pate, 1985; Gortmaker, 1987; Ross, 1987; Shear, 1988). Between the years of 1963 and 1980, the mean triceps skinfold thickness increased 1.7 mm and mean weight increased 1.3 kg for children age 6 to 11 years. In contrast, mean height for children of this age group exhibited only a modest increase of one cm. A similar trend was observed among the values identifying the mean weight, height and triceps skinfold thickness for adolescents. Mean triceps skinfold thickness for adolescents increased 1.6 mm. Mean weight for adolescents increased one kg, while mean height for adolescents increased less than one cm. Greater shifts were found among the values identifying the 95th percentiles for triceps skinfold thicknesses and weight in children, and for triceps skinfold thicknesses in adolescents.

Other evidence indicating that American children were becoming fatter include the changes in the percentages of body fat used to mark the average amount of fat found in children. Previously. the percentage of body fat declined throughout early childhood, reaching at the age of seven years a prepubertal nadir of 13% in boys and 17% in girls (Fomon, 1982). Average amounts of body fat for boys and girls of the same age were recently reported to be 19% and 20%, respectively (Barlett, 1991). An increase in the percentage of body fat continues to occur prior to the pubertal growth spurt, but at a higher level. The amount of body fat in preadolescent males was previously reported to increase slightly from 13% to 15% of body weight, while the amount of body fat in preadolescent females increased from 17% to 21% (Fomon, 1982). Recently, the percentage of body fat in preadolescent males was reported to increase from 19% to 21%, while the percent of body fat in preadolescent females was reported to increase from 20% to 22%. In the periadolescent period, the percentage of body fat for boys was reported to decrease to 12%, while the percentage of body fat decreased to 18% for girls (Holliday, 1978). Among periadolescent males, the percentage of body fat was recently reported to remain at approximately 21%, while the percentage of body fat among periadolescent girls was observed to increase to 30% (Barlett, 1991). By the age of 18 years, adolescent males were previously reported to be about 15-18% body fat and adolescent females to be about 20-25% body fat (Bray and Gray, 1988). Adolescent males and females of the same age are now on average approximately 19% and 27% body fat, respectively (Barlett, 1991).

More American children and adolescents were identified as being obese in NHANES II than in NHES. Based on NHANES II data, 24.5% of children age 6 to 17 years in the United States were obese and 10.4% were superobese. Changes in the values identifying the mean weight, height and triceps skinfold thickness of children indicated that American children were fatter compared to their counterparts of the

1960's. Further evidence of the changes that have occurred in the body composition of American children were detected among the values used to identify the average amounts of body fat in children.

Identification of Childhood Obesity

Identification of childhood obesity depends on the definition used to diagnose obesity and the techniques used to assess the body composition of a child. Obesity is identified by an excessive amount of body fat. The obese state can be further characterized by the size and number of adipocytes, the location of body fat and/or the severity of the condition. Many techniques are used to assess the body composition of a child. Methods include both laboratory and clinical procedures. Since each procedure features a specific set of disadvantages, the ideal method to assess the body composition of a child remains to be determined.

Definition of Overweight

The terms overweight and obesity are used interchangeably. However, these two terms describe two different weight situations. The overweight condition is characterized by an excessive amount of body weight in relation to height; whereas, obesity is distinguished by an excessive amount of body fat (Bray, 1976). Since an overweight state can be the result of an excess of lean body mass or an excess of adipose tissue, being overweight does not necessarily imply the existence of obesity (Vasselli, 1983). For children, the severity of the overweight condition can be classified by weight for height measurements. A weight for height measurement falling between the 75th and 89th percentiles identifies a mildly overweight state. A weight for height value falling between the 90th and 94th percentiles identifies a moderately overweight state. A weight for height measurement greater than or equal to the 95th percentile identifies a severely overweight state (Peck and Ullrich, 1985).

Definition of Obesity

Obesity is defined as an excess in the percentage of body fat. The amount of body fat is influenced by several factors including age, sex, race and physical activity. At birth, the human body contains between 10 to 15% fat (Forbes, 1987). During the first year of life, the amount of body fat steadily increases to 20-25% of body weight (Forbes, 1987). The percentage of body fat declines during early childhood, reaching a prepubertal low of 19% in boys and 20% in girls. An increase in the percentage of body fat occurs prior to the adolescent growth spurt. The amount of body fat in preadolescent males increases to 21%, while the amount of body fat in preadolescent females increases to 22%. The percentage of body fat continues to change throughout adolescence. Levels of body fat approach young adult levels, reflecting the differences in the amount of body fat exhibited between the sexes. In adolescent males, the percentage of body fat decreases to 19%; whereas, in adolescent females, the percentage of body fat rises to 27% (Barlett, 1991). Women continue to demonstrate greater percentages of body fat than men at every age throughout life.

Levels of Body Fat. Percentage of body fat used to define obesity varies with age and gender. A percentage of body fat greater than 30% has been suggested to define obesity in preadolescent children. Percentages of body fat greater than 35% and 25% have been recommended as appropriate levels indicative of obesity in adolescent females and males, respectively (Westrate and Deurenberg, 1989). Percentages of body fat recommended by the Metropolitan Life Insurance Company in 1959 to define obesity among adult males and females, continue to be used today. A percentage of body fat greater than 30% is used to define obesity in adult females, while a percentage of body fat greater than 20-25% is used to define obesity in adult males (Metropolitan Life Insurance CO, 1959 and 1983).

Adipose Tissue Development. Based on morphological changes occurring within the adipose tissue, obesity is categorized as either hypertrophic or hyperplastic-hypertrophic. Enlarged adipocytes characterizes hypertrophic obesity, while an excessive number and size of adipocytes describes hyperplastic-hypertrophic obesity. A full adipocyte can be 10 times the size of an empty adipocyte which is approximately 15 micrometers in diameter. An adipocyte from a non-obese adult contains between 0.3 and 0.9 micrograms of lipid. The number of adipocytes can be expanded from 2 x 10^{10} to 16 x 10^{10}, emphasizing the body's ability to increase its fat reserves (Sjostrom, 1980). Usually, hypertrophic obesity has been associated with adult onset obesity and hyperplastic-hypertrophic with juvenile onset obesity (Vasselli, 1983). However, research conducted by Hirsch and Batchelor (1976) demonstrated that hyperplastic-hypertrophic obesity was better correlated with increases in body weight than the age of onset.

Deviations from typical adipose tissue development can be detected in obese children between the ages of one and two years (Knittle, 1972; Knittle, 1979). Changes in the fat deposits of non-obese children between birth and one year of age are primarily due to increases in the lipid content of adipocytes. This period of adipose tissue hypertrophy is followed by a year long period characterized by a decrease in the lipid content of fat cells. Small increases in the number of adipocytes occur throughout this period. After the age of two years, the fat deposits of non-obese children remain relatively quiescent until the age of ten years when increases in adipocyte number and size occur (Hager, 1977: Knittle, 1979). This usual pattern of adipocyte tissue development is not followed within the fat deposits of obese children. Between the ages of one and two years, the lipid content within the adipocytes of obese children continues to increase rather than decrease (Knittle, 1972: Knittle, 1979). Changes in adipose tissue cellularity that usually do not occur in non-obese children until after the age of ten years have been shown to occur between the ages of two and ten years in obese children (Knittle, 1972: Knittle, 1979). Thus, hyperplastic-hypertrophic obesity can be detected in children as young as two years of age based on the morphological changes occurring within their adipose tissue.

Prognosis for the treatment of hyperplastic-hypertrophic obesity is acknowledged to be poor due to the "ratchet effect" (Krotkiewski, 1977; Vasselli, 1983). The ratchet effect describes the body's ability to increase but never decrease its fat storage capacity. The size of adipocytes can increase or decrease but the number of adipocytes can only increase. Once the adipose cells become full with lipid, new adipose cells become available through the conversion of preadipocytes to mature adipocytes. Although the actual triggering mechanism remains unknown, the conversion of preadipocytes to differentiated adipocytes appears to be influenced by hormones such as insulin (Negrel, 1978), 17-beta-estradriol (Roncari and Van, 1978) and some prostaglandins (Bjorntorp, 1980).

The ratchet effect influences the timing of weight loss intervention. In a ten year longitudinal study, Ginsberg-

Fellner and Knittle (1981) reported that prepubescent children who successfully completed a weight reduction program had initial total adipose cell numbers below 2 x 10^{10} adipocytes. Weight loss success was defined as the maintenance of body weight below 130% of ideal body weight. The authors further reported that the initial relative weights of the children who successfully lost weight were significantly lower than the initial relative weights of the children who were unsuccessful at weight loss. Average initial relative weight of the successful group was 158% compared to 180% for the unsuccessful group. Other researchers have also documented the relationship between adipose cell number and weight loss success (Knittle and Ginsberg-Fellner, 1972; Brook and Lloyd, 1973; Hager, 1978).

Body Fat Distribution. Greater emphasis has been placed on the distribution of body fat to classify obesity since health risks associated with obesity appear to vary with the location of body fat. Body fat can be distributed either in a generalized fashion, in a gynoid pattern or in an android pattern (Bray, 1978). With generalized obesity, body fat is widely distributed throughout the body including the extremities. With the gynoid or female type of obesity, body fat is found predominately in the lower portion of the body around the hips and thighs. With the android or male type obesity, body fat is located mainly in the upper portion of the body around the arms, chest and abdomen.

Waist-to-hip or abdominal-to-gluteal circumferences are used to distinguish the different patterns of obesity. A waist circumference is obtained by placing an inelastic tape around the natural waist of the subject which is the narrowest part of the torso as viewed from the anterior aspect and recorded to the nearest 0.1 cm (Callaway, 1988). If the natural waist cannot be identified, which can occur with obese subjects, the waist circumference is measured around the smallest area between the ribs and iliac crest. To obtain an abdominal circumference, an inelastic tape is placed around the greatest anterior extension of the abdomen of the subject, which is usually but not always at the level of the umbilicus and recorded to the nearest 0.1 cm. A hip circumference is made around the maximum extension of the buttocks and measured to the nearest 0.1 cm.

A nomogram was devised to aid in the determination of waist-to-hip ratios (Bray, 1989). Waist-to hip ratios greater than 0.90 for males and 0.80 for females are indicative of android or abdominal obesity, while lower ratios identify gynoid or gluteal obesity (Gray and Bray, 1988).

Abdominal-to-gluteal ratios change over the life span with respect to age and gender (Forbes, 1990). In both sexes, the ratio declines similarly in late childhood. By the age of 12 1/2 years statistical differences occur among the ratios along gender lines. A sharp decrease in the ratio occurs at the beginning of adolescence for females, while the ratio for adolescent males declines slightly. The ratio for females reaches its lowest level in late adolescence. Throughout the adult years, the ratio steadily rises in both males and females. The rise in the ratio for males precedes the rise in the ratio for females. Obese subjects, regardless of age or sex exhibit elevated abdominal-to-hip ratios compared to their non-obese counterparts.

Centrally-located body fat is associated with an increased risk of death, diabetes mellitus, hypertension and cardiovascular disease (Vague, 1956; Kissebah, 1982; Kalkhoff, 1983; Krotkiewski, 1983; Blair, 1984; Lapidus, 1984; Larsson, 1984; Stokes, 1985; Weinsier, 1985; Ducimetiere, 1986; Stern and Haffner, 1986; Donahue, 1987; Pi-Sunyer, 1991). The relationship between centrally-located fat and increased morbidity appears to exist in children. Elevated blood pressure (Shear, 1987; Gutin, 1990), glucose intolerance and hyperinsulinemia (Freedman, 1987; Legida, 1987; Molnar, 1990) have been documented in children with centrally-located body fat.

Severity of the Obese Condition. Measurements used to assess the severity of obesity include relative weight, weight-height indexes and skinfold thicknesses. The most common methods used to distinguish between mild, moderate and severe obesity are relative weight and body mass index

(BMI). Relative weight is the ratio between usual body weight and expected weight. For an adult, the expected or standard weight is based on the data from the Metropolitan Life Insurance Company (1959; 1983), while the expected weight for a child is based on the data from the National Center for Health Statistics (Hamill, 1979). Body weights that are 20-39% above the expected weight are indicative of mild obesity. Body weights that are 40-59% above the expected weight are indicative of moderate obesity. Body weights that are 60% or greater above the expected weight are indicative of severe obesity.

The most common weight-height index used to diagnose obesity is the Quetelet Index or BMI. BMI is defined as weight in kilograms divided by height in meters squared (kg/m^2). A BMI value can be used to indicate the severity of the obese condition by its associated mortality risk. Curves relating BMI to mortality in men and women indicate that minimum mortality is associated with a BMI of 22 kg/m^2 in both sexes (Gray, 1989). Mortality begins to rise at BMI levels above 25 and to rise precipitously at BMI values above 30 kg/m^2. To aid in the calculation of BMI values for adults, various nomograms have been developed.

Values of BMI are generally divided into four or five categories (Garfinkel, 1979). Category I is associated with the lowest morality risk and is identified by a BMI value between 20 and 24.9 kg/m^2. Category II is associated with a low mortality risk and is identified by a BMI value between 25 and 29.9 kg/m^2. Values defining the third and fourth categories are often combined to form a moderate to high mortality risk group which is identified by a BMI value between 30 and 39.9 kg/m^2. A very high mortality risk is identified by a BMI above 40 kg/m^2. In both men and women, obesity is identified by a BMI value above 30 (Bray, 1978).

For children age 6 months to 19 years, a calculated BMI value can be compared to selected percentile values appropriate for the child's gender and age from data generated by NHANES II (Najjar and Rowland, 1987). Recently, reference data specific for race as well as for gender and age have been made available from data collected in NHANES I (Must, 1991a and b). Both data sets allow the comparison of a child's BMI to the appropriate 85th and 95th percentile values which are used to identify obesity and superobesity, respectively.

A BMI value can also be used to predict the occurrence of obesity later in life. Correlations between BMI values (r=0.49-0.73) measured annually from the ages of 8 to 12 years and at 21 years of age were greater than the correlations between individually or combined skinfold thicknesses measured over the same time period (Rolland-Cachera, 1989). This trend held true for both males and females. Although less predictive than BMI, arm skinfolds, particularly biceps skinfolds (r=0.41-0.56) were more predictive of later obesity in females age 8 to 12 years than trunk skinfolds. In males age 8 to 12 years trunk skinfolds, particularly suprailiacal skinfolds (r=0.57-0.59) exhibited greater correlations between childhood and adulthood values than arm skinfolds.

Triceps skinfold thicknesses are used to distinguish between obesity and superobesity. The 85th and 95th percentiles are commonly used to identify obesity and superobesity, respectively (Gortmaker, 1987). A triceps skinfold thickness is measured over the triceps muscle at a point midway between the lateral projection of the acromion process of the scapula and the inferior margin of the olecranon process of the ulna. The triceps skinfold measurement is made by grasping the subcutaneous tissue between the thumb and index finger six to eight cm apart, shaking it gently to exclude any underlying muscle and recording with the tips of the caliper to the nearest 0.1 cm (Harrison, 1988). Triceps skinfold thicknesses of children can be compared to the percentile values appropriate for their sex and age compiled from NHANES I and II (Must, 1991; Najjar and Rowland, 1987). Percentile values complied from NHANES I and II are also available for subscapular skinfold measurements of children (Johnson, 1981; Najjar and Rowland, 1987). Percentile values for other sites of skinfold measurements are unavailable to date.

Techniques Used to Measure Obesity in Children

Of all the measurement techniques used to diagnose obesity and to assess the severity of the obese condition, questions arise regarding the technique that is best to measure adiposity in children. Certain laboratory methods such as the measurement of body density by underwater weighing or estimation of lean body mass by isotope distribution are impractical to use with children in a clinical setting. Furthermore, these methods are based on assumptions regarding body density and lean body mass that were inferred from studies involving principally non-obese adults. Thus, these assumptions may not hold true for children or for obese persons (Lohman, 1984; Bray and Gray, 1988).

Weight and Height Measurements. Body weight is not a good measure of body fat, particularly in children due to the strong correlation between body weight and height and to the influence the amount of lean muscle mass has on weight (Garn, 1985; Gray, 1989). Relative weight requires the determination of a standard weight based on the height of the subject, thus this technique shares the same limitations of body weight as a measure of adiposity (Garn, 1985). Furthermore, how close an obese subject must approach their expected weight before an improvement in health occurs remains unknown (Gray, 1989).

A BMI value is thought to give the maximum correlation with body fat while having a minimum correlation with body height (Gray, 1989). Debate surrounds the appropriateness of using BMI values for the estimation of body fat in children since BMI is influenced by relative leg length, frame size and amount of lean muscle mass (Gortmaker, 1987). Obese children not only have greater amounts of adipose tissue than non-obese children of the same age and sex, they also have larger skeletal, muscle and mineral masses and are taller than their lean counterparts (Garn and Clark, 1975). Because of variations that exist among children in the amount of lean body mass, BMI may be a good indicator of relative fatness only at extreme weights (Garn, 1985). Furthermore, BMI values do not provide any information regarding the distribution of body fat.

Skinfold Measurements. In contrast, skinfold thicknesses can characterize the distribution of body fat. This measurement technique of body fatness is based on two assumptions (Lukaski, 1987). It is assumed that the thickness of the subcutaneous fat layer reflects a constant proportion of total body fat. It is further assumed that the sites selected for measurement represent the average thickness of the subcutaneous layer of adipose tissue. Neither of these assumptions have been proven. The extent to which subcutaneous fat reflects total body fat varies with the age, sex and ethnic background of the individual.

A sum of skinfolds remains relatively constant throughout the life of an individual, while their amount of body fat will increase with age. This discrepancy indicates that body fat accumulates in sites other than the subcutaneous deposits (Bray, 1989). Body sites used for skinfold measurements vary in regards to their predictive value for total body fat, with some sites such as triceps skinfolds having a higher correlation to the percentage of body fat than others (Roche, 1981). Regression equations which calculate the amount of body fat from skinfold thicknesses measured at several sites can improve the estimation of the percentage of body fat but only for the populations from which the equations were derived (Gray, 1989).

Other difficulties surrounding the measurement of skinfolds include the compressibility of the skin and adipose tissue at different body sites, the ease with which the muscle layer can be separated from the adipose layer and the size of the subject. The compressibility of skinfolds varies with body site, state of hydration, age, size and individual (Martin, 1985; Harrison, 1988). The ability of the adipose tissue to be separated from the underlying muscle layer varies with body site and among individuals (Harrison, 1988). Measuring skinfold thicknesses of obese subjects presents special problems. In general, skinfold measurements of obese subjects exhibit greater variability and are less reproducible than skinfold measurements of normal weight individuals. The location of the site to be measured is made with less precession in an obese subject than a lean subject. Bony landmarks used to identify particular body sites are more difficult to locate in an obese subject. The skinfolds of an obese subject may not be possible to separate from skin sides that are parallel to each other; and the skinfold may overwhelm the opening of the calipers (Bray and Gray, 1988).

Sensitivity and Specificity of Techniques. All of the methods used to diagnose obesity in children are associated with error. Thus, the technique chosen as the preferred method should be associated with the highest possible degree of sensitivity and specificity. However, most anthropometric measurements of obesity are associated with a low degree of sensitivity and a high degree of specificity (Himes and Bouchard, 1989). Sensitivity of a method is indicated by the proportion of the sample that is correctly identified by the method as being obese (true positives). Specificity of a method is indicated by the proportion of the sample that is correctly identified by the method as not being obese (true negatives). The sensitivity and specificity of a method is of a greater concern for individuals who are mildly obese than for individuals that are severely obese.

The sensitivity and specificity of the method used to diagnose obesity will influence the prevalence of obesity obtained from a sample. Prevalence of obesity among Finnish children age 9 to 18 years was 2.5% when obesity was identified by a combination of BMI and triceps skinfold measurements. Prevalence of obesity among the same sample of children was 3.5% when obesity was identified by a combination of BMI and subscapular skinfold measurements (Nuutinen, 1991). Prevalence rates obtained by either of these two methods were lower than the prevalence rates obtained by any single method. The results of this study exemplified the variability in sensitivity and specificity that exists among the methods used to diagnose obesity.

Evaluation of Techniques. The best method to detect obesity in children varies with gender and age of the child (Roche, 1981; Himes and Bouchard, 1989; Marshall, 1990 and 1991). Roche and co-workers (1981) concluded that a triceps skinfold measurement ($r=0.78-0.84$) was the best indicator of percentage body fat in children age 6 to 18 years. The best indicator of total body fat varied with the age and sex of the child. In children age 6 to 13 years, BMI ($r=0.84-0.90$) was determined to be the best indicator of total body fat. Body mass index ($r=0.89$) continued to be the best indicator of total body fat in girls age 13 to 18 years, but a subscapular skinfold ($r=0.94$) was the best indicator of total body fat in boys age 13 to 18 years. These conclusions were based on the correlations between the various anthropometric measurements and either the percentage of body fat or total body fat in children age 6 to 18 years.

Himes and Bouchard (1989) reported that the best indicator of obesity in boys age 8 to 19 years was a triceps skinfold thickness with a sensitivity of 24% and a specificity of 100%. Subscapular skinfold thickness and BMI were identified as good alternatives for boys with sensitivities of 38% and 29%, respectively and specificities of 99%. In girls age 8 to 19 years, the best indicator of obesity was determined to be BMI with a sensitivity of 23% and a specificity of 100%. Subscapular skinfold thickness was identified as a good alternative for girls with a sensitivity of 30% and a specificity of 99%.

When studying adolescents age 11 to 16 years, Marshall and co-workers (1990) found that the relative BMI of a child was 100% sensitive, regardless of sex. The high degree of sensitivity was offset by a low degree of specificity. Alternative methods to identify obesity in adolescent males were relative weight and the O-scale determination. The O-scale is the sum of six skinfold thicknesses: triceps, subscapular, supraspinal, abdominal, front thigh, and medial calf which is geometrically scaled to a standard height of 170.18 cm [sum of skinfolds x (170.18/ht in cm)]. The scaled value is then compared with normative data, resulting in an adiposity rating between one and nine. The CSTF measure was determined as the best alternative for identifying obesity in adolescent females. This measure is the sum of five skinfold thicknesses: triceps, biceps, subscapular, suprailiac and medial calf. Although each of the alternative methods exhibited a lower degree of sensitivity than the relative BMI measure, these methods were considered to be acceptable alternatives because of their higher degree of specificity.

When Marshall and co-workers (1991) completed a second study using children 7 to 14 years of age, they found that the most sensitive and the least specific indicator of obesity in both sexes was the CSTF measure and not the relative BMI measure. The best alternative method to diagnose obesity in females was relative weight, followed by relative BMI and triceps skinfold. The best alternative method to identify obesity in males was also relative weight, followed by triceps skinfold and relative BMI. Again, the best alternative methods were chosen by their higher degree of specificity. Inconsistencies between the two investigations conducted by the Marshall group were thought to be due to the differences between the standards used to identify true obesity.

The best method to diagnose obesity in children remains to be determined. Although several different anthropometric measures have been proposed to be the best single diagnostic indicator of obesity in children, no method has been consistently identified as being the preferred method. The most sensitive methods are not considered the best methods because of their low specificities. The potential adverse psychosocial consequences associated with being incorrectly classified as obese outweigh the benefits of identifying all children who are truly obese (Himes and Bouchard, 1989; Marshall, 1990). Thus, the methods to diagnose obesity in children such as relative weight, BMI, relative BMI, triceps skinfold, subscapular skinfold and CSTF measure are recommended by their higher degree of specificity rather than their sensitivity. BMI, followed by arm skinfolds for girls and trunk skinfolds for boys may be the best methods to diagnose obesity in children age 8 to 12 years for two reasons. These anthropometric measures exhibited greater correlations between child and adult values than other anthropometric measurements (Rolland-Cachera, 1989). These anthropometric measures also exhibited greater correlations with either the percentage of body fat or total body fat than other anthropometric measurements (Roche,1981).

Monitoring Childhood Obesity

The most appropriate time to start treatment for obesity would be before the obese status becomes a permanent condition, affecting morbidity and mortality rates. Various studies have been conducted to determine the age when obesity continues or "tracks" from one age group to a subsequent age group. Conclusions from these studies indicate that the weight status obtained in early childhood, particularly at weight extremes is related to the weight status exhibited later in life (Zack, 1979; Aristimuno, 1984; Garn and La Velle, 1985; Harsha, 1987; Muramatsu, 1990).

Tracking Childhood Obesity

In a 40-year follow-up study of 504 overweight children, Mossberg (1989) found that 47% of children whose initial relative weight was greater than or equal to 115% remained in this weight category as an adult. Children were initially measured between the age of 5 months and 17 years.

When Charney and co-workers (1976) examined the health records of 366 infants born between 1945 and 1955, they found that an infant whose weight fell above the 90th percentile at six months of age exhibited a greater risk to be overweight or obese as an adult than an infant whose weight was considered either average or light. Fourteen percent of the subjects whose weight was above the 90th percentile at six months of age were considered obese as adults. Thirty-six percent of these subjects were overweight or obese. Fourteen percent of the infants whose weights were identified as either average or light were considered overweight or obese as adults. Five percent of the average weight infants and eight percent of the light weight infants became obese as adults. A weight falling between the 25th and 75th percentile during infancy was considered average weight. A weight falling below the 10th percentile was indicative of a light weight infant. Overweight was identified by a relative weight between 110% and 119%. Obesity was identified by a relative weight that was greater than or equal to 120%.

Garn and La Velle (1985) found that 26.5% of infants and preschool children whose initial triceps and subscapular skinfold measurements fell at or above the 85th percentile for their age and sex group remained at or above the same percentile 20 years later. By chance, only 15% of the obese infants and children were expected to remain obese at follow-up. Results of this study indicate that obese infants and children exhibited a relative risk of 1.77 of remaining obese as an adult.

In a retrospective study using medical records of approximately 1,000 school age children, Asher (1966) found that 57% of the children who were considered obese at five years of age continued to be obese at the age of 10 and 15 years. Obesity was defined as a weight for height above the 97th percentile.

Persistence of obesity was investigated over a five year period in 2,230 children age 2 1/2 to 14 years as part of the Bogalusa Heart Study (Aristimuno, 1984). Of the 352 children who were considered to be very obese at the initial examination, 39% remained very obese and 69% remained obese or very obese at the five year follow-up examination. The two weight categories: obese and very obese were defined as a triceps skinfold thickness great than or equal to the 70th and 85th percentiles, respectively.

Data from Cycle II and III of the U.S. Health Examination Surveys were used to analyze the relationship between childhood and adolescent obesity (Zach, 1979). A sample of 2,177 children age 6 to 11 years from Cycle II were reexamined two to five years later in Cycle III. Seventy percent of the children considered obese at Cycle II remained obese at Cycle III. Children were classified as obese if their triceps skinfold measurements were in the fifth quintile. In a study conducted by Lloyd and co-workers (1961), 75% of the children classified as obese between the ages of 9 and 11 years remained obese eight years later.

In a longitudinal study of 5,362 children, 42% of children whose relative weight was greater than or equal to 120% at seven years of age continued to have a relative weight at or above 120%, twenty years later (Stark, 1981). Abraham and Nordsieck (1960) reported that 72% of females and 74% of males who were considered to be markedly overweight at the age of 10 to 13 years remained markedly overweight as an adult. Markedly overweight was defined as a relative weight greater than 120%. In a second study, Abraham and co-workers (1971) compared the relative weights of 1,963 males at the age of 9 to 13 years to their relative weights 35 years later. Sixty-three percent of the markedly overweight preadolescent males remained markedly overweight as an adult.

Age of Onset of Obesity

Depending on the age of the child, 14 to 75% of obese children remained obese as adults. The chance of a child remaining obese as an adult increased with the age of the child. Although some studies have shown a relationship between either birth weight or weight gain during the first year of life and obesity later in life (Asher, 1966; Eid, 1970; Shukla, 1972; Fisch, 1975; Charney, 1976; Harsha, 1987; Binkin, 1988), other studies have shown no relationship between birth weight or first year weight gain and later obesity (Heald and Hollander, 1965; Melbin and Vuille, 1973; Dine, 1979; Shapiro, 1984).

The strongest association between childhood obesity and obesity later in life appears to begin between the ages of one and five years. Harsha and co-workers (1987) reported a significant degree of tracking for weight, height and subscapular skinfolds in children from age one to seven years. Fisch and co-workers (1975) reported that 78% of children who had a weight to height ratio above the 90th percentile at the age of seven years had maintained the same weight status since the age of four years.

Shapiro and co-workers (1984) found that weight gains between the ages of one and two years for girls and between the ages of two and three years for boys were highly related to the weight status of the child at nine years of age. The sums of skinfolds obtained by the age of two years for girls and three years for boys were also highly related to the weight status at nine years of age.

Unger and co-investigators (1990) found that 60% of children who were obese by the age of seven years were obese by four years of age. Obesity was defined as a relative weight greater than 120%. Fifty percent of children who were severely obese by the age of seven years obtained their weight status by the age of five years. Severe obesity was defined as a relative weight greater than 140%.

Muramatsu and co-workers (1990) reported that among girls, the body habitus at 3, 6, 11, 14 and 17 years of age was related to body habitus at birth. Among boys, body habitus at three years of age was related to body habitus at all subsequent ages. Depending on the age of the child, body habitus was calculated by BMI or Rohrer Index ($weight/height^3$). The authors concluded that the treatment of obesity should be considered at the age of three years as indicated by the weight to height index of the child.

Not all chubby infants and children outgrow their weight status later in life. Children identified as obese tend to remain obese. Between 14 and 75% of all children identified as obese in previously published studies remained obese from childhood into adulthood. The weight status obtained between the first and fifth year of life was found to be predictive of the weight status maintained later in life. The weight status of girls at the age of two years and boys at the age of three years appears to be the earliest age when weight problems can be detected.

Health Risks Associated With Childhood Obesity

Health consequences associated with childhood obesity are similar to the health risks associated with adult obesity. Obese children experience a variety of social, psychological and physiological problems as a result of their adiposity. Physiological problems include respiratory problems, unusual orthopedic conditions, carbohydrate metabolism abnormalities, elevated blood pressures and poor lipid profiles. As with adults, many of the health risks improve with weight reduction.

Social and Psychological Problems

Strong prejudices persist against obese individuals, regardless of their age, sex, race or socioeconomic status. Among children, as young as six years of age, the social stigma attached to obesity was illustrated by the words chosen by these children to describe obese persons. Even health care providers, when surveyed, described obese patients in derogatory terms. Both average weight and obese adults and children selected obese children as least physically acceptable from a series of pictures depicting normal weight, obese, handicapped and facially disfigured children. Other social problems faced by obese children and adolescents include lower acceptance ratings by colleges and universities and discrimination by future employers (Wadden and Stunkard, 1985; Buckmaster and Brownell, 1988).

Psychological disturbances thought to be the cause of obesity are now considered to be a consequence. The two most common psychological problems experienced by obese children and adolescents are a distorted body image and low self-esteem (Stunkard and Burt, 1967; Wadden and Stunkard, 1985).

Physiological Problems

Physiological problems associated with obesity in childhood include a greater incidence of respiratory infections, a higher incidence of unusual orthopedic disorders, hyperinsulinemia, hypertension and hyperlipidemia.

Respiratory Problems. Obese children experience a greater number of respiratory infections than non-obese children (Tracy, 1971; Hutchinson-Smith, 1971). Obesity also interferes with normal breathing patterns. The Pickwickian Syndrome or obesity-induced hypoventilation and sleep apnea occurs more frequently among obese children (Simpser, 1977). Children with severe obesity experience chronic hypoxemia. In some of these children, their level of ventilation fails to compensate sufficiently, resulting in an inability to normalize PCO_2 values (Tracy, 1971).

Orthopedic Problems. Higher incidences of unusual orthopedic disorders observed among obese children are thought to be due to the effects of excessive weight on developing joints, bones and ligaments (Dietz, 1981). Excess weight is assumed to place undue stress on the developing skeleton of an obese child, resulting in uncommon orthopedic disorders such as slipped capital femoral epiphysis, Blout's disease and severe bilateral genu varum (Sorenson, 1968; Kelsey, 1970 and 1972; Dietz, 1972; Chung, 1977).

Glucose Intolerance and Hyperinsulinemia. Disturbances within carbohydrate metabolism occur more frequently among obese children. Frequencies of impaired glucose tolerance vary between 15 and 74% among obese children (Paulsen, 1968; Chiumello, 1969; Drash, 1973; Martin and Martin, 1973; Barta, 1975; Kida, 1982; Molnar, 1990). The wide range of reported frequencies is thought to related to differences among experimental designs (Molnar, 1990). Different glucose loads and definitions of glucose intolerance were utilized in these studies. Other differences were the age and the degree of obesity of the child studied.

Glucose intolerance among obese children is associated with basal hyperinsulinemia and an abnormal insulin response to glucose and other secretagoges (Parra, 1971; Drash, 1973; Martin and Martin, 1973; Deschamps, 1977 and 1978; Molnar, 1981 and 1982). Both basal insulin levels and the response of insulin to glucose is related to the degree of obesity (Deschamps, 1977 and 1978). Many of the abnormalities of carbohydrate metabolism associated with childhood obesity improve with weight reduction (Deschamps, 1978).

Hypertension. Identification of high blood pressure in children is difficult to achieve because of potential errors in methodology and definition (Task Force on Blood Pressure Control in Children, 1987). Details outlining the appropriate method for measuring a child's blood pressure are available (Voors, 1979; Joint National Committee, 1988; Task Force on Blood Pressure Control in Children, 1988).

No uniform standard exists that distinguishes a normal blood pressure from a pathological blood pressure in children. Identification of a child's blood pressure as being normal or hypertensive is complicated by a multitude of factors. Throughout childhood and adolescence, blood pressure increases with age among both sexes. Blood pressure also increases with the size of the child. Heavier and/or taller children will exhibit higher blood pressure levels than smaller children of the same age group. Thus, the height, weight, age, gender and maturation level of a child must be considered before a child's blood pressure can be properly evaluated (Katz, 1980; Gillum, 1982; Pistulkova, 1982).

Other factors influencing the blood pressure level of a child include pulse rate, room temperature and time of day.

An elevated pulse rate increases both the systolic and diastolic blood pressure levels (Holland and Beresford, 1975; Miller and Shekelle, 1976; Prineas, 1980a). Systolic blood pressure is inversely related to room temperature, while diastolic blood pressure is directly related to room temperature (Prineas, 1980a). Systolic blood pressure levels are higher in the afternoon than in the morning. No differences are observed among morning and afternoon diastolic blood pressure measurements (Prineas, 1980a).

The Report of the Second Task Force on Blood Pressure Control in Children, 1987 recommended blood pressure standards for children. Blood pressure levels suggested by the Task Force to identify normal, high normal and hypertension were based on data pooled from nine separate studies involving over 70,000 white, black and Mexican-American children. The Task Force determined that race did not significantly influence a child's blood pressure level. Thus, the panel concluded that race-specific blood pressure standards were unnecessary. Recommended standards were considered applicable to children of all races.

Results of studies conducted by Holland and Beresford (1975) indicated that race did not significantly affect children's blood pressure levels. Results from other studies concluded that race did significantly influenced children's blood pressure levels. Gutgesell and co-workers (1981) reported that black children had higher blood pressure levels than either white or Hispanic children. However, they attributed the disparity between blood pressure levels to differences in body size. Prineas and co-workers (1980b) reported that systolic pressures of black children were significantly lower than the systolic pressures of white children.

The 1987 Task Force defined a normal blood pressure level for a child as systolic and diastolic blood pressures below the 90th percentile for the appropriate age and sex group. Systolic and diastolic blood pressures between the 90th and 95th percentiles for a given age and sex group defined a child's blood pressure as high normal. Systolic and diastolic blood pressures greater than or equal to the 95th percentile for a given age and sex group defined a child's blood pressure as hypertensive. Hypertension was further defined as being significant or severe. Blood pressure readings between the 95th and 99th percentiles for a given age and sex group defined significant hypertension. Blood pressure levels greater than or equal to the 99th percentile for a given age and sex group defined severe hypertension. Blood pressure readings must be recorded and averaged from at least three separate occasions before hypertension can be diagnosed (Task Force on Blood Pressure Control in Children, 1987).

Height and weight of a child must be considered before their blood pressure is regarded as elevated. If a child is tall and lean for their age and sex group, a blood pressure reading above the 90th percentile may be considered normal. If a child is tall and heavy for their sex and age group, a blood pressure reading may still be considered normal if the weight is proportional to their height. The overweight status is due to an excess in lean body mass. The elevated blood pressure level is considered proportional to their body size. However, if the excess weight is due to obesity, a blood pressure level above the 90th percentile is abnormal and should be treated by nonpharmacological means, namely weight loss. Favorable improvements occur among systolic and diastolic levels of obese children with weight loss (Bal, 1990).

Percentile values of blood pressure for children age 6 to 18 years is available from data collected in NHANES I (Roberts and Mauer, 1977). The Report of the Second Task Force on Blood Pressure Control in Children, 1987 includes average heights and weights for each age and sex group as well as percentile values of blood pressures for children from infancy to 18 years of age.

A direct relationship between weight and blood pressure is well documented. Obesity during adulthood is associated with an elevated blood pressure level (Kannel, 1979; Waaler, 1984; National Institutes of Health, 1985). Obesity during childhood is also associated with an elevated blood pressure level (Londe, 1971; Lauer, 1975; Rames, 1978; Aristimuno, 1984; Gortmaker, 1987; Burns, 1989; Gutin, 1990; Unger, 1990). Blood pressure levels exhibited during childhood appear to persist throughout childhood and into adulthood, particularly among children demonstrating the highest and lowest blood pressure levels (Clarke, 1978; Voors, 1979; Swiet, 1980; Lauer, 1984; Lauer, 1989; Julius, 1990). The strength of the relationship between blood pressure levels exhibited during childhood and adulthood varies with the age and sex of the child. The relationship is also stronger for systolic pressure than for diastolic pressure.

Hyperlipidemia. Plasma total cholesterol (TC) levels remain relatively constant during the first two decades of life. Average TC level in American children between the ages of 1 and 19 years is approximately 160 mg/dL. The 75th and the 95th percentiles for TC among children of the same age group are approximately 170 and 200 mg/dL, respectively (The Lipid Research Clinics Population Studies Data Book, 1980; National Cholesterol Education Program Coordinating Committee, 1991).

Plasma low-density lipoprotein (LDL) cholesterol levels also remain relatively constant throughout the first two decades of life. Average value of LDL cholesterol in American children, age 1 to 19 years is roughly 100 mg/dL, with the 75th and the 95th percentiles being approximately 110 and 130 mg/dL, respectively (The Lipid Research Clinics

Population Studies Data Book, 1980; National Cholesterol Education Program Coordinating Committee, 1991).

Plasma high-density lipoprotein (HDL) cholesterol levels remain relatively constant only during the first decade of life. During the second decade of life, males experience an average decrease in plasma HDL levels of 10 mg/dL, while plasma HDL levels among females remain constant between the ages of 1 and 19 years. Average HDL cholesterol levels among children age one to ten years is about 55 mg/dL (Kwiterovich, 1991).

Plasma triglyceride (TG) levels also exhibit a digression between the sexes during the second decade of life. During the first decade of life, average plasma TG levels of male and female children are about 58 mg/dL. The 75th and 95th percentiles for children of this age group are 75 and 100 mg/dL, respectively. During the second decade of life, plasma TG levels increase, particularly among males. Average plasma TG levels of males and females age 11 to 19 years is roughly 73 mg/dL. The 75th percentile is approximately 90 mg/dL, while the 95th percentile is about 130 mg/dL (Kwiterovich, 1991).

Lipid profiles of children are evaluated according to percentiles (Kwiterovich, 1989). Desirable values for TC, LDL cholesterol and TG correspond to values below the 75th percentile. Values of TC, LDL cholesterol and TG falling between the 75th and 95th percentiles are considered borderline high. Values of TC, LDL cholesterol and TG greater than the 95th percentiles are considered high. Thus, TC levels below 170 mg/dL are considered desirable for children of both sexes between the ages of 1 and 19 years, levels of TC above 200 mg/dL are considered high. Levels of LDL cholesterol below 110 mg/dL are considered acceptable for children of this age group, while LDL cholesterol levels above 130 mg/dL are considered high. For children under the age of ten years, TG levels below 75 mg/dL are acceptable, while values above 100 mg/dL are considered high. For children between the ages of 10 and 19 years, TG levels below 90 mg/dL are desirable; whereas, TG values above 130 mg/dL are considered high.

Values of HDL cholesterol are evaluated against the 25th and 5th percentiles due to the inverse relationship between HDL cholesterol and the prevalence of coronary artery disease (Kwiterovich, 1989). For children under the age of 10 years, a desirable level of HDL cholesterol falls above 45 mg/dL. Levels of HDL cholesterol falling below 40 mg/dL are considered too low for children of this age group. For children between the ages of 10 and 19 years, a desirable HDL cholesterol level also falls above 45 mg/dl, but a HDL cholesterol level falling below 35 mg/dl is considered too low. The value used to identify a low level of HDL cholesterol for children of this age group reflects the fall in HDL cholesterol that occurs among adolescent males.

Factors adversely affecting plasma lipid levels of children include the use of oral contraceptives, cigarette smoking and the lack of physical fitness (Orchard, 1980; Craig, 1990; Fripp, 1985). In general, these factors raise TC, LDL cholesterol and TG levels and lower the level of HDL cholesterol.

Obesity during childhood is also associated with a poor lipid profile. Several studies have documented a positive relationship between adiposity and levels of TC, LDL cholesterol and TG and an inverse relationship between adiposity and HDL cholesterol (Laskarzewski, 1980; Aristimuno, 1984; Freedman, 1985; Smoak, 1987; Burns, 1989; Resnicow, 1990; Unger, 1990). Levels of TC and LDL cholesterol and to a lesser extent TG levels persist from childhood through adolescence into adulthood, particularly among children who exhibit extreme lipid values (Clarke, 1978; Aristimuno, 1984; Freedman, 1985; Lauer, 1988; Burns, 1989; Lauer and Clarke, 1990). Levels of HDL cholesterol and the ratio between LDL cholesterol and HDL cholesterol persist from childhood to adulthood (Aristimuno, 1984). Aristimuno and co-workers (1984) further noted that the differences between the HDL cholesterol levels of lean and obese children became more pronounced over time.

Obesity during childhood is associated with many health risks including problems with carbohydrate metabolism, elevated blood pressure and a poor lipid profile. The health risks, particularly hypertension and hyperlipidemia continue from childhood into adulthood along with the obese condition. Childhood and adulthood relationships are strongest for weight status (r=0.6-0.8) followed by lipid profiles (r=0.4-0.6) and blood pressure levels (r=0.2-0.5) (Clarke, 1978; Lauer, 1988).

Genetic versus Environmental Factors

Susceptibility to the development and maintenance of obesity appears to be influenced by both genetic and environmental factors. Conclusions from studies investigating the role of heredity indicated that genetic factors strongly affected the development of obesity. Results of these studies were based on the similarity of weight status within twin pairs and between parents and their biological offspring. Other studies that demonstrated a strong genetic component included studies that examined the response to overfeeding between and within twin pairs.

Conclusions from research examining behavioral and lifestyle components stressed the importance of environmental factors on the development and maintenance of obesity. Conclusions from a third area of obesity research identified trends among obese individuals and their families. Effects of genetic and environmental factors were blended within these trends. Thus, these trends supported an interaction between genetic and environmental factors on the development and maintenance of obesity.

Evidence Supporting a Strong Genetic Influence

In 1937, Newman and co-workers reported that the body weights of monozygotic twins reared apart exhibited a great amount of similarity. In 1962, research work conducted by Shields also demonstrated that the body weights of monozygotic twins reared apart demonstrated a great amount of similarity. In 1990, Stunkard and co-workers concluded that childhood environment was of minor importance on the development of obesity. Conclusions were based on the high degree of similarity between the weight status of 93 pairs of monozygotic twins reared apart and 154 pairs reared together. Weight status of dizygotic twin pairs exhibited a smaller degree of similarity than that of monozygotic twin pairs (Newman, 1937; Stunkard, 1990).

In adoption studies, a strong relationship existed between the weight status of adopted children and their biological parents, particularly among adopted children and their biological mothers (Stunkard, 1986; Price, 1987). No relationship existed between the weight status of adopted children and their adoptive parents.

Similarity in response to overfeeding was greater within monozygotic twin pairs than between monozygotic twin pairs (Poehlman, 1986; Bouchard, 1988; Bouchard, 1990).

Responses to overfeeding included changes in body weight, body composition, body fat distribution, resting metabolic rate and thermic effect of a meal.

Twin pairs varied in the amount of weight gained and the type of tissue gained. Some twin pairs deposited more excess calories as fat, while other twin pairs deposited more excess calories as lean body mass (Poehlman, 1986; Bouchard, 1988 and 1990). Twin pairs that increased their fat free mass in response to overfeeding exhibited the smallest gains in weight. Twin pairs also differed in the location of body fat deposition (Bouchard, 1990). Some twin pairs deposited fat more centrally than peripherally. The genetic predisposition to deposit fat in particular areas of the body was also observed among relatives other than monozygotic twins (Bouchard, 1988). Differences in the tendency to store excess calories as fat or to deposit fat in one area of the body over another area were attributed to differences in metabolism (Bouchard, 1989 and 1991). Metabolic differences in adipose tissue development and location would be under genetic control. Results from these studies supported an interaction between genetic and environmental factors in the development of obesity.

Evidence Supporting a Strong Environmental Influence

Adoption studies were also used to support the effect of a strong environmental influence on the development of obesity. Relationships between the weight status of parents and their adoptive children were found not to differ from relationships between the weight status of parents and their biological children (Withers, 1964). Similar results were reported for relationships between the weight status of biological siblings and adopted siblings (Garn, 1976).

Relationships between the weight status of parents and their biological children steadily increase until children reach the age of 18 years (Rao, 1975; Garn, 1985). After children reach the age of 18 years, relationships between the weight status of parents and children steadily declines. Since most children leave home at the age of 18 years, the results of these studies support a stronger role for a shared family environment than for shared genes on the development and maintenance of obesity.

Other environmental factors associated with the development and maintenance of obesity in the United States include geographical location, population density, time of year, family size, socioeconomic level, the amount of television viewed and family dynamics.

Dietz and Gortmaker (1984) found that the prevalence of obesity among children varied according to geographical location, population density and season. Prevalence of obesity was significantly greater among children living in the Northeast and Midwest portions of the United States than in the Western portion of the United States. Similarly, the prevalence of obesity among children was greater in more population dense urban areas than in the less population dense rural areas. Prevalence of obesity among children was also greater during the fall and winter months than in the summer months.

Jacoby and co-workers (1975) reported that the prevalence of obesity was greater for only children than for children living in families containing two, three or four children. Prevalence of obesity increased among children living in families containing five or more children. However, the prevalence of obesity among children living in large families remained lower than the prevalence of obesity among children living in families with only one child.

In 1962, Moore and co-workers reported that children from lower socioeconomic levels were leaner than children from higher socioeconomic levels. In 1972, Stunkard and co-workers reported that obesity was more prevalent among girls from lower socioeconomic levels than among girls from higher socioeconomic levels. No trend in the prevalence of obesity occurred among boys of different socioeconomic backgrounds. Ginsberg-Fellner and co-workers (1981) also reported that the prevalence of obesity was greater among children of lower socioeconomic levels than among children of higher socioeconomic levels.

Garn and co-workers (1991) recently reported that the incidence of obesity was greatest among young children, aged five to nine years whose parents were more educated.

However, the incidence of obesity among older children, aged 10 to 19 years was greater among children whose parents were less educated than among older children whose parents were more educated.

With such inconsistent results, other environmental factors such as family size needed to be controlled in these studies before the effects of socioeconomic level on the prevalence and incidence of obesity could be firmly established.

Changes in activity habits have been examined for a possible role in the development and maintenance of obesity. Physical activities performed by children have shifted from more physically demanding activities to more sedentary activities as reflected by the amount of television viewed by children (Gortmaker, 1990). Children between the age of 2 and 11 years watch an average of 25 hours of television per week (AC Nielsen CO, 1990). This figure excludes other popular forms of video entertainment such as video games, computer games or videocassette recorders.

Bernard-Bonnin and co-workers (1991) reported that children age three to ten years watched an average of 14 hours of television per week, with a range between 1 and 56 hours per week. Parental level of education, particularly the education level of the mother was inversely related to the amount of television viewed by a child. Children who did not attend day care watched more television than children who attended day care.

Dietz and Gortmaker (1985) determined that for every additional hour of television viewed per day by adolescents, the prevalence of obesity among adolescents rose by 2%. Dietz and Gortmaker further noted that the rates of remission of obesity decreased significantly with increased amounts of television viewed. Similar results were reported for adult males (Tucker and Friedman, 1989).

Family environment also was examined for factors that promoted the development and maintenance of obesity. Particular family behaviors appear to influence the advent of eating disorders, including obesity. Family interaction patterns, particularly between mothers and obese children were found to be less constructive in families with obese children (Birch, 1981; Kinston, 1988). Interactions among family members were less frequent, less encouraging and less positive in families with obese children.

Stunkard and co-workers (1986) reported that a greater weight status was associated with a dysfunctional family environment. Dysfunctional family environments were found to affect the food intake of family members. Members of dysfunctional families consumed diets of lower nutrient quality than members of functional families (Kinter, 1981).

Family functioning is based on a family's ability to problem solve, communicate, allocate responsibility, promote accountability, respond to needs of other family members, control behavior and express an interest in the activities of the other family members (Epstein, 1978). Characteristics of dysfunctional families with obese children include severe family disorganization, periodic separation of mother and child, displacement of child care to others, maternal depression, ineffective limit setting, denial of the problem, hostility towards health care providers and inconsistent follow-up with medical care (Bruch, 1971; Kinston, 1987; Christoffel and Forsyth, 1989).

Parents of obese children were observed to be overprotective, rigid and disappointed with their own lives (Bruch, 1971; Hecker, 1986; Brone and Fisher, 1988; Christoffel and Forsyth, 1989). Parents' problems interfered with the abilities of obese children to develop independence and a healthy sense of identity. Obese children from dysfunctional families served as a scapegoats for the unresolved problems experienced by other family members. Sabotage of a child's weight reduction attempts by a family member can occur (Hecker, 1986). Thus, the success of weight control, particularly for children depends upon the level of family functioning (Hertzler, 1981).

Health care practitioners and researchers need to acknowledge the effect of a dysfunctional family environment on the development and treatment of obesity.

Familial Associations

Members of the same family were found to consume similar amounts of nutrients (Garn and Clark, 1976; Laskarzewski, 1980; Perusse, 1988) and achieve similar levels of fatness (Garn and Clark, 1976; Garn, 1981; Price, 1990; Unger, 1990). Designs of these studies made it impossible to distinguish whether genetic or environmental factors had the greatest influence on the development of obesity.

Family members demonstrated similar daily intakes of calories and macronutrients (Laskarzewski, 1980; Perusse, 1988). Percentages of total caloric intake derived from the macronutrients also were similar between members of the same family. Garn and Clark (1976) assumed that the similarity between nutrient intakes of family members and other environmental factors explained the gravitation between family members to a similar level of fatness. However, similar nutrient intakes among family members may be controlled genetically. Various peptides influence the intakes of calories and macronutrients (Bray, 1992). Family members may share a similar profile of these peptides, resulting in similar intakes of calories and nutrients. Peptide levels of family members were not evaluated in the above studies.

Family members exhibit similar levels of fatness and BMI (Garn and Clark, 1976; Garn, 1981; Burns, 1989; Price, 1990; Unger, 1990). Gurney (1937) estimated that children living in a family with two obese parents had a 73% chance of becoming obese, while children living in a family with two lean parents had a 9% chance of becoming obese. Children living in a family with one lean and one obese parent had a 41% chance of becoming obese. Garn (1985) reported similar results in the levels of fatness between parents and their children (Garn, 1985). Garn and co-workers (1981) further reported that the risk for a child to become obese steadily increased as the number of family members who were obese increased. These studies did not distinguish between the effects of shared genes and the effects of shared environments on the development of obesity.

As emphasized by the results of the above studies, the development and maintenance of obesity involves an interplay between both genetic and environmental factors.

Pathogenesis

Pathology of human obesity continues to be an area of research under intense investigation. Endocrine disorders such as hypothyroidism and congenital syndromes such as Prader-Willi's and Down's syndrome account for only 3% and 2% of the incidence of obesity, respectively (Collipp, 1980). Research efforts are focused on the components of energy balance to explain the etiology of human obesity.

Energy Expenditure

Energy expenditure is partitioned into three components: resting metabolic rate (RMR), thermic effect of food (TEF) and physical activity. The most substantial component of total energy expenditure is RMR, accounting for approximately 70% of total energy expenditure. It is the energy required by the body in the resting state for the function of cardiac and respiratory muscles, the maintenance of transmembrane ion gradients and protein turnover. Factors influencing RMR include age, gender, body weight, climate, genetics and thyroid hormones. Resting metabolic rate is related to lean body mass but is also related to surface area and body weight. On a per weight basis, RMR is highest during infancy. Resting metabolic rate per kilogram of body weight gradually declines throughout childhood and adulthood. Men exhibit higher RMR than women of similar height and weight due to greater amounts of lean body mass.

Results of studies examining RMR of lean and obese individuals indicated that in absolute terms obese individuals display a greater RMR than lean individuals (Bruch, 1939; Talbot and Worcester, 1940; James, 1978; Hoffmans, 1979; Ravussin, 1982; Epstein, 1989; Bandini, 1990). Obese individuals gain both lean body mass and adipose tissue, thus a greater RMR is not unprecedented. No difference is observed between the RMR of lean and obese individuals when RMR is expressed per kilogram of lean body mass (James, 1978; Ravussin, 1982; Bandini, 1990).

Resting metabolic rates among individuals matched for sex, age and lean body mass may vary by 20% (Bogardus, 1986). Resting metabolic rates have also been found to aggregate among family members (Bogardus, 1986). If one family member demonstrated a low RMR, other family members also exhibited a low RMR. Similarity of RMR was greater among monozygotic twin pairs than among dizygotic twin pairs which suggested a genetic link for the clustering of RMR among family members (Fontaine, 1985; Bouchard, 1989). A low RMR was a risk factor for weight gain in adults (Ravussin, 1988) and in infants (Roberts, 1988).

The TEF accounts for approximately 15% of total energy expenditure. Typically, TEF is subdivided into obligatory and facultative components. Both components are influenced by food intake, temperature, drugs and stress. Obligatory thermogenesis is the increase that occurs in the metabolic rate after food consumption. It includes the energy required for the absorption, metabolism and storage of nutrients within the body. Facultative thermogenesis is the loss of metabolizable energy as heat. This subcomponent of total energy expenditure is thought to be due to the activities of the sympathetic nervous system and insulin and to some extent thyroid hormone (O'Dea, 1982; Danforth, 1985; Danforth, 1986; Tappy, 1986; Sims and Danforth, 1987).

Turnover rate of norepinephrine increased during periods of overfeeding and decreased during periods of underfeeding (O'Dea, 1982). Several researchers documented an inverse relationship between TEF and insulin resistance (Sims, 1976; Golay, 1982; Ravussin, 1983 and 1985, Katzeff and Danforth, 1989; Segel, 1990).

Physical activity comprises the most variable component of total energy expenditure. Griffith and Payne (1976) reported that energy expenditure for physical activity was reduced in children who became obese. Roberts and co-workers (1988) reported similar results for infants who became obese. Conflicting results are reported for adults. Neither the amount of time spent on sedentary, light or moderate activities nor the amount of energy used for total daily physical activity differed significantly among obese and lean adults (Maxfield and Konishi, 1966; McCarthy, 1966; Blair and Buskirk, 1987). These conclusions were based on studies with small sample sizes. Using a larger sample, Romieu and co-workers (1988) reported a significant difference between the amount of physical activity completed by lean and obese women. Since obese individuals use more energy than lean individuals for any given physical activity, the differences between obese and lean individuals in the amount of energy spent on restless or spontaneous activity under free-living conditions needs to be investigated (Bray, 1983; Blair and Buskirk, 1987).

Energy Intake

Food surveys have dispelled the myth that an individual becomes obese solely due to an excessive consumption of food. Results from several surveys indicated that obese individuals often consumed less calories per day than their lean counterparts (Baecke, 1983; Kromhout, 1983; Romieu, 1988). This discrepancy between the caloric intakes of lean and obese individuals was explained by questioning the reliability of food intake records of obese individuals. Beaudoin and Mayer (1953) reported that the food intake records of lean individuals were more reliable than the food intake records of obese individuals. Bray and co-workers (1978) reported that obese individuals consistently underreported their food intake, particularly during the initial interview. These authors concluded that a food intake record becomes more unreliable as weight increases. However, research work conducted both in the United States and in Britain indicated that the majority of individuals, regardless of age, sex or weight underreported their food intake by 18 to 20% (Livingstone, 1990; Mertz, 1991).

Although the caloric content of diets consumed by lean and obese individuals have not varied significantly, the fat content of the diets have differed significantly between lean and obese individuals. Among adult males and females, a positive relationship existed between dietary fat intake and obesity (Dreon, 1988; Romieu, 1988). Obese individuals also demonstrated a greater preference for high fat foods than lean individuals (Jiang and Hunt, 1983; Drenowski, 1985).

Excessive intakes of dietary fat does not promote the use of fat as the primary fuel source by the body (Dallosso and James, 1984; Flatt, 1985; Schutz, 1989). Sims and Danforth (1987) further ascertained that dietary fat was a more potent stimulator of adipose tissue formation than other macronutrients. Research work conducted by Jacobsen and co-workers (1983) and by Flatt (198&) supported the results of Sims and Danforth. Fatty acid composition of subcutaneous fat reflected the fatty acid composition of the dietary fat consumed (Jacobsen, 1983). Depositing preformed fatty acids as triglycerides in adipose tissue is a more energy efficient process than depositing carbohydrate as fat. Approximately 23% of the original calories from carbohydrate are required for the de novo production of fat from carbohydrate, while only 3% of the original calories from fat are required to convert preformed fatty acids into adipose tissue triglycerides (Flatt, 1987).

Examining the components of energy expenditure underscores the heterogeneity of obesity and the difficulty surrounding obesity research. The development and maintenance of obesity may be due to a variety of problems in the different components of energy expenditure. Obese subjects participating in obesity research may exhibit as many different causes of obesity as there are participants. Thus, it is not surprising to find conflicting results between similar study designs in the area of obesity research (Sims, 1989).

High intakes of dietary fat promote the accumulation of adipose tissue. From the years of 1910 to 1984, dietary fat intake among Americans rose from 27% to 44% of total caloric intake (Daxum, 1986). Consumption of a high fat diet by Americans may explain the increased prevalence of obesity among the American population.

Characteristics of Weight Loss Programs

A review of weight loss programs for obese children, adolescents and adults revealed several components that were associated with a greater level of treatment success. These components were a structured diet, a low fat diet, regular exercise, behavior modification, family involvement and a "fun" learning environment.

Structured Diet

Many weight loss programs for children, adolescents and adults contain a dietary component. The Stoplight Diet used in the treatment of obese children and adolescents illustrates the importance of a structured diet for the success of weight loss (Epstein and Squires, 1988; Epstein, 1990). The Stoplight Diet emphasizes a reduction in caloric intake and an improvement in diet quality (Epstein, 1983; Epstein, 1990). Foods from each food group are categorized into low calorie, moderate calorie and high calorie groups that are designated by the colors green, yellow and red, respectively (Epstein, 1985). Children are instructed to limit their caloric intake to between 1200 and 1500 calories per day by consuming more green foods, some yellow foods and few red foods. Ten years after the initial treatment, children who participated in the Stoplight Diet program exhibited lower relative weights than children who did not participate in the program. Children, participating in the program were 35% overweight at the ten year follow-up evaluation, while children not participating in the program were 60% overweight (Epstein, 1990). As acknowledged by the authors after the ten year follow-up evaluation, "additional work needs to be done to promote larger weight losses that would ensure greater success for obese children" (Epstein, 1990).

Although a structured diet influenced the success of weight loss among children and adolescents, a diet structured around caloric reduction appears not to be the entire solution to childhood obesity. Changes in the caloric intakes recommended in the Stoplight program emphasize that alterations in intakes of other dietary components are required. Initially, 900 to 1200 calories were recommended to be consumed daily by Stoplight participants (Epstein, 1983). By 1990, the participants were recommended to consume between 1200 and 1500 calories per day (Epstein, 1990).

Results from weight loss programs emphasizing a reduction in dietary fat intake suggest that a decreased consumption of fat and not caloric restriction is the key dietary component for successful weight loss.

Low Fat Diet

Sheppard and co-workers (1991) investigated the weight changes occurring over a two year period among 303 women consuming either a 20% or 40% fat diet. At the end of six months, women consuming the low fat diet lost an average of 3.2 kg while women consuming a normal diet lost 0.4 kg. At the end of one year, women in the treatment group maintained an average weight loss of 3.0 kg, while women in the control group maintained an average weight loss of 0.4 kg. At the end of two years, women in the treatment group maintained an average weight loss of 1.9 kg; whereas, women in the control group maintained an average weight loss of 0.1 kg. Analysis of food frequency records indicated that women in the treatment group consumed a 21% fat diet at six months, a 22% fat diet at one year and a 23% fat diet at two years. Women in the control group consumed a 38% fat diet throughout the course of the study. Change in the percent of total calories from fat predicted weight loss better than change in total caloric intake.

Prewitt and co-workers (1991) found that the consumption of a 20% fat diet for 20 weeks resulted in a decrease in total body weight and body fat and an increase in lean body mass and in daily energy intake. Total body weight decreased by 2.8%. Total body fat decreased by 11.3%, while lean body mass increased by 2.2 %. Daily energy intake during the treatment period was 19% greater than during the control period. The results could not be explained by changes in the daily activity habits of the women. Results were similar for obese (BMI>30) and non-obese (BMI<30) women.

Schlundt and co-workers (1990) reported similar results for obese men and women consuming a 18% fat calorie diet. Although subjects consuming a 1200 caloric diet lost more weight during the treatment period than the subjects consuming the low fat diet, subjects in the low fat group lost significantly less lean body mass and more body fat than subjects consuming the low calorie diet. Subjects consuming a low calorie diet lost an average of 9.8 kg of body weight over the study period, while subjects consuming a low fat diet lost an average of 5.6 kg of body weight. After 12 months, subjects consuming a low fat diet maintained an average weight loss of 4.1 kg. Subjects consuming a low calorie diet maintained an average weight loss of 3.9 kg.

The use of a low fat diet for children continues to be debated among health care professionals. Concerns are raised regarding the effect of a low fat diet on the growth and development of children and on the adequacy of their nutrient and caloric intakes. Any diet containing less than 67% of the recommended caloric intake will adversely affect the growth and development of a child (Pugliese, 1987). Adequate caloric and nutrient intakes can be maintained by children (McPherson, 1990) and by adults (Dougherty, 1988) consuming a low fat diet when appropriate food substitutions are implemented. Reductions in dietary fat intake without modification of the overall daily food intake of a child will result in inadequate intakes of nutrients and calories (Nicklas, 1992). Thus, changes in the daily food plan of a child such as the use of lean meats and low fat dairy products and an increased consumption of fruits, vegetables and grains must be instituted in order for a low fat diet to provide sufficient amounts of calories and nutrients.

Regular Exercise

Many weight loss programs incorporate an exercise component. A review of studies examining the effects of exercise on energy balance of obese individuals indicated that the primary benefits of exercise are to maintain RMR and lean body tissue (Calles-Escandon and Horton, 1992). Other benefits of exercise included an improvement in insulin sensitivity, blood pressure and HDL cholesterol levels.

Obese men who consumed a low fat diet and exercised three days per week for one year lost significantly more body weight and body fat than obese men who consumed a low fat diet only (Wood, 1991). Men in the diet plus exercise group also exhibited significant increases in their plasma HDL cholesterol levels than men in the diet only group.

Obese adolescents who participated in a diet, behavior modification and exercise program demonstrated greater increases in their HDL cholesterol levels and greater decreases in their blood pressure levels than obese adolescents who either participated as the control group or who participated in a diet plus behavior modification program (Becque, 1988). No significant changes were observed between pre- and post-treatment values of body weight or percent body fat for any of the treatment groups. Dietary invention involved caloric restriction, with a weight loss goal of one to two pounds per week. Behavior modification emphasized record keeping, alteration of external cues that triggered eating and reinforcements of the new habits. Exercise intervention entailed three 50 minute exercise sessions per week.

Obese preadolescent children consuming a normocaloric diet and attending a weekly exercise program continued to grow normally while simultaneously experiencing a decrease in body fat (Amador, 1990). Normal growth was indicated by changes in height, lean body mass and mid-upper arm circumference. Body fat was assessed by the changes in total body fat and percent of body fat. Percent of body fat was calculated from the sum of five skinfold measurements. Total body fat was calculated from percent body fat and total body weight.

Exercise completed on an informal basis also resulted in weight loss among obese children (Reybrouck, 1990). Obese children who participated in a diet plus unsupervised exercise program exhibited a greater decrease in their relative weights than children who participated in the diet only program. Children were allowed to choose the type of exercise activity and were encouraged to perform the chosen activity on a daily basis. Dietary and exercise compliance was monitored by food and activity diaries.

Behavior Modification

Behavior modification is generally used in weight reduction programs in conjunction with other intervention methods (Minderaa and Wit, 1983; Becque, 1988; Hills and Parker, 1988; Hoerr, 1988; Amador, 1990; Lavery, 1988; Epstein, 1990; Schlundt, 1990). The purpose of behavior modification is to assist in the transition from old to new habits. Methods of behavior modification are used by an individual to alter their physical, social and personal environment in order to achieve more advantageous dietary and exercise behaviors.

The most common behavioral management techniques include self-monitoring of food intake, stimulus control, modifications of eating behavior, self-monitoring of physical activity, cognitive restructuring and reinforcement of appropriate new behaviors (Brownell, 1985). Adams and co-workers (1983; 1986) found that significant weight loss was related to the use of food records, food cue elimination, a slower rate of eating, menu planning and cognitive restructuring. Miller and Sims (1981) reported that the continued use of new exercise habits, cognitive restructuring, modifications in eating style and new social skills were associated with the maintenance of weight loss. Participants of Hudiburgh's weight loss program (1984) rated menu planning, substitution of alternate activities for eating, increased physical activity, taking time to enjoy meals and their individualized diet plans as the most constructive methods for achieving weight loss. Minderaa and Wit (1983) reported that the most important aspects for the institution of behavioral change among children was the development of self-control and adequate psychosocial development.

Although behavioral modification in conjunction with other forms of intervention has been documented to be beneficial for the achievement of weight loss, a greater emphasis needs to be placed on behavioral strategies used during weight maintenance (Council on Scientific Affairs, 1988; Lavery, 1989). As summarized by Evans and Hall, (1978) many problems may be encountered by both the client and the health care provider when instituting behavioral modification techniques in a weight loss program.

Family Involvement

The importance of family involvement and support has been documented as a key element for successful weight control among children (Kingsley and Shapiro, 1977; Epstein, 1985 and 1990), adolescents (Brownell, 1983; Mellin, 1987; Wadden, 1990) and adults (Hart, 1990). Family participation underscores the concept that the development and maintenance of obesity is a family matter and not the problem of one family member. Food and exercise habits are learned and reinforced within the context of the family unit (Frankle, 1985; Sherman and Alexander, 1990). To change food and exercise habits, particularly among children, the individuals who manage the selection, preparation and dispensation of food and who monitor activity need to be involved in order for the transformation process to succeed. However, as discussed by Hertzler, (1981) the level of family function will determine whether family involvement will have a positive or negative influence on weight control.

"Fun" Learning Environment

Adolescent girls participating in a multidisciplinary weight control program cited boredom with the program as one of the main impediments to success (Hoerr, 1988). Program facilitators of other weight control programs also have cited program format as an obstacle to the achievement of successful weight loss (McCoy, personal communication, annual meeting of the American Dietetic Association, Denver, CO., October, 1990; Dey, personal communication, Denver, CO., August 1990).

Nutrition Education Theories

To improve the effectiveness of nutrition education research, the research design requires a sound theoretical framework (Achterberg, 1985). To improve the effectiveness of nutrition education, methods used to convey the information require a theoretical base. An understanding of the needs and abilities of the recipients of the information also needs to be addressed before effective learning can occur (Achterberg, 1988).

Four major learning theories were used in the development of a weight control program for preadolescent children. Bandura's Social Learning Theory, Bruner's Cognitive Field Theory, Bloom's Cognitive Taxonomy and Maslow's Hierarchy were used for the theoretical base from which the weight control program was constructed.

Bandura's Social Learning Theory

Bandura's Social Learning Theory gave equal weight to the individual and the environment in the development of behaviors (Bigge, 1982a). Behaviors of an individual are influenced by the environment, but by the same token the environment is influenced by the individual's behaviors. Thus, to learn new behaviors, the individual needs to rearrange their environment in a manner that will elicit the desired responses. Over time, the desired behaviors become automatic as the individual perceives the value of the consequences of the new behaviors.

Individuals will change their behaviors only in situations where they perceive a need for change, have the desired skills for change and have adequate incentives for change. Bandura acknowledged that people vary in their ability to change their behaviors according to their capabilities and their level of self-discipline.

Bandura viewed behavioral change as a goal orientated process. Goals that are fulfilled should be rewarded since reinforcement is necessary for change to become permanent.

The newly designed weight control program for obese preadolescent children used growth, food and activity records to help the participants and their parents understand the scope of the problem and the behaviors that required change. Contracts and program activities also were used to identify the problems and to provide direction for change. Skills used to change food and exercise habits were taught throughout the program. Activities were incorporated throughout the program that provided the participants and parents time to practice their newly learned skills at the program sessions and at home. Food logs, activity records and activity tallies were used to monitor the progress of the participants. Incentives for change such as exercise passes, exercise equipment and stickers were used in the program. Rewards for completion of weekly and contract goals were established between the participants and their parents.

Parental involvement was based on Bandura's principle of modeling. Modeling or observational learning is the process by which the behaviors of an individual are based on the observed behaviors of others. According to Bandura, most behaviors are learned either deliberately or unintentionally by modeling.

Bruner's Cognitive Field Theory

Bruner's Cognitive Field Theory influenced the type of information that was included in the newly designed weight control program and how that information was presented to the program participants. Bruner placed an emphasis on the necessity to teach individuals at a level that matched their learning needs and abilities (Bigge, 1982b). He further emphasized that a concept must be mastered before it can be expanded.

Learning abilities vary according to the level of cognitive development. The level of cognitive development is indicated by the verbal skills of an individual. Initial stages of learning require teaching methods that encourage interaction between children and their environment, while subsequent stages of learning can utilize teaching methods that contain increasingly more abstract symbols.

A weight control program for preadolescent children age 7 to 11 years implied that the information was to be presented in its simplest form. Program materials were designed for children of this age group (Grammatik IV, Reference International Software, 1989). Question periods conducted at the beginning of each program session and pre-tests were used to identify the learning needs and abilities of the participants and to promote the interest of the participants in the program sessions.

Information was presented sequentially. Initial program sessions contained basic nutrition and exercise concepts. These basic concepts were to be applied by the children and parents to evaluate and change their food and exercise behaviors. Program activities were designed to promote mastery of their newly learned skills and knowledge in a format designed to hold their interest and foster their self-confidence. Program activities also were designed to encourage interaction between the children and the instructor and between the children and their parents. Bruner viewed instructors as interactive working models.

Bloom's Cognitive Taxonomy of Educational Objectives

The design of the program's activities was also influenced by Bloom's Cognitive Taxonomy of Educational Objectives (Bloom, 1956). Bloom advocated the use of instructional activities to promote mastery of concepts and not mere memorization of facts. Mastery of a concept is achieved by progression through the six major categories of the taxonomy: knowledge, comprehension, application, analysis, synthesis and evaluation. Knowledge involves the learner's ability to recall specific elements of a subject. Comprehension encompasses the learner's ability to interpret memorized information beyond its literal meaning. Application involves the learner's ability to apply newly learned information to different problems and situations. Analysis involves the learner's ability to partition information into its constituent parts and to understand the relationship between the parts. Synthesis requires the learner to be able to rearrange the parts of information into a new pattern or structure. Evaluation involves the learner's ability to appraise information according to standards.

Program information consisted of diet and exercise facts and methods to change food and activity habits. The information was divided into ten learning units. Each unit involved a set of specific objectives. Activities of each program session were designed to promote the mastery of the information presented in the session as well as the realization of the objectives by the program participants. Activities provided the participants an opportunity to recognize and to understand specific elements of information presented during each program session. Activities also gave the participants an opportunity to apply newly learned information and to analyze, synthesize and evaluate both new and old information. Thus, the intent of the program was not only to transfer nutrition knowledge from the instructor to the participants but to enable the participants to transfer the program information into new lifestyle behaviors. Participants also would be able to analyze, synthesize and evaluate future dietary and exercise information.

Bandura (Bigge, 1982a), Bruner (Bigge, 1982e) and Bloom (Bloom, 1956) viewed learning as a goal oriented process. All three theories stressed the need for a grand program objective as well as for individual program session objectives. Bandura and Bruner further emphasized the process as one that required rewards. Rewards were understood to be more extrinsically based for children. However, for long-term learning to occur, rewards need to shift from an extrinsic to an intrinsic basis. The reward system used in the program was primarily based on external compensations. Intrinsic rewards would become part of the reward process only after the children appreciated the results of their efforts.

Maslow's Hierarchy of Needs

Maslow's Hierarchy of Needs emphasized the importance of understanding the psychosocial background of the program participants. The hierarchy contains five different levels of needs that are ranked in sequential order. Physiological needs of an individual must be met before the safety needs of a person can be fulfilled. The need to feel loved and to feel a sense of belonging must be satisfied before self-esteem can be fully developed. Only when a healthy self-esteem is developed can an individual realize the highest level of Maslow's hierarchy of self-actualization (Maslow, 1970). Maslow stressed that the behavior of an individual is influenced by their placement in the hierarchy.

Participants of the program were obese preadolescent children recruited through a referral process from local health care professionals. Psychosocial backgrounds and problems of the participants would vary as well as their placements in Maslow's Hierarchy. Thus, program sessions were designed to allow interaction between the instructor and each participant for the development of individualized solutions in a group setting.

Program sessions and activities also were designed to promote the sense of belonging to the group by encouraging participation of each program member. Parental involvement was used to encourage the child's sense of belonging and to stress their importance to the family unit. Program activities were planned to promote competency and self-confidence of the participants. Competency and self-confidence are viewed by Maslow as key components in the development of self-esteem.

The objective of the program was to develop an effective weight control program for obese preadolescent children. The program was designed to help the children and their families understand the need for lifestyle changes, learn new strategies to make the necessary lifestyle changes and master the strategies so that the new lifestyle behaviors would permanently replace their old behaviors.

DEVELOPMENT OF A WEIGHT CONTROL PROGRAM FOR OBESE PREADOLESCENT CHILDREN

Introduction

To improve the effectiveness of nutrition education research, the research design requires a sound theoretical framework (Achterberg, 1985). The need for an effective weight control program for preadolescent children is indicated by the increasing prevalence of obesity among children age 6 to 11 years (Gortmaker, 1987). Weight loss programs previously and currently available to children revealed several factors that influenced the success of weight loss. These factors included family involvement (Kingsley and Shapiro, 1977; Epstein, 1985 and 1990), a structured diet (Epstein, 1990), regular exercise (Amador, 1990; Reybrouck, 1990), behavior modification (Minderaa and Wit, 1983; Hills and Parker, 1988; Amador, 1990; Epstein, 1990) and a "fun" learning environment (Hoerr, 1988). Results from adult weight loss studies stressed the inclusion of a low fat diet in a successful weight loss regimen (Schlundt, 1990; Sheppard, 1991; Prewitt, 1991). No weight control treatment for obese preadolescent children has incorporated a low fat diet.

Similarly, to improve the effectiveness of nutrition education, the methods used to convey the information require a theoretical foundation. Bandura's Social Learning Theory, Bruner's Cognitive-field Theory, Bloom's Cognitive Taxonomy and Maslow's Hierarchy of Needs have provided the theoretical constructs from which the current weight control program was developed. An understanding of the needs and abilities of the recipients of the information also needs to be addressed before effective learning can occur (Achterberg, 1988).

The purpose of the study was to develop an effective weight control program that incorporated a structured low fat diet, regular exercise, behavior modification, family involvement and a fun learning environment for obese preadolescent children. The program was designed to teach obese preadolescent children methods to reduce their daily fat intake to between 25 and 30% of their total daily caloric intake.

Effectiveness of the weight control (special intervention) program was evaluated by changes in the weight status of program participants after the conclusion of the study compared to a standard care group. Results of the anthropometric, dietary and activity measurements are discussed elsewhere (Chapter 3). Program effect was also evaluated by the amount of food and nutrition knowledge gained by the children from the program and the amount of knowledge retained three months after conclusion of the program. Results of the children's and parent's weekly and overall evaluations were used to provide recommendations for revisions of the program.

Methods

Theory

As discussed in Bandura's Social Learning Theory, individuals will change their behaviors only in situations where they perceive a need for change, have the desired skills for change and have adequate incentives for change (Bigge, 1982a). The special intervention program used growth, food and activity records to help obese preadolescent children and their parents understand the scope of the problem and the behaviors that required change. Contracts and program activities also were used to identify problems and to provide direction for change. Skills used to change food, particularly dietary fat intake and exercise habits were taught throughout the program. Activities were incorporated throughout the program that provided the children and parents time to practice their newly learned skills at the program sessions and at home. Food logs, activity records and activity tallies were used to monitor the children's progress. Incentives for change such as exercise passes, exercise equipment and stickers were used in the program.

Bruner's Cognitive Field Theory influenced the type of information that was included in the special intervention program and how that information was presented to the program participants. Bruner emphasized the necessity of teaching individuals at a level that matched their learning needs and abilities (Bigge, 1982b). Question periods conducted at the beginning of each program session and pre-tests were used to identify the learning needs of the children and to promote their interest in the program sessions.

Learning abilities vary according to the level of cognitive development. The level of cognitive development is indicated by the verbal skills of an individual. A weight control program for preadolescent children age 7 to 11 years implied that the information was to be presented in its simplest form. Initial program sessions contained basic nutrition and exercise concepts. These basic concepts were expanded in subsequent program sessions. Program materials including weekly handouts were designed for children of this age group (Grammatik, Reference International Software, 1989). Colors and graphics were used in the design of the weekly handouts to enhance their appeal to children of this age group.

Bruner emphasized that a concept must be mastered before it can be expanded. Program activities provided participants an opportunity to master their newly learned skills and knowledge in a format designed to hold their interest and foster their self-confidence. Program activities also encouraged interaction between the children and the instructor and between the children and their parents. Instructors were viewed by Bruner as interactive working models. Parental involvement was also based on Bandura's principle of modeling (Bigge, 1982a).

Design of the program's activities was influenced by Bloom's Cognitive Taxonomy of Educational Objectives (Bloom, 1956). Bloom advocated the use of instructional activities to promote mastery of concepts and not mere memorization of facts. Mastery of a concept is achieved by progression through the six major categories of the taxonomy: knowledge, comprehension, application, analysis, synthesis and evaluation.

Program information consisted of diet and exercise facts and methods to change food and activity habits. Dietary information focussed on methods to reduce daily dietary fat intake. Information was divided into ten learning units. Each unit involved a set of specific objectives (Table 3). Activities of each program session were designed to promote the mastery of the information presented in the session as well as the realization of the objectives by program participants (Table 3). Activities provided participants the opportunity to recognize and to understand specific elements of information presented during

Table 3. Objectives and Activities of the Newly Designed Weight Control Program for Obese Preadolescent Children by Week.

Week	Objectives	Activities
1 Program Introduction	To identify appropriate weight goals. To complete the weight goal portion of contracts. To learn how to complete a 3-day diet record. To learn how to complete a 3-day activity record.	Discuss the reasons why each group[a] enrolled in the program. Plot child's height and weight on a growth chart. Complete a 24 hour diet recall. Complete a 24 hour activity recall.
2 Food Categories	To learn the six food categories. To identify low fat foods in each category. To evaluate their current meal plan for fat and nutrient content. To learn a meal plan that meets their fat and nutrient requirements. To compare the difference between their current and recommended meal plans for fat and nutrient content. To compare their energy intakes with energy expenditures.	Discuss the reasons why we eat. Complete "Knowing the Right Size" questionnaire. Identify the appropriate food category for food models. Build food pyramids based on 24 hour diet recall from week 1 and Secret Agent Nutrition Prescription. Compare size and shape of the two food pyramids. Compare energy intake of 24 hour diet recall to energy expenditure of 24 hour activity recall.

Week	Objectives	Activities
3 Physical Activity	To understand the role of PA* in weight control. To evaluate current activity level. To determine an appropriate activity pattern. To plan how to increase daily PA. To plan how to remain physically active throughout the year.	Guest speaker: Dr. Ross, sports physician. Compare the amount of PA recorded on activity tally, 3 day activity record and on 24 hour activity recall. Discuss Exercise Away Your Calories. Discuss activity suggestions. Discuss Super You.* Exercise break-play games.
4 Fat	To understand the purpose of fat in the diet. To understand the purpose of fat in the body. To identify low fat foods appropriate for their fat budget.	Play "Wheel of Fat" game. Complete fat budget work sheets.
5 Food Labels	To learn how to evaluate a food by its food label. To identify low fat and high fat foods. To identify low fat foods appropriate for their meal plan.	Complete Buying My Food questionnaire. Play "Guess My Name" game. Complete Hidden Clues...The Search for Low Fat Food Substitutions work sheets.
6 Food Behaviors	To understand the difference between hunger and appetite signals.	Discuss Hidden Clues..The Search for Low Fat Food Substitutions work sheet.

Week	Objectives	Activities
	To identify times, places and moods that trigger food consumption. To identify methods that can be used to limit or avoid inappropriate food behaviors.	Complete Food Signal Strategies work sheets.
7 Food Preparation	To understand the effect of different cooking methods on the fat content of a food. To distinguish between low fat and high fat cooking methods. To prepare foods by low fat cooking methods. To taste foods prepared by low fat cooking methods.	Complete Fixing My Food questionnaire. Compare the fat content of foods prepared by low fat and high fat cooking methods. Prepare and taste foods prepared by low fat cooking methods. Complete "Cooking Time" questionnaire.
8 Snacks	To evaluate the fat content of snack foods. To evaluate the nutrient content of snack foods. To understand how and when to incorporate low fat snack foods into a meal plan.	Classify fat content of favorite snacks as low, medium or high. Classify nutrient value of favorite snacks as low, moderate or high. Discuss how to choose an appropriate snack based on fat budget and daily food consumption. Plan a menu incorporating healthy snack food choices.

Week	Objectives	Activities
		Prepare and taste low fat snack foods.
9 Fast Foods	To evaluate the fat content of fast foods. To evaluate the nutrient content of fast foods. To understand how to incorporate a fast food meal in a meal plan.	Classify fat content of favorite fast food choices as low, medium or high. Classify nutrient content of favorite fast food choices as low, moderate or high. Plan a menu incorporating an appropriate low fat fast food meal. Taste test.
10 Program Summary	To review contracts. To summarize the contents of the weight control program.	Review contracts. Play "Road Map" game.

*Child\parent group
**Physical activity
+National Dairy Council

each program session. Activities also gave participants an opportunity to apply newly learned information and to analyze, synthesize and evaluate both new and old information and behaviors. The intent of the program was not only to transfer nutrition knowledge from the instructor to the participants but to enable the participants to transfer the program information into new lifestyle behaviors.

Bandura (Bigge, 1982a), Bruner (Bigge, 1982b) and Bloom (Bloom, 1956) viewed learning as a goal oriented process. Goals that are fulfilled should be rewarded since reinforcement is necessary for change to become permanent (Bigge, 1982a). Rewards for completion of weekly and contract goals were established between children and their parents. Rewards were understood to be more extrinsically based for children. However, for long-term learning to occur, rewards are required to shift from an extrinsic to an intrinsic basis (Evans and Hall, 1978). The reward system used in the program was primarily based on external compensations. Intrinsic rewards would become part of the reward process only after the children appreciated the results of their efforts.

Maslow's Hierarchy of Needs emphasized the importance of understanding the psychosocial background of the program participants. The hierarchy contains five different levels of needs that are ranked in sequential order:

physiological, safety, belonging, self-esteem and self-actualization (Maslow, 1970). As stressed by Maslow, the behavior of an individual is influenced by their placement in the hierarchy.

Participants of the special intervention program were obese preadolescent children recruited through a referral process from local health care professionals. Psychosocial backgrounds and problems of the participants would vary. Thus, program sessions allowed interaction between the instructor and each child for the development of individualized solutions within the context of a group setting.

Program sessions and activities were designed to promote the sense of belonging to the group by encouraging participation of each program member. Parental involvement also was used to encourage the child's sense of belonging and to stress their importance to the family unit. Program activities were designed to promote competency and self-confidence of the participants. Competency and self-confidence are viewed by Maslow as key components in the development of self-esteem.

Program Elements

In the treatment of obese children, several components have been associated with treatment success. A weight control program was developed for obese preadolescent children that included these key components of success in a format designed to enhance their participation and learning. The elements of the special intervention program were a structured low fat diet, regular exercise, behavior modification and family involvement.

Structured diets have been found to influence the success of weight loss among children (Epstein, 1990). Results from weight loss programs for adults suggested that successful weight loss programs should emphasize a reduction in dietary fat intake (Schlundt, 1990; Prewitt, 1991: Sheppard, 1991).

Participants were prescribed a low fat normocaloric diet. Recommended daily caloric intakes were in agreement with the caloric intakes established by the National Research Council (1989) for preadolescent child. Dietary fat intakes were recommended to contribute between 25 and 30% of the total daily caloric intake. To reduce dietary fat intake and to ensure nutritional adequacy of the prescribed diet, an emphasis was placed on the use of low fat food substitutions and on an increased consumption of grains, fruits and vegetables.

Recommended diets were presented to program participants as their secret agent nutrition prescriptions. Prescriptions identified the number of servings of each food category to be consumed daily. Foods were divided into six categories: grains, fruits, vegetables, dairy, meat and other. Foods from the other category included bacon, sausage and french fries besides butter, margarine and candy. Selecting foods with the lowest fat content from each food category was emphasized. Food categories were arranged in the shape of a pyramid according to fat content and number of daily servings. Program activities were used to teach participants and their parents appropriate serving sizes, low fat methods of food preparation and how to plan or select a low fat daily food plan.

Children were instructed to view their nutrition prescription as a general guideline for their daily food intake. Caloric requirements of the participants would vary during the course of the study as they experienced periods of growth. Children were advised to increase their daily food intake when necessary by consuming more low fat foods. Additional food could be consumed as a fraction of a serving or as a whole serving.

Regular exercise is an essential component of many weight loss programs because of its ability to maintain resting metabolic rate and lean body tissue (Amador, 1990; Calles-Escadon and Horton, 1992). Effects of exercise can be obtained by children participating in either supervised (Amador, 1990) or unsupervised (Reybrouck, 1990) exercise programs.

Children were encouraged to participate in physical activities that they enjoyed on a daily basis. Free passes donated to the program by the managers of a local swimming pool, bowling alley and roller rink were presented to each child as activity incentives. Jump ropes donated by the local chapter of the American Heart Association were also given to each child. Children were encouraged to reduce the amount of TV viewed per day as well as the amount of time using video and computer games. Exercise breaks were incorporated into program sessions. Children had access to various pieces of exercise equipment including jump ropes, skip-its, soccer balls and volley balls during the exercise breaks.

Behavior modification is used in the transition from old to new lifestyle habits (Brownell, 1985). Behavioral management techniques used throughout the program included self-monitoring of food intake, stimulus control, modifications of eating behavior, self-monitoring of physical activity and reinforcement of appropriate new behaviors.

Key elements for successful weight control among children are family involvement and support (Kingsley and Shapiro, 1977; Epstein, 1985 and 1990). Food and exercise habits are learned and reinforced within the context of the family unit (Frankle, 1985; Sherman and Alexander, 1990). To change the food and exercise habits of children, individuals who manage the selection, preparation and dispensation of food and who monitor activity of children needed to be involved in the transformation process. At least one parent was required to attend each program session with a child. Each parent was also requested to assist the child in the completion of diet and activity records.

Boredom with a program's format has been cited as a main impediment to the success of a weight control program (Hoerr, 1988). To circumvent this problem, a variety of activities were used to teach the program information. Emphasis was placed on the use of games as a teaching method and, several games were developed for the program (Table 3).

Study Design

Thirty-two preadolescent children were recruited from the Cheyenne, Wyoming, area with the assistance of local health care professionals. To participate, a child had to be at least seven years of age, be considered prepubertal (Tanner, 1962), have a relative weight of 120% or more (Hammill, 1979) and have a triceps skinfold measurement greater than or equal to the 85th percentile for their age and sex group (Najjar and Rowland, 1987). Interested children and their parents were required to come to the University of Wyoming Family Practice Residency Program at Cheyenne Clinic where the study was explained to them and to sign an informed consent approved by Colorado State University's Human Research Committee and by the University of Wyoming's Institutional Review Board for Human Subjects (Appendix A).

Children were matched for gender, age and relative weight before being randomly assigned either to the special intervention group or standard care group. The standard care group received the care usually provided by the registered dietitian of the clinic. Standard care consisted of three half hour consultations with a registered dietitian. Initial consultations involved the documentation of the child's diet history, medical history including growth records, social history and activity patterns. Based on this information, recommendations were made to the child and parent about an appropriate weight for the child and changes required in the child's diet and activity habits. To assess the child's progress, two additional follow-up appointments were scheduled 4 and 16 weeks after the initial consultation. Two additional appointments were scheduled 10 and 22 weeks after the initial consultation to obtain matching anthropometric, dietary and activity data with children in the special intervention group.

Children assigned to the special intervention group participated in the newly designed ten week weight control program for obese preadolescent children. Program sessions were held one evening per week from 7:00 to 9:00 p.m. at the University of Wyoming Family Practice Residency Program at Cheyenne Clinic. At least one parent was required to accompany a child to each class. Three monthly follow-up meetings were held in the evening at the clinic after the conclusion of the program (week 10). At the three month follow-up meeting (week 22), additional anthropometric, dietary and activity measurements were obtained from each child.

Children in the either group completed three previously validated and reliable questionnaires specifically designed to determine their nutrition knowledge (National Dairy Council, 1979), food selection habits (Gilmore, 1985) and food preparation habits (Fanslow, 1982). Questionnaires were completed during the course of the program, at the end of the program (week 10) and three months after the conclusion of the program (week 22).

Program Evaluations

Using separate evaluation forms, each child and parent evaluated their group for enjoyment, benefit and knowledge. Each child and parent were asked to identify changes in their food and physical activity habits. Evaluations were obtained from each child and parent at the end of the program (week 10) and three months after the conclusion of the program (week 22). Children and parents in the special intervention group also completed weekly evaluations.

Statistical Analysis

Descriptive statistics were computed by treatment group and gender. Plots were constructed to examine data for outliers and possible gross departure from normality (Appendix D). Assignment to the original two treatment groups was at random within matched pairs by gender, age and relative weight. However, attrition among participants of the study resulted in the lost of one member of nearly every original pair. Thus, for analysis, assignment of individuals to the two treatment groups was considered to be completely at random. The repeated measurement of the same individual over time was accounted for by performing separate two way analysis of variance (treatment group and gender) on the difference of each food behavior questionnaire score for each individual at pairs of time points of interest. Time points of interest included weeks 0, 10 and 22. For instance, the difference in the nutrition knowledge scores between week 22 (follow-up) and week 0 (baseline) for each individual available at follow-up was analyzed in a two way analysis of variance. Analyses were made for each of the poosible time point pairs. All analyses were performed using the Statistical Analysis Systems package (SAS Institute, Inc., Cary, NC).

Results and Discussion

Sixteen children were enrolled in each group at the start of the study. Eleven children remained in each group until the end of the study (week 22). Not every child or parent completed all forms or all questions on a form. Activity tallies and other activities that were to be performed at home were completed by few children in the special intervention group. As indicated on the program evaluations, children in the special intervention group did not enjoy the paperwork, homework or work required of them (Appendix C). The program was implemented during the summer months, a period when children expect a respite from homework.

Demographic Data of Children and Parents

Each group consisted of 16 children. The special intervention group contained seven boys and nine girls, while the standard care group contained an equal number of boys and girls. Initial anthropometric measurements were similar between and within the two groups (Table 4). Both groups contained Caucasian, Black and Hispanic children.

Mothers in the special intervention group were heavier than the mothers in the standard care group, while fathers in either group exhibited similar weights and heights. Mean BMI values of fathers in both groups and mothers in the standard care group were above the BMI level associated with the lowest mortality risk (Garfinkel, 1979). The mean BMI value of mothers in the special intervention group was above 30 kg/m^2, the value used to define obesity in adults (Bray, 1978). Since the weight status of family members tends to aggregate (Garn and Clark, 1976; Garn, 1981: Price, 1990; Unger, 1990), it was not unexpected that the children recruited for the study would have overweight or obese parents.

TABLE 4. Demographic Data of Children by Intervention Strategy.[‡†]

Characteristic	Special Intervention Group		Standard Care Group	
Anthropometric[‡]	n=16[††]	n=11[†††]	n=16[††]	n=10[†††]
Weight, kg	59.3 ± 3.1	58.4 ± 3.7	59.1 ± 3.1	57.5 ± 3.2
Height, cm	144.2 ± 1.5	144.6 ± 2.1	145.9 ± 2.3	145.4 ± 2.6
Relative Weight	1.49 ± 0.07	1.45 ± 0.08	1.45 ± 0.04	1.43 ± 0.06
Body Mass Index	28.4 ± 1.3	27.8 ± 1.4	27.5 ± 0.8	27.0 ± 1.0
A:H Circumference[‡‡]	0.98 ± 0.02	0.97 ± 0.02	0.96 ± 0.06	1.02 ± 0.02
TSF, mm[‡‡‡]	29.2 ± 2.4	30.5 ± 3.5	30.2 ± 2.8	32.6 ± 4.0
Sum of Skinfolds[‡‡‡‡]	117.9 ± 7.7	117.9 ± 9.8	127.3 ± 6.4	127.3 ± 8.1
Age, yr	9.9 ± 0.3	10.2 ± 0.4	10.4 ± 0.3	10.1 ± 0.3
Blood Pressure				
Systolic, mmHg	109.9 ± 2.3	110.4 ± 3.1	107.2 ± 7.1	111.8 ± 3.5
Diastolic, mmHg	76.3 ± 1.8	76.5 ± 2.4	76.4 ± 2.0	78.0 ± 2.4
Gender[†]	n=16	n=11	n=16	n=10
Boys	7	4	8	4
Girls	9	7	8	6
Race[†]	n=16	n=11	n=16	n=10
Caucasian	9	8	11	7
Black	1	0	2	1
Hispanic	2	2	3	2
Mixed	4	1	0	0
Mother's[‡]	n=12	n=11	n=11	n=10
Weight, kg	89.4 ± 8.4	89.3 ± 9.2	70.2 ± 5.7	69.1 ± 6.2
Height, cm	165.7 ± 3.5	168.0 ± 2.8	161.9 ± 3.0	161.8 ± 3.3
BMI, kg/m^2	32.7 ± 3.0	31.5 ± 3.0	28.1 ± 2.1	27.8 ± 2.3
Education Level[†]				
Grade 8 or less	0	0	0	0
Grade 8-12	2	1	0	0
H.S. diploma/GED	4	4	5	5
Attended college	6	6	4	3
College graduate	0	0	2	2
Advanced degree	0	0	0	0
Father's[‡]	n=12	n=11	n=10	n=9
Weight, kg	89.8 ± 4.0	91.2 ± 4.3	91.4 ± 6.3	91.9 ± 7.1
Height, cm	181.4 ± 1.6	181.7 ± 1.8	179.2 ± 2.9	178.8 ± 3.2
BMI, kg/m^2	26.5 ± 1.0	26.7 ± 1.1	28.4 ± 1.9	28.7 ± 2.1
Education Level[†]				
Grade 8 or less	2	2	0	0
Grade 8-12	1	1	1	1
H.S. diploma/GED	5	4	4	3
Attended college	2	2	3	3
College graduate	1	1	2	2
Advanced degree	1	1	0	0

[‡]Mean ± SEM
[†]Frequency
[‡‡]Abdominal:Hip Circumference
[‡‡‡]Triceps Skinfold Thickness
[‡‡‡‡]Tricipital, bicipital, suprailiacal and subscapular skinfold measurements were used to calculate the sum of skinfolds (mm).
[††]Initial data for total sample by intervention strategy.
[†††]Initial data for sample with complete anthropometric data sets by intervention strategy.

Parents in the special intervention group tended to be less educated than the parents in the standard care group. More mothers in the special intervention group had not completed high school, while every mother in the standard care group had finished high school. More mothers in the standard care group attended and/or obtained a college degree compared to mothers in the special intervention group. Approximately 25% of fathers in the special intervention group had not completed high school with two of the fathers obtaining less than an eighth grade education. A similar proportion of fathers in both groups had completed high school, while more fathers in the standard care group attended or completed college than fathers in the special intervention group.

Only one family in the special intervention group and three families in the standard care group indicated a family medical history free of any chronic diseases (Table 5). Family medical histories of the remaining families in either intervention group included heart disease, hypertension, diabetes mellitus, cancer or a combination of these diseases.

Food Behavior Questionnaires

Initial scores on the nutrition knowledge questionnaire were similar between the two groups (Table 6). No significant differences were determined by group or gender between scores at test times one and two (Table 6a). Scores

TABLE 5. Family Medical History of Children by Intervention Strategy.

Medical Problems	Frequency: Special Intervention Group (n=16)	Frequency: Standard Care Group (n=16)
None	1	3
Heart disease	0	2
Hypertension	2	2
Hypertension and diabetes mellitus	2	0
Diabetes mellitus	1	2
Cancer	0	2
Diabetes and cancer	2	2
Hypertension and cancer	3	0
Heart disease, hypertension, diabetes mellitus and cancer	4	0
Heart disease and diabetes mellitus	1	1
Heart disease and cancer	0	1
Hypertension, diabetes mellitus and cancer	0	1

TABLE 6. Mean Scores of Food Behavior Questionnaires by Intervention Strategy and Gender.*

		Nutrition Knowledge			Food Preparation			Food Selection		
		1	2	3[b,d]	1	2	3	1	2	3
		%	%	%	%	%	%	%	%	%
Intervention Strategy	Special Intervention Group	66.5 (4.0)	77.9 (3.1)	57.7[a,c] (9.5)	89.3 (4.1)	92.3 (-)	92.7 (2.4)	62.1 (10.1)	-	46.6 (11.7)
	Standard Care Group	67.0 (2.5)	64.6 (4.5)	68.8 (5.4)	78.8 (7.3)	87.9 (6.4)	89.2 (5.3)	67.7 (7.9)	-	52.4 (10.4)
Gender	Boys	66.3 (2.9)	69.8 (3.3)	55.9 (13.6)	92.3 (3.5)	92.3 (5.2)	95.1 (3.1)	75.2 (5.6)	-	52.2 (12.4)
	Girls	67.0 (3.2)	72.0 (4.4)	65.8 (5.9)	78.8 (6.3)	84.6 (10.4)	88.8 (4.0)	60.2 (7.8)	-	48.0 (10.0)

*Mean (±SEM) of children with complete anthropometric data; n varies at each time point with maximum n=11 for special intervention group, n=10 for standard care group, n=8 for boys and n=13 for girls.

[a]Significantly different from test time 2, $P \leq 0.01$.

[b]Significant Intervention Strategy by Gender interaction, $P \leq 0.05$.

[c]Significantly different from test time 1, $P \leq 0.05$.

[d]Significant Intervention Strategy by Gender interaction, $P \leq 0.01$.

TABLE 6a. Least Squares Means of Differences of Food Behavior Questionnaires.

Questionnaire	Trt[†]	Sex[††]	Wk0-Wk10[‡]	P>[t]	Wk10-Wk22[‡]	P>[t]	Wk0-Wk22[‡]	P>[t]
Nutrition Knowledge	1	1	-0.7500000 (10.6651402)	0.9449	44.7500000 (11.6383917)	0.0020	50.0000000 (16.0050863)	0.0088
	1	2	-14.1666667 (5.7007572)	0.0252	12.3571429 (6.2209821)	0.0685	-1.8095238 (6.0493540)	0.7700
	2	1	-2.5833333 (7.5413930)	0.7367	-8.0555556 (9.5027071)	0.4119	-13.7222222 (9.2405409)	0.1633
	2	2	5.7222222 (6.1575216)	0.3674	-1.0666667 (7.3607652)	0.8870	4.8000000 (7.1576922)	0.5152
Food Preparation	1	1	- (-)	-	- (-)	-	9.6153846 (9.8080514)	0.3435
	1	2	0.0000000 (21.8532401)	1.0000	0.000000 (9.5768458)	1.0000	-7.0512821 (5.6626811)	0.2335
	2	1	-2.8846154 (10.9266200)	0.8023	-5.7692308 (4.7884229)	0.2822	-8.6538462 (6.9353397)	0.2326
	2	2	-21.7948718 (12.6169741)	0.1447	11.5384615 (5.5291945)	0.0913	-11.5384615 (5.6626811)	0.0609
Food Selection	1	1	- (-)	-	- (-)	-	93.1034483 (38.2026940)	0.0330
	1	2	- (-)	-	- (-)	-	12.6436782 (15.5961845)	0.4347
	2	1	- (-)	-	- (-)	-	-0.0000000 (22.0563356)	1.0000
	2	2	- (-)	-	- (-)	-	7.5862069 (17.0847641)	0.6656

‡ Least Squares Mean Difference (±SEM).

† Trt: 1 = Special Intervention Group with maximum n=11; 2 = Standard Care Group with maximum n=10; n varies at each time point.

†† Sex: 1 = Boys with maximum n=8; 2 = Girls with maximum n=13; n varies at each time point.

of the special intervention group increased between test times one and two. The special intervention group received more nutrition information than the standard care group which was reflected in their improved nutrition knowledge scores at the end of the program (test time two) compared to the start of the program (test time one). Scores of the special intervention group were significantly lower at test time three (follow-up) than at test times two (P=0.0026) and one (P=0.0174). Significant group by gender interactions were found between scores at test times three and one (P=0.0053) and between test times three and two (P=0.046), with boys in the special intervention group exhibiting the greatest amount of change in their scores. No significant differences were observed between the scores of the standard care group during the course of the study. However, scores of the standard care group improved slightly at test time three compared to test time one, with boys in the standard care group exhibiting the greatest amount of change (Table 6a).

Scores on the Fixing My Food questionnaire of the standard care group and girls improved over time (Table 6a). The special intervention group scored higher than the standard care group at each test time. Boys scored higher than girls at each test time. No gender differences were reported after testing the questionnaire nationally with over 1600 school age children (Fanslow, 1982).

Although the Buying My Food questionnaire was originally designed for children in the fifth or sixth grades, scores of both groups and genders were higher than scores obtained during national field testing of the questionnaire (Gilmore, 1985). In general, scores of both groups were lower at test time three than at test time one. Boys in the special intervention group exhibited the greatest decrease in their scores between test times one and three (Table 6a).

The decrease in nutrition knowledge scores of the special intervention group, particularly among boys between test time three and test times one and two could have been due to a lack of interest to complete the same test for a third time. Parents and children in both groups indicated that the least favorite part of their respective group was the paperwork, homework and/or tests (Appendix C).

Decreases in nutrition knowledge scores of the special intervention group, particularly among boys also could have been due to lower reading abilities. The nutrition knowledge questionnaire was available in three forms. Each form was specifically designed to test the nutrition knowledge of children enrolled in grades kindergarten through second grade, third and fourth grade or fifth and sixth grade (National Dairy Council, 1979). Although the appropriate form was presented to each child at each test time, it was readily apparent that the children, regardless of group, experienced difficulty in reading the questionnaire. To overcome this problem, the instructor read the questions and answers to the children at test times one and two. Due to lack of time, the instructor was unable to follow the same format at test time three. Thus, the decrease in scores at test time three, particularly among boys could have been due to the inability to read the questionnaire.

The same trend was not observed among the scores of Fixing My Food questionnaire. However, the same questionnaire was used for children in grades one through six (Fanslow, 1982). The instructor did not encounter a similar inability to read this questionnaire among group participants as she did with the nutrition knowledge questionnaire.

As with the nutrition knowledge questionnaire, the instructor read the questions of Buying My Food to each participant at test time one, but was unable to follow the same format at test time three. The same reasons discussed for the reduction in mean scores on the nutrition knowledge questionnaire could apply to the reduction in mean scores on the Buying My Food questionnaire.

Weekly and Overall Evaluations

The majority of the children and parents enjoyed each program session (Table 7 and 8). The majority of children learned something new by attending each week's class

TABLE 7. Frequency of Children's Responses on Weekly Evaluations.

Question	Response	Frequency of Response Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk
1. Did you enjoy the class?	n	15	16	11	6	11	4	10	7	4	
	yes	13	16	11	6	9	4	10	7	3	
	no	0	0	0	0	1	0	0	0	0	
	no opinion	2	0	0	0	1	0	0	0	1	
2. Did you learn something new?	n	16	16	11	6	11	4	10	7	4	
	yes	14	12	9	4	9	2	6	5	4	
	no	1	1	0	1	0	0	0	1	0	
	no opinion	1	3	2	1	2	2	4	1	0	

TABLE 8. Frequency of Parental Responses on Weekly Evaluations.

Question	Response	Frequency of Response Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10
1. Did your child enjoy the class?	n	14	15	10	5	8	3	11	6	5	1
	yes	13	14	8	5	6	2	11	6	5	1
	no	1	0	0	0	1	0	0	0	0	0
	no opinion	0	1	2	0	1	1	0	0	0	0
2. Did you enjoy the class?	n	13	15	10	5	9	3	11	7	5	1
	yes	12	15	10	5	8	2	11	7	5	1
	no	1	0	0	0	0	0	0	0	0	0
	no opinion	0	0	0	0	1	1	0	0	0	0
3. Did the class provide your child with useful information?	n	14	15	10	5	9	4	11	7	5	1
	yes	12	14	9	5	8	3	10	7	5	1
	no	0	0	0	0	0	0	1	0	0	0
	no opinion	2	1	1	0	1	1	0	0	0	0
4. Did the class provide you with useful information?	n	14	15	9	5	9	4	11	7	5	1
	yes	14	15	9	5	9	4	10	7	5	1
	no	0	0	0	0	0	0	0	0	0	0
	no opinion	0	0	0	0	0	0	1	0	0	0
5. Could the information presented in today's class be easily used by your family?	n	14	15	9	4	9	4	11	7	5	1
	yes	12	14	8	4	9	3	11	7	5	1
	no	0	0	0	0	0	0	0	0	0	0
	no opinion	2	1	1	0	0	1	0	0	0	0

(Table 7). Children's responses to the weekly question "What did you learn ?" correctly matched with at least one of the objectives listed for that week's class (Table 3 and 9).

Parents indicated that the weekly classes provided useful information to them (Table 8). Parents further indicated that the information presented in each class could be used easily by their families.

Weekly handouts receiving the most favorable responses by the children included weeks one, two, three, five, seven and eight (Table 10). Less favorable responses were received for weeks four, six and nine. No weekly handout received the least favorable response. However, one child did not understand week's one handout. Handouts receiving more favorable ratings may have provided information that was more understandable or useful to the children and/or discussed a behavior that required the least amount of change. Handouts receiving less favorable ratings may have provided information that was less understandable or useful to the children and/or discussed a behavior that required a greater amount of change. The special intervention group identified limiting foods from the "other" group and food signal strategies as the least enjoyable parts of their program (Appendix C). Children in the special intervention group had changed their food habits by altering what they ate, particularly the amount of food consumed from the

TABLE 9. Frequency of Children's Responses to the Question "What did you learn?"

Week	n	Response		Frequency of Response
1.	13	a.	How to eat.	2
		b.	What I will be doing.	1
		c.	I can eat many foods.	1
		d.	About weight loss.	7
		e.	How to complete food and activity records.	2
2.	12	a.	What to eat and how to exercise.	5
		b.	How to make a food pyramid and how to group food.	5
		c.	How to lose fat.	1
		d.	Food is good for you.	1
3.	6	a.	How to lose fat and build more muscles.	2
		b.	Exercise is fun.	1
		c.	How to lose weight.	2
		d.	How to eat right.	1
4.	4	a.	The fat content of (specific) foods.	1
		b.	How to group food.	1
		c.	Many things.	2
5.	7	a.	Nutrient value of different foods.	4
		b.	Good food choices for meals.	1
		c.	How to lose weight.	1
		d.	Good food choices at fast food restaurants.	1
6.	2	a.	What it means to feel full and hungry.	1
		b.	How to control my eating when I'm not hungry.	1
7.	6	a.	Food helps you grow.	1
		b.	How to cook low fat.	3
		c.	Low-fat foods taste good.	1
		d.	How to lose weight.	1
8.	5	a.	What to eat as a snack.	1
		b.	Healthy foods are fun and how to choose a healthy food.	2
		c.	How to make a food....how to follow a recipe.	2
9.	3	a.	How to play volleyball.	1
		b.	Many things.	1
		c.	How to choose a fast food meal.	1
10.	-	-		-

TABLE 10. Frequency of Children's Response to Weekly Handouts.

Week	n	Handout	Frequency of Response			
			Great	Good	Okay	Terrible
1.	14	Road Map.[a]	11	1	1	0
2.	15	Secret Agent Nutrition Prescription.	11	2	3	0
3.	10	Super You.	8	1	1	0
4.	6	The Balance of Food.	1	4	1	0
5.	11	Hidden Clues...The Search for Low-Fat Foods.	7	3	1	0
6.	4	Food Signal Strategies.	0	2	2	0
7.	9	Cooking Time Questionnaire.	6	2	1	0
8.	7	Managing the Snack Attack.	4	1	2	0
9.	4	Navigating Through Fast Food Alley.	1	0	3	0
10.	1	Keys to Success.	0	0	1	0

[a]One child responded "Did not understand."

"other" group, the type of foods consumed at snack time and the amount of food eaten at a given time. Handouts receiving less favorable responses by the children discussed these same topics.

Parents considered the information provided on the handouts to be useful (Table 11). The information containedon handouts five, six, seven and eight was already being used by families in the special intervention group. These handouts addressed reading food labels, strategies to modify inappropriate food behavior, low fat cooking methods and low fat snack food suggestions, respectively. The handout from week one which outlined the content of the program received the most varied responses by the parents.

Children, regardless of group, enjoyed their weight control care (Appendix C). Food demonstrations and exercise breaks were identified as the most enjoyable parts of the special intervention program. Children in the standard care group indicated that the instructor and learning the nutrient value of food were the most enjoyable parts of standard care. These responses are consistent with the type of care given to each group. The special intervention strategy was a group based program that emphasized a hands-on approach as its primary teaching method. The standard care group received individualized nutritional counseling. Children in each group appeared to respond favorably to the unique characteristic of their intervention strategy.

TABLE 11. Frequency of Parent's Responses to Weekly Handouts

Week	n	Handout	Will use information	Will not use information	Already use information	Undecided	No opinion
			Frequency of Response				
1.	12	Road Map	8	1	0	1	2
2.	15	Secret Agent Nutrition Prescription	15	0	0	0	0
3.	7	Super You	7	0	0	0	0
4.	4	The Balance of Food	4	0	0	0	0
5.	7	Hidden Clues...The Search for Low-Fat Foods	5	0	1	0	1
6.	3	Food Signal Strategies	2	0	1	0	0
7.	7	Cooking Time Questionnaire	6	0	1	0	0
8.	6	Managing the Snack Attack	5	0	1	0	0
9.	5	Navigating Through Fast Food Alley	5	0	0	0	0
10.	1	Keys to Success	1	0	0	0	0

Children in the special intervention group may be more inclined to participate in a variety of physical activities given the opportunity and support. Playtime was identified as a favorite part of the special intervention program. During the exercise breaks, these children were encouraged and provided a variety of means to exercise. Lack of physical activity may be due to lack of encouragement, motivation or exercise equipment.

Except for the anthropometric measurements, no other part of the special intervention program was identified as being highly unacceptable. Five children in the standard care group indicated that no part of their care was unacceptable, while two children indicated that standard care required too much work.

Regardless of group, children learned the correct amount and type of food to eat. Children also learned how to read food labels. Children in both groups thought they ate foods with a lower fat content. The special intervention group was specifically instructed how to select foods for a 25-30% fat calorie diet. Children in the standard care group were recommended to consume a 30% fat calorie diet in agreement with the recommendations made by the National Cholesterol Education Program Coordinating Committee (1991). Furthermore, many of the diseases cited in the family medical histories of the standard care group would warrant a reduction in dietary fat intake (Table 5).

Children in both groups reduced their food consumption by eating smaller portions of food. Food labels were used by more families in either group to select food. Other changes in food selection included the purchase of special diet foods, lite foods, different snacks foods and/or less or no "junk" food. Children in either group who had changed their food selections at restaurants did so by selecting salads in place of french fries. Two children in the control group indicated that their families ate at home instead of eating at a restaurant. Mixed responses were obtained to whether the children would alter their school lunch choices. Children in both groups who had altered their school lunch selections did so by packing a sack lunch instead of eating school lunch. Children in both groups consumed fewer fried or "greasy" foods. The type of food consumed by children in either group as a snack had changed. Changes made in snack food selections varied.

Similar proportions of children in both groups increased their level of physical activity by week ten. A greater proportion of the standard care group changed their level of physical activity by week twenty-two. Children who changed their type of physical activity did so by a variety of methods.

In agreement with the children's overall evaluations, parents in both groups indicated that the children enjoyed their weight control care (Appendix C). Parents in the special intervention group agreed with the children at week 10 that the exercise breaks were an enjoyable component of the program. At week 22, parents indicated that the most enjoyable portions of the special intervention program were the food demonstrations. This response was in agreement with the children's responses. Parents also indicated that their children enjoyed the opportunity to socialize while attending classes. Parents in the standard care group identified the instructor and the individualized attention as the most enjoyable components of standard care at week ten. At week 22, parents in the standard care group indicated that the most enjoyable portions of standard care were the individualized attention followed by learning about different foods, healthy food choices and methods to lose weight.

The majority of parents in either group enjoyed their child's weight control care. The most enjoyable aspect varied with intervention strategy. Regardless of week, parents in the special intervention group appreciated the program information. At week 10, parents in the standard care group enjoyed watching their child lose weight, stop gaining weight and/or take care of him/herself besides the individualized counseling. At week 22, parents in the standard care group also appreciated the information provided during the counseling session.

Parents in the special intervention group identified anthropometric measurements as the children's least favorite portion of the program at week ten. This response was in agreement with the children's response. At week 22, no single aspect of the special intervention program was emphasized as least enjoyable for the children. Parents in the standard care group identified anthropometric measurements and changing food/exercise habits as the least enjoyable portion of standard care for the children. At week 22, paperwork was cited by parents as the most objectionable component of standard care for the children. The parents' least favorite aspects of the special intervention program were class length and waiting, while paperwork was the least favorite component of the parents in the standard care group.

At week 10, parents of both groups indicated that they and their children learn how to use food labels to select foods. Parents in the special intervention group also learned that parental support was necessary for children to make the required changes for weight loss. At week 22, parents in the special intervention group learned that the nutrient value of food varies and weight control requires diet and exercise. Parents in the standard care group also learned at week 10 that parental support was required for their child to make the necessary changes to lose weight and the nutrient value of food varies. At week 22, the majority of parents in this group learned that the nutrient value of food varies.

At week 10, parents in the special intervention group thought that the children were eating healthier foods. At week 22, parents in this group indicated that the children were consuming less fatty or fried foods and more fruits. These responses were similar to the responses given by the children of this group on their evaluations. At week 10, parents in the standard care group indicated that their children were also consuming less fatty or fried foods, sweets and junk food besides eating more fruit. At week 22, parents of this group thought that the children were eating healthier foods, consumed smaller amounts of food and selected different foods as snacks. Responses of the parents in the standard care group varied more than the children's responses. Parents in either group had altered their eating habits by consuming more fruits, vegetables and lean meats and less and/or no fried foods.

Parents, regardless of group indicated that the children had reduced the amount of food consumed by eating smaller portions and/or eliminating the number of second helpings of food. Parental responses agreed with the responses of the children on their evaluations. Parents also decreased their food consumption by eating smaller portions of food. Parents in both groups exhibited mean BMI values above 25 kg/m^2. Mothers in the special intervention group had a mean BMI value above 30 kg/m^2. Weight control, particularly for mothers in the special intervention group would be recommended.

Parents of both groups purchased more lean meats, fruits, vegetables and grains and less junk and snack foods, particularly ice cream and cookies at grocery stores. Food label information was used to select food. These responses agreed with the responses of the children. Parents of both groups as well as children selected more salads and chicken and less or no fried foods at restaurants. Parents in the special intervention group changed school lunches by preparing sack lunches. Parents in the standard care group planned to evaluate the school lunch menu selections more closely, packing lunches when necessary. Parental responses were similar to responses made by the children.

Parents in the special intervention group prepared less or no fried foods or used low fat cooking methods when preparing foods at home. Parents in the standard care group initially gave the same response as the parents in the special intervention group. However, by week 22, parents in the standard care group used less fat during food preparation. Parents' responses agreed with the children's responses.

Majority of parents in both groups thought that the snacks consumed by the children had changed. Children in the special intervention group consumed more fruits, vegetables, grains and low fat foods as snacks. Children in the standard care group ate less chips and regular soda besides consuming more fruits, vegetables and grains as snacks. Parents of both groups also ate more low fat foods, particularly fruits as snacks.

Parents in both groups thought the children's level of physical activity increased by a variety of ways. As with the children's responses, more parents in the standard care group indicated that the children's amount and type of physical activity had changed by week 22. Some parents in both groups increased their level of physical activity by increasing their amount of walking and/or bike riding.

Both children and parents in the special intervention group considered the classes to be too long in length (Table 12). To reduce class length, class activities receiving the lowest approval ratings by both parents and children could be discarded from the program (Tables 13 and 14). An alternate solution would be to teach the children and parents separately since some class activities received higher approval ratings from children than parents while other class activities received higher approval ratings from parents than children. A greater proportion of children than parents indicated that the special intervention program should last longer than ten weeks (Table 12). Only one child indicated that the program should last shorter than ten weeks. Two children indicated that the program should

TABLE 12. Evaluation of Class and Program Length by Parents and Children.

		Parents	Children
		n=10	n=10
	Too Long	6	6
Class Length	Too Short	-	1
	Just Right	4	3
		n=9	n=9
	Longer than 10 weeks	4	6
Program Length	Shorter than 10 weeks	-	1
	Run for 10 weeks	5	2

TABLE 13. Frequency of Children's Responses to Weekly Activities.

Week	n	Activity	Great	Frequency of Response Good	Okay	Terrible
1.	16	a. Reasons for enrolling in the Program.	5	4	7	0
	16	b. Growth charts.	7	5	2	2
	16	c. 24-hour diet recall.	4	5	3	4
	16	d. 24-hour activity recall.	7	4	4	1
2.	15	a. Reasons why we eat.	5	7	2	1
	16	b. Knowing the "right size."	11	0	2	3
	16	c. Food groups.	10	3	2	1
	16	d. Food pyramids.	9	2	1	4
	14	e. Balance.	5	3	4	2
3.	11	a. Dr. Skip Ross.	8	0	3	0
	11	b. Activity evaluation.	5	6	0	0
	11	c. Exercise away your calories.	9	0	0	2
	11	d. Activity suggestions.	6	4	1	0
	11	e. Games.	9	2	0	0
4.	6	a. Wheel of fat.	5	0	1	0
	5	b. Fat budgeting.	3	2	0	0
5.	11	a. Buying My Food questionnaire.	6	1	3	1
	11	b. Guess My Name.	4	3	2	2
	11	c. Low-fat food substitutions.	6	5	0	0
6.	4	a. Shopping questionnaire.	1	1	2	0
	4	b. Food signal strategies.	3	1	0	0
7.	10	a. Fixing My Food questionnaire.	5	2	3	0
	8	b. Cooking method comparisons.	6	2	0	0
	10	c. Food taste tests.	9	1	0	0
	9	d. Cooking time questionnaire.	5	2	2	0

Week	n	Activity	Great	Frequency of Response Good	Okay	Terrible
8.	7	a. Snack food choices.	6	0	1	0
	7	b. Healthy snack choices.	5	2	0	0
	7	c. Snack preparation and taste tests.	7	0	0	0
9.	4	a. Fast food choices.	3	1	0	0
	4	b. Fast food meals.	4	0	0	0
	4	c. Fast food taste test.	4	0	0	0
10.	1	a. Contract review.	1	0	0	0
	1	b. Road map game.	1	0	0	0

TABLE 14. Frequency of Parent's Response to Weekly Activities.

Week	n		Activity	Frequency of Response[a] 1	2	3	4
1.	14	a.	Reasons for enrolling in the Program.	7	4	2	1
	14	b.	Growth charts.	9	3	0	2
	14	c.	24-hour diet recall.	5	3	6	0
	14	d.	24-hour activity recall.	4	0	2	8
2.	11	a	Reasons why we eat.	3	1	1	6
	15	b.	Knowing the "Right Size".	5	6	2	2
	15	c.	Food groups.	7	2	3	3
	15	d.	Food pyramids.	2	6	3	4
	10	e.	Balance.	4	1	3	2
3.	9	a.	Dr. Skip Ross.	6	3	0	0
	10	b.	Activity evaluation.	5	2	1	2
	10	c.	Exercise away your calories.	6	1	1	2
	10	d.	Activity suggestions.	7	1	1	1
	10	e.	Games.	6	1	1	2
4.	5	a.	Wheel of fat.	2	0	0	3
	5	b.	Fat budgeting.	2	1	1	1
5.	9	a.	Buying My Food questionnaire.	3	1	4	1
	9	b.	Guess my name.	6	1	1	1
	8	c.	Low-fat food substitutions.	0	5	2	1
6.	4	a.	Shopping questionnaire.	2	1	0	1
	4	b.	Food signal strategies.	1	3	0	0
7.	8	a.	Fixing My Food questionnaire.	2	3	2	1
	8	b.	Cooking method comparisons.	1	6	1	0
	11	c.	Food taste tests.	11	0	0	0
	7	d.	Cooking time questionnaire.	3	0	2	2
8.	7	a.	Snack food choices.	3	3	1	0
	7	b.	Healthy snack choices.	3	1	3	0
	7	c.	Snack preparation and taste tests.	7	0	0	0
9.	5	a.	Fast food choices.	4	1	0	0
	5	b.	Fast food meals.	0	1	4	0
	5	c.	Fast food taste test.	2	3	0	0
10.	1	a.	Contract review.	1	0	0	0
	1	b.	Road Map game.	0	1	0	0

[a]Weekly activities were rated 1 to 4, 1 = most favorite and 4 = least favorite.

last ten weeks. A greater proportion of parents indicated that the program should last for ten weeks.

This special intervention strategy was specifically designed for preadolescent children. The tailoring of the intervention to preadolescent child was reflected in the approval ratings obtained at the end of the program (week 10). Children enjoyed more of the classes and enjoyed the classes to a greater degree than their parents (Table 15). The class identified by the parents as their most favorite (week two) was identified by the children as one of their least favorite. Topics discussed during week two included serving sizes, food categories and the balance between energy intake and expenditure (Table 3). Week two was also the time when the children received their secret agent nutrition prescription which outlined the recommended number of servings of each food category to be consumed daily. Both children and their parents considered weeks five and seven as one of their most favorite classes. How to select low fat foods based on the information provided on food labels was the primary objective of week five. Week's seven objective was low fat methods of food preparation. Other weekly classes receiving high approval ratings by the children included weeks three, four, eight, nine and ten. The objectives of these weeks were increasing physical activity, fat budgeting, low fat snack selections and the program summary, respectively.

TABLE 15. Class Ratings by Parents and Children.[1]

Class	n	Parents' Ratings Frequency Percentages 1	2	3	4	5	6	7	8	9	10
1	10	30.0	20.0	10.0	–	10.0	10.0	–	10.0	10.0	–
2	10	50.0	10.0	10.0	10.0	–	10.0	10.0	–	–	–
3	10	20.0	–	–	30.0	10.0	–	10.0	10.0	–	20.0
4	10	20.0	10.0	–	10.0	10.0	10.0	–	30.0	10.0	–
5	9	44.4	22.2	22.2	–	–	–	–	11.1	–	–
6	9	22.2	11.1	–	11.1	–	22.2	22.2	–	11.1	–
7	10	40.0	20.0	–	–	10.0	10.0	–	20.0	–	–
8	7	28.6	14.3	–	28.6	–	14.3	–	–	14.3	–
9	7	28.6	–	28.6	–	14.3	–	28.6	–	–	–
10	9	33.3	–	–	–	11.1	11.1	–	–	22.2	22.2

Class	n	Children's Ratings Frequency Percentages 1	2	3	4	5	6	7	8	9	10
1	10	30.0	–	–	10.0	–	10.0	10.0	–	20.0	20.0
2	10	30.0	10.0	–	–	–	10.0	–	–	30.0	20.0
3	9	55.6	–	–	–	22.2	–	–	11.1	11.1	–
4	10	60.0	20.0	10.0	–	–	–	–	–	10.0	–
5	10	80.0	–	10.0	–	–	–	–	–	–	10.0
6	10	30.0	–	10.0	10.0	–	–	20.0	–	10.0	20.0
7	10	60.0	10.0	–	10.0	10.0	–	–	–	10.0	–
8	8	75.0	–	–	–	12.5	–	–	–	–	12.5
9	7	57.1	28.6	–	–	–	14.3	–	–	–	–
10	10	60.0	–	20.0	–	–	–	10.0	–	10.0	–

[1] Classes were rated on a scale from 1 to 10, 1 = most favorite and 10 = least favorite.

Weeks one and six along with week two received the lowest approval ratings by children. The objectives of week one were to identify an appropriate weight goal for each child and to learn how to complete food and activity records. The goal of week six was to identify inappropriate food behaviors and methods to alter these behaviors.

Approval ratings of the handouts also reflected the tailoring of the intervention to preadolescent children (Table 16). In general, children rated the weekly handouts more favorably than parents. Handouts from weeks three and nine received high approval ratings from both children and parents. Week three's handout provided activity suggestions. Week nine's handout provided information about fast food selections. Children rated the Road Map handout from week one more favorably than parents. This handout outlined the contents of the program. The children were also able to color the different parts of the road map as a means of marking their progress through the program. The weekly handout that received the least favorable rating was the food behavior strategies discussed during week six.

Activity Incentives

Activity incentive used by a greater percentage of children in the special intervention group was the jump rope followed by the roller skating pass, swimming pass and bowling pass (Table 17). A child does not need a parent to use a jump rope; whereas, the other activity incentives

TABLE 16. Ratings of Weekly Handouts by Parents and Children.[a]

Handout	n	1	2	3	4	5	6	7	8	9	10
		Parents' Ratings Frequency Percentages									
1	10	–	30.0	–	–	–	–	–	–	40.0	30.0
2	10	40.0	20.0	20.0	–	10.0	–	10.0	–	–	–
3	9	44.4	22.2	–	–	–	33.3	–	–	–	–
4	10	10.0	20.0	–	–	20.0	–	–	30.0	–	20.0
5	9	33.3	11.1	11.1	22.2	11.1	–	–	11.1	–	–
6	9	–	22.2	11.1	22.2	22.2	–	11.1	11.1	–	–
7	10	30.0	10.0	10.0	10.0	10.0	20.0	10.0	–	–	–
8	8	25.0	12.5	25.0	–	12.5	–	12.5	–	–	12.5
9	7	42.9	14.3	14.3	14.3	–	–	14.3	–	–	–
10	8	25.0	–	–	–	–	12.5	12.5	–	–	12.5
		Children's Ratings Frequency Percentages									
Handout	n	1	2	3	4	5	6	7	8	9	10
1	10	50.0	10.0	10.0	–	10.0	–	10.0	–	–	10.0
2	10	30.0	30.0	10.0	–	10.0	–	–	–	10.0	10.0
3	10	60.0	–	10.0	10.0	10.0	10.0	–	–	–	–
4	10	40.0	–	–	10.0	10.0	10.0	–	10.0	–	20.0
5	10	50.0	10.0	10.0	–	–	–	10.0	10.0	–	10.0
6	10	40.0	–	–	–	30.0	–	–	–	–	30.0
7	10	50.0	20.0	–	10.0	–	–	–	–	10.0	10.0
8	8	62.5	25.0	12.5	–	–	–	–	–	–	–
9	8	62.5	12.5	–	–	–	–	12.5	–	–	12.5
10	10	60.0	20.0	–	–	–	–	–	–	–	20.0

[a]Weekly handouts were rated on a scale from 1 to 10, 1 = most favorite and 10 = least favorite.

TABLE 17. Utilization of Physical Activity Incentives.[1]

	Frequency n=11	
Physical Activity Incentives[1]	Used	Did not use
Jump Rope	8	3
Bowling Pass	4	7
Roller Skating Pass •	7	4
Swimming Pool Pass	5	6

[1]Incentives were donated by local businesses.

required a child to depend on their parents for transportation to either the roller rink, swimming pool or bowling alley.

Conclusions

Children and parents responded favorably to the special intervention program. Except for anthropometric measurements, no particular aspect of the special intervention program was emphasized by children or parents as being unacceptable. The newly designed weight control program provided classes, activities and handouts that satisfied the preferences and needs of children and parents from a variety of racial and educational backgrounds. This newly designed weight control program featured a normocaloric low fat diet. The program emphasized food evaluation rather than food group deletion or caloric restriction. Children and parents used the program information by evaluating foods selected for purchase at grocery stores and restaurants and for snacks. They also changed methods of food preparation used at home and moderated serving portions of food. Modeling appeared to be more effective for changing food habits than exercise habits. More children in the special intervention group indicated they altered their food habits than their exercise habits which paralleled parental changes. Decreasing the consumption of fried foods and increasing the consumption of fruit occurred more readily than increasing the consumption of vegetables. To help increase a child's level of physical activity, exercises requiring minimal parental involvement should be emphasized.

Children in the special intervention group increased their nutrition knowledge to greater extent and more rapidly than the children in the standard care program. However, the nutrition knowledge gained by the children in the special intervention group appeared to be transient, particularly among boys. Children in both groups gained and retained equivalent amounts of food preparation knowledge. Food selection knowledge of both groups exhibited a similar decrease over the course of the study.

To increase the amount of nutrition, food preparation and food selection knowledge gained and retained by children in a weight control program, a program should last longer than 10 weeks. Children may gain and retain more food behavior knowledge if more time was given between instruction. The effectiveness of the special intervention program could be improved by meeting on a bimonthly basis instead of a weekly basis. A 20 week weight control program would satisfy the children's recommendation that the program should last longer than ten weeks.

Length of each program session could be reduced by including only class activities approved by both children and parents. Class length could be decreased by conducting separate classes for children and parents. Class activities found to be more beneficial to the children could be included in the child's portion of the program, while class activities found to be more useful to the parents could be incorporated in the parents' program section.

This special intervention program which featured a structured low fat diet, regular exercise, behavior modification, family involvement and a "fun" learning environment was appealing and effective for obese preadolescent children from a variety of backgrounds.

IMPLEMENTATION AND EVALUATION OF A WEIGHT CONTROL PROGRAM FOR OBESE PREADOLESCENT CHILDREN

Introduction

Obesity is a common nutritional problem in Western societies, particularly in the United States (Kluthe and Schubert, 1985). American children appear to be more prone to obesity than children from other countries (Ginsberg-Fellner, 1981; Nuutinen, 1991). The prevalence of obesity and superobesity has steadily increased among American children since the 1960's (Gortmaker, 1987). Health consequences experienced by obese children are similar to the health conditions encountered by obese adults. Health risks, particularly poor lipid profiles (Wynder, 1989) and hypertension (Julius, 1990) appear to continue into adulthood along with the obese weight status.

Lack of effective treatment combined with the health implications associated with an increasing prevalence of childhood obesity concern health care professionals. Factors found to influence the success of weight loss treatment for children include family involvement (Epstein, 1990), a structured diet (Epstein, 1990), regular exercise (Amador, 1990; Reybrouck, 1990) and behavior modification (Minderaa and Witt, 1983). Encouraging results have been reported for adult weight loss studies that emphasized a low intake of dietary fat (Schlundt, 1990; Sheppard, 1991; Prewitt, 1991). No weight control treatment available to children incorporates a low fat diet.

The purpose of the study was to design an effective weight control (special intervention) program that incorporated a structured low fat diet, regular exercise, behavior modification, family involvement and a fun learning environment for obese preadolescent children. The program was designed to teach obese preadolescent children methods to reduce their daily fat intake to between 25 and 30% of their total daily caloric intake. Effectiveness of the special intervention program was evaluated by changes in the weight status of program participants after the conclusion of the study and at a three month follow-up.

METHODS

Subjects

Thirty-two preadolescent children were recruited from the Cheyenne, Wyoming area with the assistance of local health care professionals. Health status of each child was evaluated by a member of the medical staff at the University of Wyoming Family Practice Residency Program at Cheyenne for any health problems that would exclude a child from participating in a weight control program. To participate, a child had to be at least seven years of age, be considered prepubertal (Tanner, 1962), weigh 120% or more of their expected weight for height (Hamill, 1979) and have a triceps skinfold measurement greater than or equal to the 85th percentile for their age and sex group (Najjar and Rowland, 1987). Interested participants and their parents were required to come to the University of Wyoming Family Practice Residency Program at Cheyenne Clinic where the study was explained to them and to sign an informed consent form approved by Colorado State University's Human Research Committee and by the University of Wyoming's Institutional Review Board for Human Subjects (Appendix A).

Children completed medical questionnaires with parental assistance. Parents completed questionnaires about their height, weight and educational background (Appendix B).

Treatment Groups

Children were matched by sex, age and relative weight before being randomly assigned to either the special intervention group or standard care group. The standard care group received the care usually provided by the clinic's registered dietitian. Standard care consisted of three half hour consultations with the registered dietitian. Initial consultations involved the documentation of a child's diet history, medical history including growth records, social history and activity patterns. Based on this information, recommendations were made to the child and parent about an appropriate weight for the child and changes needed in the child's diet and activity habits. To assess the child's progress, two follow-up appointments were scheduled 4 and 16 weeks after the initial consultation. Two additional appointments were scheduled 10 and 22 weeks after the initial consultation to obtain matching anthropometric, dietary and activity measurements with children in the special intervention group.

Children assigned to the special intervention group participated in the newly designed ten week weight control program for preadolescent children (Chapter 2). Components of this program included a structured low fat diet, regular unsupervised physical activity, family involvement and behavior modification. No weight control treatment for obese children has incorporated a 25-30% fat calorie diet. Information was presented to the children in a format designed to enhance participation and learning. At least one parent was required to accompany a child to each class. Children were prescribed low fat normocaloric diets. Recommended daily caloric intakes were in agreement with the caloric intakes established by the National Research Council (1989) for preadolescent children. Dietary fat intakes were recommended to contribute between 25 and 30% of the total daily caloric intake. To reduce dietary fat intake and to ensure nutritional adequacy of the prescribed diet, an emphasis was placed on the use of low fat food substitutions and on an increased consumption of grains, fruits and vegetables. Children were encouraged to participate in physical activities that they enjoyed on a daily basis. Children also were encouraged to reduce the amount of TV viewed per day as well as the amount of time using video and computer games. Exercise breaks were incorporated into program sessions. Behavioral management techniques used throughout the program included self-monitoring of food intake, stimulus control, modifications of eating behavior, self-monitoring of physical activity and reinforcement of new behaviors.

Anthropometric Measurements

Height and weight of participants were measured with indoor clothing and without shoes. Waist, abdominal and hip circumferences were measured as previously described (Callaway, 1988). Tricipital, bicipital, suprailiacal and subscapular skinfold thicknesses were measured in triplicate using Lange calipers (Cambridge, MD) as previously described (Harrison, 1988). Blood pressure was measured according to previously described methods (Task Force on Blood Pressure Control in Children, 1987). Anthropometric measurements were obtained from each child at week 0 (initial), week 10 (final) and week 22 (follow-up).

Diet Analysis

Children in each group completed five 3-day diet records with parental assistance. Diet records were completed using a series of two week days and one weekend day (Stuff, 1983). Diet records were completed at week 0 (initial), week 4, week 10 (final), week 16 and week 22 (follow-up). Explicit verbal and written instructions (Appendix B) and examples were given to participants as well as measuring utensils and food patterns to ensure accuracy of the diet records. A registered dietitian reviewed the records with each child/parent group for accuracy and completeness. Nutrient intakes of calories, protein, carbohydrates, fat, iron, zinc, vitamin C, vitamin A, folacin and fiber were determined by a Nutritionist III computer program (N-Squared Computing, Silverton, OR). These nutrients were analyzed because of their importance to growth and to monitor the effects of the special intervention on the nutritional content of the diet. Nutrient densities [(mean nutrient intake/mean caloric intake) x 1000] were calculated to assess changes among food choices (Hansen and Wyse, 1980).

Children in either group completed three previously validated and reliable questionnaires specifically designed to determine their nutrition knowledge (National Dairy Council, 1979), food selection habits (Gilmore, 1985) and food preparation habits (Fanslow, 1982). Questionnaires were completed during the course of the program and at weeks 10 (final) and 22 (follow-up).

Physical Activity Analysis

Children in each group completed five 3-day activity records with parental assistance. Time spent per day in each of the five activity categories: resting, very light, light, moderate and heavy activity was recorded by each child to the nearest half hour (National Research Council, 1989). Explicit verbal and written instructions were given to each child/parent group to ensure accuracy and completeness. Activity records were completed for the same days and at the same time intervals as the diet records. Activity records were reviewed with each child/parent group for accuracy and completeness.

Program Evaluations

Using separate questionnaires, children and parents evaluated their group for enjoyment, benefit and knowledge. Children and parents also identified changes in their food and physical activity habits. Evaluations were obtained from children and parents at week 10 (final) and week 22 (follow-up). Children and parents in the special intervention group also completed weekly evaluations.

Statistical Analysis

Descriptive statistics were computed by assigned group and gender. Plots were constructed to examine the data for outliers and possible gross departure from normality (Appendix D).

Assignment to the original two treatment groups was at random within matched pairs by gender, age and relative weight. However attrition among participants of the study resulted in the loss of one member of nearly every original pair. Thus, for analysis, assignment of individuals to the two treatment groups was considered to be completely at random. The repeated measurement of the same individual over time was accounted for by performing separate two way analysis of variance (treatment and gender) on the difference of each study response for each individual at pairs of time points of interest. Time points of interest for anthropometric measurements included weeks 0, 10 and 22. Time points of interest for dietary and activity measurements included weeks 0, 4, 10, 16 and 22. For instance, the difference in the relative weights between 22 (follow-up) and week 0 (baseline) for each individual available at follow-up was analyzed in a two way analysis of variance. Anthropometric, dietary and activity data of study participants with complete anthropometric measurements for weeks, 10 and 22 were used in the final analysis. Eleven children in each group had complete anthropometric measurements at the end of the study. However, the follow-up measurements of one preadolescent male in the standard care group were removed before analysis. Due to illness and scheduling conflicts arising from sports practice, the anthropometric, dietary and activity measurements were delayed by one month. Thus, the maximum number of anthropometric, dietary and activity data sets available for final analysis were 11 for the special intervention group and 10 for the standard care group. The following analysis of variance was used, where n_i represents the number of individuals available at week 10 or 22 in the ith of the four treatment by gender groups (i=1,2,3 and 4) and $n. = \sum_{i=1}^{4} n_i.$:

Source of Variation	df
Model	3
treatment (t)	1
gender (g)	1
treatment x gender	1
Error	n.-4
Total	n.-1

Relationships between differences in responses for specific pairs of time points were studied by the use of regression techniques. Pearson product-moment correlation coefficients were calculated for each dependent-independent variable pair. Dependent variables were relative weight and BMI. Independent variables were total calories, grams of fat, activity factors and percentage of calories from fat. The relationships between the differences in either of the dependent variables and the differences in either grams of fat or percentage of calories from fat was tested by $Ho: r \leq 0$ versus $Ha: r > 0$. The relationships between the differences in either dependent variables and the differences in either total calories or activity factors were tested by $Ho: r = 0$ versus $Ha: r \neq 0$. Multiple regression analysis was used to describe the extent, direction and strength of the relationship between the previously identified independent variables and either of the previously identified dependent variables. A significance level of 0.05 was used for all tests of significance. All analyses were performed by using the Statistical Analysis Systems package (SAS Institute, Inc, Cary, NC).

Results

Sixteen children were enrolled in a group at the start of the study. Eleven children remained in each group until the end of the study at week 22. Attrition was due to family illness (1), lack of interest for weight control on the part of the child (6) or conflict with parent's schedule (3). The latter reason was given for two participants in the standard care group even though the counseling sessions were scheduled at the convenience of participants and their families. Not every child or parent completed all forms or all questions on a form. Results of the food behavior questionnaires, evaluations and the utilization of activity incentives are discussed elsewhere (Chapter 2).

Demographic Data of Children and Parents

Each group consisted of 16 children. The special intervention group contained seven boys and nine girls, while the standard care group contained an equal number of boys and girls. Initial anthropometric measurements were similar between and within the two groups (Table 4). Both groups contained Caucasian, Black and Hispanic children.

Mothers in the special intervention group were heavier than the mothers in the standard care group, while the fathers in either group had similar heights and weights. Mean BMI values of fathers in both groups and mothers in the standard care group were above the BMI level associated with the lowest mortality risk (Garfinkel, 1979). The mean BMI value of mothers in the special intervention group was above 30 kg/m^2, the value used to define obesity in adults (Bray, 1978). Since the weight status of family members tend to aggregate (Garn and Clark, 1976; Garn, 1981: Price, 1990; Unger, 1990), it was not unexpected that the children recruited for the study would have overweight or obese parents.

Parents in the special intervention group tended to be less educated than the parents in the standard care group. More mothers in the special intervention group had not completed high school, while every mother in the standard care group had completed high school. More mothers in standard care group had attended and/or obtained a college degree compared to mothers in the special intervention group. Approximately 25% of the fathers in the special intervention group had not completed high school with two of the fathers obtaining less than an eighth grade education. A similar proportion of fathers in both groups had completed high school, while more fathers in the standard care group had attended or completed college than fathers in the special intervention group.

Only one family in the special intervention group and three families in the standard care group indicated a family medical history free of any chronic diseases (Table 5). Family medical histories of the reminding families in either intervention group included heart disease, hypertension, diabetes mellitus, cancer or a combination of these diseases. Medical histories of the children in either group were not exceptional. One child in the special intervention group was being treated for asthma. As discussed by Unger (1990), the development and maintenance of obesity may be associated with asthma through an affect on a child's exercise capacity.

Six children in the special intervention group and five children in the standard care group experienced a recent change in weight prior to the start of the study (Table 18). Changes in weight varied from one to five pound weight loss to 21-25 pound weight gain. Two children in each group indicated they had experienced a recent weight change but did not identify the direction or amount. However, the majority of children in both groups may not have been aware of any recent weight changes. Eleven children in each group were referred to the study by their school nurse. This number corresponds to the number of children reporting no recent weight change in either group. Five children in either group were referred to the study by local physicians

TABLE 18. Self-Reported Weight Changes of Children That Occurred Six Months Before Intervention.

Weight Change	Response Frequency Special Intervention Group (n=16)	 Standard Care Group (n=16)
No change in weight, lbs.	10	11
Decrease in weight, lbs.		
1-5	1	2
Increase in weight, lbs.		
1-5	1	0
6-10	1	0
16-20	0	1
21-25	1	0
Unidentified amount of weight change	2	2

which corresponds to the number of children reporting a recent change in weight.

Only one child in the special intervention group had previously attempted weight loss. This child had enrolled in a school-based weight loss program two years prior to the onset of this study. All other children indicated that they had not attempted weight loss prior to this study.

Food dislikes of children in either group included the usual food dislikes of childhood such as vegetables and liver. The majority of children in either group enjoyed "all" foods. Foods highlighted by children in both groups included pizza, tacos and ice cream. The majority of the children in both groups had not experienced any recent changes in appetite, food preparation habits or food purchasing habits.

The physical activity of three children in the special intervention group was limited by an asthma condition (1) and size (2). All other children were free of any conditions or physical handicaps that would interfere with physically activity.

As a group, children who completed the special intervention program were slightly less physically active [7.8 $\pm$ 1.4 (SEM) hours per week] than children who initially were assigned to the special intervention group (9.2 $\pm$ 2.7 hours per week), but watched similar amounts of television per week (25.0 $\pm$ 3.6 hours and 25.2 $\pm$ 3.2 hours, respectively, Table 19). Type of physical activities included "other" activities such as tag and tetherball, bicycling, walking and team sports. Children who completed standard care also were slightly less physically active (11.1 ± 3.2 hours per week) than children who initially were assigned to standard care (15.8 ± 3.5 hours per week), but watched similar amounts of television per week (29.1 ±3.9 and 28.6 ± 4.2 hours, respectively). Type of physical activities included walking, bicycling and team sports.

Anthropometric Data

At the start of the study, children in the special intervention group demonstrated a mean relative weight of 1.46 ± 0.08, while children in the standard care group exhibited a mean relative weight of 1.43 ± 0.06 (Table 20). Relative weights of children in the standard care group were significantly lower (P=.0004) at week 10 (1.34 ± 0.06) than at the start of the study (Table 20a). Relative weights of children in the standard care group remained significantly lower (P=0.0251) at week 22 (1.34 ± 0.05) than at the start of the study. No significant differences were observed between the relative weights of children in the standard care group at weeks 10 and 22 or between the relative weights of children in the special intervention group with any time point pair.

Similar patterns were observed among the BMI values of the two groups. BMI values of children in the standard care

TABLE 19. Average Weekly Amount and Type of Physical Activity.[*]

Activity	Hours Per Week: Special Intervention Group (n=16)[**]	Special Intervention Group (n=11)[***]	Standard Care Group (n=16)[**]	Standard Care Group (n=10)[***]
Walking	2.2 ± 0.6	1.4 ± 0.7	7.6 ± 3.2	8.3 ± 4.9
Jogging	0.2 ± 0.2	0.2 ± 0.2	0.9 ± 0.5	0.6 ± 0.5
Swimming	0.2 ± 0.2	0.3 ± 0.3	0.3 ± 0.2	0.5 ± 0.3
Bicycling	2.2 ± 0.1	2.4 ± 0.7	3.4 ± 1.0	2.0 ± 0.5
Team Sports	1.5 ± 0.6	1.9 ± 0.9	2.9 ± 0.9	2.5 ± 0.9
Other	2.9 ± 1.3	1.7 ± 1.0	0.9 ± 0.6	1.4 ± 1.0
Total/wk	9.2 ± 2.7	7.8 ± 1.4	15.8 ± 3.5	11.1 ± 3.2
T.V., hr/d	3.6 ± 0.5	3.6 ± 0.5	3.9 ± 0.6	4.0 ± 0.5
T.V., hr/wk	25.2 ± 3.2	25.0 ± 3.6	28.6 ± 4.2	29.1 ± 3.9

[*]Mean ±SEM
[**]Initial average weekly amount and type of physical activity for total sample by intervention strategy.
[***]Initial average weekly amount and type of physical activity for sample with complete anthropometric data by intervention strategy.

TABLE 20. Children's Initial, Final and Follow-up Anthropometric Measurements.[†]

	Special Intervention Group (n=11) Week			Standard Care Group (n=10) Week		
	0	10	22	0	10	22
Relative Weight	1.46 (0.08)	1.45 (0.08)	1.42 (0.08)	1.43 (0.06)	1.34[a] (0.06)	1.34[b] (0.05)
BMI	27.8 (1.4)	28.1 (1.5)	28.1 (1.5)	27.0 (1.0)	25.9[a] (1.0)	26.4[c] (1.0)
Sum of four skinfolds[‡]	117.9 (9.8)	119.6 (10.8)	114.6 (9.4)	127.3 (8.1)	125.3 (8.1)	122.2 (8.4)
Blood Pressure						
Systolic	110.4 (3.1)	108.3 (3.5)	111.3 (2.5)	111.8 (3.5)	106.5 (3.8)	105.7[b] (2.7)
Diastolic	76.5 (2.4)	74.9 (3.0)	75.2 (2.0)	78.0 (2.4)	73.7 (2.2)	72.3 (2.4)

[†]Mean (±SEM).
[‡]Tricipital, bicipital, suprailiacal and subscapular skinfold measurements were used to calculate the sum of skinfolds (mm).
[a]Significantly different from week 0, $P \leq 0.001$.
[b]Significantly different from week 0, $P \leq 0.05$.
[c]Significantly different from week 0, $P \leq 0.01$.

TABLE 20a. Least Squares Means of Differences of Children's Anthropometric Measurements.

Measurement	Trt[†]	Sex[††]	Wk0-Wk10[‡]	P>[t]	Wk10-Wk22[‡]	P>[t]	Wk0-Wk22[‡]	P>[t]
Relative weight	1	1	0.00500000 (0.02116156)	0.8160	0.02500000 (0.02386169)	0.3094	0.03000000 (0.02623557)	0.2687
	1	2	0.01285714 (0.01599664)	0.4326	0.02285714 (0.01803774)	0.2222	0.03571429 (0.01983223)	0.0895
	2	1	0.11750000 (0.02116156)	0.0001	-0.00250000 (0.02386169)	0.9178	0.11500000 (0.02623557)	0.0004
	2	2	0.06666667 (0.01727834)	0.0013	0.00000000 (0.01948299)	1.0000	0.06666667 (0.02142126)	0.0063
BMI	1	1	-0.52500000 (0.41284734)	0.2206	-0.05000000 (0.43172509)	0.9092	-0.57500000 (0.42083559)	0.1896
	1	2	-0.22857143 (0.31208326)	0.4739	0.07142857 (0.32635349)	0.8294	-0.15714286 (0.31812180)	0.6276
	2	1	1.70000000 (0.41284734)	0.0007	-0.65000000 (0.43172509)	0.1505	1.05000000 (0.42083559)	0.0232
	2	2	0.71666667 (0.33708844)	0.0484	-0.30000000 (0.35250206)	0.4066	0.41666667 (0.34361082)	0.2419
Sum of skinfolds	1	1	-2.43333333 (3.16785144)	0.4536	4.70000000 (2.36245801)	0.0640	2.26666667 (3.46638513)	0.5225
	1	2	-1.31428571 (2.07384557)	0.5352	5.05714286 (1.54659181)	0.0048	3.74285714 (2.26928175)	0.1186
	2	1	5.45000000 (2.74343982)	0.0644	4.22500000 (2.04594865)	0.0555	9.67500000 (3.00197758)	0.0053
	2	2	-0.31666667 (2.24000923)	0.8893	2.33333333 (1.67051008)	0.1816	2.01666667 (2.45110443)	0.4227

Measurement	Trt[†]	Sex[††]	Wk0-Wk10[‡]	P>[t]	Wk10-Wk22[‡]	P>[t]	Wk0-Wk22[‡]	P>[t]
Systolic blood pressure	1	1	5.75000000 (4.83375590)	0.2506	-6.75000000 (4.27877882)	0.1331	-1.00000000 (3.69739006)	0.7901
	1	2	0.00000000 (3.65397600)	1.0000	-0.85714286 (3.23445276)	0.7942	-0.85714286 (2.79496417)	0.7628
	2	1	3.75000000 (4.83375590)	0.4485	4.00000000 (4.2787882)	0.3630	7.75000000 (3.69739006)	0.0513
	2	2	6.33333333 (3.94674516)	0.1270	-1.33333333 (3.49360828)	0.7074	5.00000000 (3.01890634)	0.1160
Diastolic blood	1	1	3.50000000 (3.05235593)	0.2674	-3.25000000 (3.37333318)	0.3488	0.25000000 (3.55127014)	0.9447
	1	2	0.57142857 (2.30736420)	0.8074	1.42857143 (2.55000020)	0.5826	2.00000000 (2.68450789)	0.4664
	2	1	2.00000000 (3.05235593)	0.5211	0.00000000 (3.37333318)	1.0000	2.00000000 (3.55127014)	0.5807
	2	2	5.83333333 (2.49223818)	0.0317	2.33333333 (2.75431501)	0.4087	8.16666667 (2.89959993)	0.0119

‡ Least Squares Mean Difference (±SEM).
† Trt: 1 = Special Intervention Group with maximum n=11; 2 = Standard Care Group with maximum n=10; n varies at each time point.
†† Sex: 1 = Boys with maximum n=8; 2 = Girls with maximum n=13; n varies at each time point.

group were significantly lower (P=0.0005) at week 10 (25.9 ± 1.0 kg/m^2) than at the start of the study (27.0 ± 1.0 kg/m^2). BMI values of children in this group continued to be significantly lower (P=0.0099) at week 22 (26.4 ± 1.0 kg/m^2) than at the start of the study. No significant differences were observed between the BMI values of children in the standard care group at weeks 10 and 22 or between the BMI values of children in the special intervention group at any time point pair.

Systolic blood pressures of children in the standard care group were significantly lower (P=0.0423) at week 22 (105.7 ± 2.7 mm Hg) than at the start of the study (111.8 ± 3.5 mm Hg). No significant differences were found among diastolic blood pressure levels or sums of four skinfold measurements between the two groups.

<u>Nutrient Analysis</u>

No significant differences were found among nutrient intakes by group (Table 21). Percentage of calories from fat was found to significantly different (P=0.0257) at week 4 than at week 0 among boys (Tables 22 and 22a). No other significant differences were found among nutrient intakes by gender.

Nutrient densities for protein, dietary fiber, calcium, iron, zinc and vitamin A were greater at weeks 10 and 22 than at baseline among children in the special intervention group (Table 23). Nutrient density for dietary fat was

TABLE 21. Daily Nutrient Intake Analysis of Children by Intervention Strategy.[a]

	Special Intervention Group					Standard Care Group				
	Week					Week				
	0	4	10	16	22	0	4	10	16	22
Calories, Kcal	2254 (218)	2006 (186)	1668 (144)	1478 (227)	1638 (110)	1879 (94)	1365 (150)	1645 (88)	1490 (124)	1338 (124)
Protein, g	66.7 (5.3)	69.4 (3.4)	65.4 (6.3)	62.6 (10.6)	65.6 (5.3)	64.0 (6.4)	54.3 (6.5)	68.6 (3.3)	70.5 (7.7)	58.7 (6.0)
Carbohydrate, g	273 (30)	226 (20)	180 (11)	196 (32)	199 (14)	224 (11)	173 (21)	204 (17)	177 (18)	173 (16)
Simple Sugar, g	71.8 (12.8)	59.8 (7.2)	49.0 (5.5)	60.1 (11.8)	50.6 (4.9)	61.7 (8.8)	56.1 (10.7)	60.1 (9.9)	60.6 (9.3)	52.8 (7.9)
Dietary Fiber, g	9.9 (1.5)	9.8 (1.3)	9.0 (1.2)	10.1 (1.5)	11.0 (1.5)	7.7 (0.6)	8.0 (1.2)	10.7 (1.2)	9.8 (1.3)	9.9 (1.4)
Fat, g	83.1 (9.0)	75.4 (6.0)	61.8 (8.9)	48.4 (8.5)	62.6 (6.0)	70.7 (8.9)	45.6 (5.6)	64.0 (7.9)	50.7 (5.6)	45.1 (4.9)
Cholesterol, mg	232 (28)	222 (22)	204 (53)	156 (26)	184 (20)	223 (22)	147 (22)	188 (27)	187 (21)	165 (31)
Calcium, mg	808 (102)	828 (96)	673 (101)	821 (188)	853 (102)	741 (90)	742 (114)	846 (83)	776 (98)	789 (118)
Iron, mg	13.9 (1.9)	13.1 (1.5)	10.6 (0.8)	10.0 (1.5)	11.8 (1.5)	12.4 (1.2)	10.5 (1.7)	13.8 (1.7)	10.3 (0.9)	9.6 (1.0)
Zinc, mg	8.1 (0.8)	9.7 (1.1)	7.3 (1.0)	11.2 (1.8)	7.6 (0.6)	7.1 (0.9)	7.2 (0.7)	9.6 (0.7)	8.1 (0.9)	7.1 (1.0)

	Special Intervention Group					Standard Care Group				
	Week					Week				
	0	4	10	16	22	0	4	10	16	22
Vitamin C, mg	84.0 (14.5)	103.2 (16.8)	74.3 (10.3)	67.8 (14.4)	55.5 (9.6)	70.6 (10.1)	71.3 (11.3)	76.3 (19.5)	60.6 (12.4)	66.6 (18.4)
Vitamin A, RE	866 (239)	943 (213)	724 (121)	848 (90)	1387 (375)	909 (149)	919 (171)	1650 (499)	798 (108)	1069 (300)
Folacin, μg	213 (50)	218 (28)	129 (13)	216 (22)	153 (27)	140 (11)	145 (24)	185 (24)	171 (22)	153 (30)
Protein, %Kcal	13.1 (0.8)	15.0 (0.8)	17.0 (1.3)	17.8 (2.2)	16.2 (0.7)	13.9 (1.1)	16.3 (0.4)	16.7 (0.8)	19.7 (1.5)	17.5 (0.9)
Carbohydrate, %Kcal	52.0 (2.2)	48.5 (1.3)	47.8 (2.2)	53.2 (2.6)	49.3 (1.6)	50.1 (2.3)	52.7 (1.7)	49.2 (3.2)	48.8 (2.4)	51.8 (1.8)
Fat, %Kcal	35.1 (1.7)	36.5 (1.1)	35.2 (2.4)	29.0 (1.7)	34.5 (1.7)	36.0 (1.8)	31.0 (1.7)	34.1 (2.9)	31.5 (2.3)	30.7 (1.7)
Polyunsaturated fat: saturated fat ratio	0.522 (0.062)	0.402 (0.090)	0.476 (0.038)	0.380 (0.059)	0.399 (0.097)	0.465 (0.088)	0.349 (0.037)	0.399 (0.052)	0.498 (0.056)	0.340 (0.039)
Keys' score†	66.8 (4.9)	75.3 (7.9)	57.6 (7.8)	53.1 (7.5)	64.9 (7.5)	69.4 (5.8)	53.2 (6.2)	69.6 (9.0)	49.9 (4.4)	53.5 (5.7)
CSI††	37.6 (3.1)	38.6 (3.5)	30.8 (5.7)	24.9 (4.2)	31.1 (3.3)	35.8 (3.3)	24.7 (3.3)	34.1 (4.5)	25.3 (2.2)	24.7 (3.3)

¶Mean (± SEM) of children with complete anthropometric data; n varies at each time point with maximum n=11 for special intervention group and maximum n=10 for standard care.

†The Keys' score was calculated as

$$1.35[(2 \times g, \text{saturated fat}) - g, \text{polyunsaturated fat}] + 1.5\sqrt{(1000 \times mg, \text{cholesterol}/kCal}.$$

††The CSI was calculated as

$$(1.01 \times g, \text{saturated fat}) + (0.05 \times mg, \text{cholesterol}).$$

TABLE 22. Daily Nutrient Intake Analysis of Children by Gender.[a]

	Boys Week					Girls Week				
	0	4	10	16	22	0	4	10	16	22
Calories, kCal	1930 (258)	1701 (284)	1701 (149)	1347 (218)	1420 (124)	2130 (124)	1703 (157)	1629 (100)	1542 (121)	1541 (120)
Protein, g	67.5 (9.3)	59.6 (8.1)	68.2 (7.5)	55.4 (6.1)	55.8 (5.6)	64.0 (4.0)	63.7 (4.2)	66.2 (3.4)	73.4 (7.8)	66.3 (5.2)
Carbohydrate, g	201 (20)	203 (30)	184 (11)	145 (24)	172 (14)	274 (18)	200 (18)	197 (16)	197 (17)	196 (15)
Simple sugar, g	58.6 (10.9)	62.6 (12.8)	54.2 (9.2)	50.4 (14.6)	48.6 (8.6)	71.1 (10.1)	55.4 (6.7)	54.7 (7.5)	64.5 (8.4)	54.1 (5.1)
Dietary fiber, g	6.7 (0.7)	8.0 (1.3)	10.6 (1.1)	8.4 (1.4)	11.0 (1.4)	9.9 (1.1)	9.5 (1.2)	9.4 (1.2)	10.5 (1.3)	10.1 (1.4)
Fat, g	75.5 (11.5)	55.4 (9.3)	70.0 (10.9)	50.2 (12.3)	54.5 (7.9)	77.2 (7.9)	64.7 (6.6)	58.2 (7.1)	50.0 (4.5)	54.1 (5.3)
Cholesterol, mg	264 (34)	190 (31)	219 (69)	127 (17)	167 (34)	207 (17)	184 (21)	182 (22)	199 (19)	180 (21)
Calcium, mg	670 (66)	559 (79)	803 (140)	633 (187)	661 (112)	832 (95)	920 (85)	732 (69)	851 (91)	921 (93)
Iron, mg	11.0 (1.8)	11.8 (2.5)	11.3 (0.9)	7.8 (1.0)	9.5 (1.0)	14.4 (1.3)	11.9 (1.2)	12.8 (1.6)	11.1 (0.8)	11.5 (1.3)
Zinc, mg	8.3 (1.2)	8.6 (1.4)	9.3 (1.4)	6.9 (1.8)	6.3 (1.0)	7.2 (0.6)	8.6 (0.8)	7.9 (0.6)	9.9 (0.9)	8.0 (0.6)
Vitamin C, mg	73.6 (12.2)	86.7 (22.6)	68.9 (13.3)	66.2 (27.7)	76.4 (22.5)	78.9 (11.9)	88.9 (11.7)	79.4 (15.7)	61.3 (8.9)	51.2 (7.9)

	Boys Week 0	4	10	16	22	Girls Week 0	4	10	16	22
Vitamin A, RE	679 (179)	748 (225)	862 (172)	662 (184)	1741 (571)	1011 (177)	1038 (168)	1394 (431)	872 (83)	925 (127)
Folacin, mg	145 (8)	160 (32)	147 (20)	121 (34)	148 (31)	192 (39)	197 (26)	164 (21)	209 (14)	155 (26)
Protein, %kCal	15.3 (1.2)	15.4 (0.4)	16.6 (1.1)	18.3 (1.3)	15.9 (0.7)	12.4 (0.6)	15.9 (0.7)	17.2 (1.1)	19.4 (1.6)	17.5 (0.8)
Carbohydrate, %kCal	47.0 (2.3)	52.8 (2.4)	45.8 (2.4)	47.0 (4.5)	49.5 (2.5)	53.3 (1.9)	48.9 (1.1)	50.1 (2.6)	51.3 (2.0)	51.0 (1.3)
Fat, %kCal	37.7 (2.0)	31.8[a] (2.6)	37.6 (2.1)	34.5 (4.4)	34.5 (2.1)	34.3 (1.5)	35.2 (1.0)	32.7 (2.6)	29.3 (1.5)	31.5 (1.6)
Polyunsaturated fat: saturated fat ratio	0.405 (0.076)	0.399 (0.119)	0.405 (0.066)	0.493 (0.094)	0.494 (0.123)	0.543 (0.071)	0.364 (0.040)	0.458 (0.035)	0.453 (0.053)	0.295 (0.031)
Keys' Score[†]	73.3 (7.0)	57.4 (7.2)	75.0 (10.2)	49.2 (8.9)	55.5 (9.9)	65.3 (4.3)	69.1 (7.8)	56.4 (6.7)	51.5 (4.1)	61.9 (5.2)
CSI[††]	39.0 (4.3)	28.9 (4.0)	38.4 (6.7)	22.7 (4.5)	26.5 (4.3)	35.3 (2.5)	33.9 (3.9)	28.7 (3.8)	26.2 (2.1)	29.0 (2.9)

[*]Mean (± SEM) of children with complete anthropometric data; n varies at each time point with a maximum n=11 for special intervention group and maximum n=10 for standard care group.

[†]The Keys' Score was calculated as

$$1.35\,[(2 \times g, \text{ saturated fat}) - g, \text{ polyunsaturated fat}] + 1.5\sqrt{(1000 \times mg, \text{ cholesterol}, kCal}.$$

[††]The CSI was calculated as

$$(1.01 \times g, \text{ saturated fat}) + (0.05 \times mg, \text{ cholesterol}).$$

[a]Significantly different from week 0, $P \leq 0.05$.

TABLE 22a. Least Squares Mean of Difference of Percent of Calories from Fat.

Percent of Calories from Fat				
Trt[†]	Sex[††]	Wk0-Wk4[‡]	SEM	P>[t]
1	1	5.50000000	3.77941455	0.1693
1	2	-2.66666667	2.18204601	0.2434
2	1	9.25000000	2.67244966	0.0042
2	2	3.20000000	2.39031164	0.2036

[‡] Least Squares Mean of Difference.

[†] Trt: 1 = Special Intervention Group with maximum n=11; 2 = Standard Care Group with maximum n=10; n varies at each time point.

[††] Sex: 1 = Boys with maximum n=8; 2 = Girls with maximum n=13; n varies at each time point.

TABLE 23. Nutrient Densities[*] of Children's Diets by Intervention Strategy.[†]

	Special Intervention Group					Standard Care Group				
	Week					Week				
	0	4	10	16	22	0	4	10	16	22
Protein, g	30.5 (1.6)	36.5 (2.6)	40.5 (3.6)	43.8 (5.9)	40.3 (2.0)	33.8 (2.9)	39.7 (1.7)	42.2 (2.0)	47.8 (3.5)	44.1 (2.1)
Carbohydrate, g	122.8 (8.6)	113.6 (3.5)	110.5 (5.5)	132.8 (4.5)	121.9 (3.9)	120.9 (6.4)	127.8 (5.0)	124.9 (8.2)	118.1 (6.0)	129.6 (4.8)
Simple sugar, g	34.5 (7.1)	31.4 (3.8)	29.9 (2.8)	41.4 (5.7)	32.0 (3.1)	32.8 (4.2)	45.1 (9.3)	36.9 (6.4)	39.7 (4.6)	38.3 (4.5)
Dietary fiber, g	4.7 (0.9)	5.1 (0.7)	5.6 (0.6)	7.3 (1.2)	6.9 (0.9)	4.1 (0.3)	6.1 (0.8)	6.7 (0.8)	6.7 (0.8)	7.4 (0.8)
Fat, g	36.9 (1.9)	38.9 (2.5)	36.6 (3.3)	32.3 (1.9)	38.0 (2.0)	36.6 (3.4)	33.4 (2.2)	38.4 (3.3)	34.7 (3.2)	33.9 (1.9)
Cholesterol, mg	117.6 (26.1)	114.6 (13.3)	119.7 (23.0)	108.1 (12.6)	112.7 (11.4)	118.5 (9.6)	105.8 (6.7)	111.8 (11.9)	133.0 (17.3)	130.9 (29.0)
Calcium, mg	383.1 (49.0)	454.1 (84.1)	412.0 (57.1)	527.4 (61.5)	514.2 (48.5)	397.1 (40.9)	573.3 (78.6)	526.9 (53.1)	512.8 (53.4)	583.3 (67.5)
Iron, mg	6.7 (1.2)	6.7 (0.6)	6.8 (0.9)	6.9 (0.6)	7.3 (0.8)	6.7 (0.7)	7.6 (0.9)	8.4 (0.8)	7.1 (0.6)	7.2 (0.4)
Zinc, mg	3.8 (0.5)	5.0 (0.5)	4.5 (0.6)	8.3 (1.9)	4.8 (0.6)	3.8 (0.4)	5.5 (0.5)	5.9 (0.4)	5.6 (0.6)	5.2 (0.5)

	Special Intervention Group					Standard Care Group				
	Week					Week				
	0	4	10	16	22	0	4	10	16	22
Vitamin C, mg	40.5 (9.1)	52.6 (9.3)	45.2 (5.8)	55.4 (22.8)	37.1 (8.3)	37.0 (4.6)	54.8 (7.8)	47.1 (12.5)	38.1 (6.3)	48.6 (12.4)
Vitamin A, RE	430.3 (127.8)	523.5 (140.6)	469.7 (92.1)	615.6 (99.4)	893.7 (269.2)	487.0 (76.0)	906.5 (330.0)	1028.7 (314.0)	539.5 (61.7)	797.8 (222.4)
Folacin, µg	112.9 (34.7)	111.4 (12.3)	77.7 (4.5)	168.7 (51.1)	100.3 (20.4)	75.6 (6.4)	112.0 (15.9)	119.8 (20.6)	112.8 (13.3)	113.9 (21.0)

‡Nutrient density was calculated as [(mean nutrient intake/mean caloric intake) X 1000] (Hansen and Wyse, 1980).
†Mean (±SEM) of children with complete anthropometric data; n varies at each time point with maximum n=11 for special intervention group and n=10 for standard care group.

similar at weeks 0 and 10 before increasing at follow-up. Nutrient densities for carbohydrate, simple sugars and folacin declined at weeks 10 and 22 compared to baseline. Nutrient densities for vitamin C and cholesterol increased at week ten compared to baseline before decreasing at follow-up.

Nutrient densities for protein, carbohydrate, simple sugars, dietary fiber, calcium, iron, zinc, vitamins A and C and folacin were greater at weeks 10 and 22 than at baseline among children in the standard care group. Nutrient density for fat increased at week 10 compared to baseline before decreasing at follow-up. Nutrient density for cholesterol decreased at week 10 compared to baseline before increasing at follow-up.

Among boys and girls, nutrient densities for protein, dietary fiber, iron, vitamin A and folacin increased at weeks 10 and 22 compared to week 0 (Table 24). Nutrient densities for dietary fat among boys and girls initially increased at week 10 before decreasing at week 22 compared to baseline. Among boys, nutrient densities for cholesterol were lower at weeks 10 and 22 than at week 0, while among girls, nutrient densities for cholesterol were greater at weeks 10 and 22 compared to baseline. Nutrient densities for carbohydrate were greater at weeks 10 and 22 compared to baseline among boys; whereas, among girls, nutrient densities for carbohydrate were lower at weeks 10

TABLE 24. Nutrient Densities[‡] of Children's Diets by Gender.[†]

	Boys					Girls				
	Week					Week				
	0	4	10	16	22	0	4	10	16	22
Protein, g	35.8 (3.8)	36.8 (2.2)	40.6 (3.3)	42.9 (4.2)	39.4 (1.7)	30.2 (1.3)	38.8 (2.2)	41.9 (2.6)	48.2 (3.8)	43.8 (2.0)
Carbohydrate, g	108.0 (7.1)	124.4 (7.4)	111.1 (7.1)	108.6 (6.4)	122.0 (5.9)	130.0 (6.0)	118.0 (3.2)	121.9 (7.0)	127.8 (5.4)	127.7 (3.5)
Simple sugar, g	33.1 (5.6)	45.4 (12.2)	32.6 (6.1)	36.9 (8.1)	35.8 (6.3)	33.9 (5.4)	33.5 (3.4)	34.0 (4.5)	41.6 (4.0)	34.4 (2.4)
Dietary fiber, g	3.7 (0.4)	5.2 (0.8)	6.3 (0.6)	6.2 (0.4)	8.0 (1.0)	4.8 (0.7)	5.8 (0.7)	5.9 (0.8)	7.0 (0.9)	6.6 (0.8)
Fat, g	39.2 (3.0)	33.7 (3.8)	40.9 (3.2)	37.9 (7.3)	37.9 (2.6)	35.3 (2.6)	37.8 (1.6)	35.4 (3.1)	32.4 (1.7)	34.9 (1.7)
Cholesterol, mg	148.9 (29.3)	113.8 (10.9)	120.8 (28.6)	103.9 (22.1)	130.0 (37.6)	100.1 (9.1)	108.4 (10.4)	112.6 (11.3)	134.7 (15.7)	116.1 (8.7)
Calcium, mg	384.0 (51.7)	388.2 (79.5)	489.0 (84.8)	442.6 (105.0)	452.0 (54.1)	494.2 (40.1)	581.9 (73.7)	456.9 (41.5)	546.9 (39.2)	605.7 (51.4)
Iron, mg	6.1 (1.1)	6.8 (0.7)	6.8 (0.6)	6.0 (0.5)	6.6 (0.4)	7.0 (0.8)	7.3 (0.8)	8.1 (0.9)	7.4 (0.5)	7.6 (0.7)
Zinc, mg	4.4 (0.5)	5.5 (0.7)	5.5 (0.7)	4.9 (1.0)	4.3 (0.5)	3.5 (0.4)	5.2 (0.3)	5.0 (0.4)	6.9 (0.9)	5.4 (0.5)

	Boys					Girls				
	Week					Week				
	0	4	10	16	22	0	4	10	16	22
Vitamin C, mg	38.3 (3.8)	53.5 (11.1)	40.1 (7.3)	43.4 (14.2)	56.1 (15.8)	38.9 (7.5)	53.7 (7.3)	50.0 (10.0)	42.9 (9.6)	34.2 (6.1)
Vitamin A, RE	385.6 (103.2)	797.2 (449.6)	550.8 (135.0)	487.5 (102.9)	1245.0 (414.1)	503.6 (95.4)	651.1 (114.5)	875.4 (268.0)	591.7 (59.6)	603.7 (73.1)
Folacin, µg	89.0 (19.5)	102.6 (16.4)	93.7 (22.3)	82.5 (15.8)	105.8 (20.8)	95.7 (24.7)	117.0 (12.2)	101.9 (13.1)	146.9 (21.5)	107.4 (20.0)

*Nutrient Density was calculated as [(mean nutrient intake/mean caloric intake) X 1000] (Hansen and Wyse, 1980).

†Mean (±SEM) of children with complete anthropometric data; n varies at each time point with maximum n=11 for special intervention group and n=10 for standard care group.

and 22 than at baseline. Among boys, nutrient density for simple sugars initially decreased at week 10 compared to week 0 before increasing at follow-up. Among girls, nutrient densities for simple sugars were higher at weeks 10 and 22 than at baseline. Nutrient densities for calcium and vitamin C among boys were greater at weeks 10 and 22 compared to baseline. Nutrient density for calcium among girls initially decreased at week 10 before increasing at week 22 compared to baseline. Initially, the nutrient density for vitamin C increased at week 10 compared to week 0 before decreasing at follow-up. Boys' nutrient density for zinc initially increased at week 10 compared to baseline before decreasing at follow-up, while nutrient densities for zinc among girls were greater at weeks 10 and 22 compared to baseline.

Children in both groups, regardless of week, were consuming diets containing fewer calories per kilogram of body weight than recommended by the National Research Council (1989) for their age and sex (Table 25). At weeks 10 and 22, caloric intakes of children in the special intervention group decreased by 586 and 616 calories, respectively compared to week 0 (Table 21). Caloric intakes of children in the standard care group also were lower at weeks 10 and 22 compared to baseline. Heights of children in both groups increased during the study, despite the decreased total caloric intake.

TABLE 25. Changes in Weight and Height in Relation to Caloric Content of Children's Diets by Intervention Strategy.[a]

	Special Intervention Group			Standard Care Group		
		Week			Week	
	0	0	22	0	10	22
Calories, Kcal	2254 (218)	1668 (145)	1638 (110)	1879 (94)	1645 (87)	1338 (124)
Weight, kg	58.4 (3.7)	60.6 (4.1)	62.0 (4.0)	57.5 (3.2)	57.1 (3.1)	59.1 (3.4)
Height, cm	144.6 (2.1)	146.3 (2.1)	148.0 (2.1)	145.4 (2.6)	148.1 (2.9)	149.3 (3.0)

[a]Mean (± SEM) of children with complete anthropometric data; n varies at each time point with maximum n=11 for special intervention group and n=10 for standard care group.

Activity Factors

Activity factors for children in the special intervention group were significantly greater at week 22 than at weeks 0 (P=0.0048) and 16 (P=0.015, Tables 26 and 26a). Activity factors for children in the standard care group were significantly lower (P=0.0271) at week 22 than at week 10. No significant differences were observed among the activity factors by gender.

Correlations and Multiple Regression Analysis

A significant correlation was observed between the change in relative weight between weeks 0 and 10 and the change in grams of fat between weeks 0 and 16 for the standard care group (r=0.64, P=0.0268, Appendix D). Significant correlations also were observed between the change in BMI between weeks 0 and 10 and the change in grams of fat between weeks 0 and 4 (r=0.69, P=0.0196) and weeks 0 and 10 (r=0.76, P=0.0085). A significant correlation was observed between the change in BMI between weeks 0 and 10 and the change in percentage of calories from fat between weeks 0 and 10 (r=0.64, P=0.03165). No other significant correlations were observed.

Relationships between independent variables and dependent variables were described by multiple regression analysis (Appendix D). The change in relative weight between weeks 0 and 10 equaled 0.071 (P=0.00025) plus 0.00081 (P=0.0268) multiplied by the change in grams of fat

TABLE 26. Children's Daily Activity Factors by Intervention Strategy and Gender.[‡,†]

		WEEK 0	4	10	16	22
Intervention Strategy	Special Intervention Group	1.75 (0.11)	1.82 (0.12)	1.94 (0.18)	1.64 (0.09)	2.05[a,c] (0.13)
	Standard Care Group	1.67 (0.10)	1.60 (0.13)	1.75 (0.16)	1.66 (0.12)	1.52[b] (0.08)
Gender	Boys	1.73 (0.10)	1.62 (0.13)	1.96 (0.21)	1.63 (0.07)	1.90 (0.21)
	Girls	1.69 (0.10)	1.77 (0.12)	1.78 (0.15)	1.66 (0.10)	1.79 (0.11)

[‡]Mean (±SEM) of children with complete anthropometric data; n varies at each time point with maximum n=11 for special intervention group, n=10 for standard care group, n=8 for boys and n=13 for girls.
[†]Daily activity factor was calculated by multiplying representative values for activity categories per unit time of activity. Sum was divided by 24 hours. Activity categories were resting, very light, light, moderate and heavy. Representative values for each category were 1.0, 1.5, 2.5, 5.0 and 7.0, respectively (National Research Council, 1989).
[a]Significantly different from week 0, $P \leq 0.01$.
[b]Significantly different from week 10, $P \leq 0.05$.
[c]Significantly different from week 16, $P \leq 0.05$.

TABLE 26a. Least Squares Means of Differences of Children's Daily Activity Factors.

Difference	Trt†	Sex††	LSMean	SEM	P>[t]
Wk0-Wk4	1	1	-0.02666667	0.13971965	0.8516
	1	2	-0.04600000	0.10822638	0.6778
	2	1	0.31250000	0.12100077	0.0227
	2	2	-0.05800000	0.10822638	0.6011
Wk0-Wk10	1	1	-0.33333333	0.13273959	0.0289
	1	2	-0.14000000	0.11495585	0.2488
	2	1	0.07333333	0.13273959	0.5917
	2	2	-0.07400000	0.10281964	0.4867
Wk0-Wk16	1	1	0.18000000	0.32870960	0.5949
	1	2	0.01000000	0.14700340	0.9470
	2	1	0.13000000	0.18978058	0.5075
	2	2	-0.02500000	0.13419513	0.8556
Wk0-Wk22	1	1	-0.50500000	0.17551268	0.0122
	1	2	-0.23166667	0.14330551	0.1283
	2	1	0.33000000	0.20266459	0.1257
	2	2	0.07800000	0.15698332	0.6270
Wk4-Wk10	1	1	-0.30666667	0.18445515	0.1223
	1	2	0.01000000	0.14287835	0.9454
	2	1	-0.35333333	0.18445515	0.0796
	2	2	-0.01600000	0.14287835	0.9127
Wk4-Wk16	1	1	0.07000000	0.23185915	0.7689
	1	2	0.05600000	0.10369057	0.6010
	2	1	-0.25666667	0.13386394	0.0842
	2	2	0.07000000	0.10369057	0.5149
Wk4-Wk22	1	1	-0.51333333	0.21092499	0.0315
	1	2	-0.22166667	0.14914649	0.1630
	2	1	-0.09666667	0.21092499	0.6549
	2	2	0.18000000	0.18266640	0.3439

Difference	Trt[†]	Sex[††]	LSMean	SEM	P>[t]
Wk10-Wk16	1	1	0.22000000	0.39377500	0.5917
	1	2	0.20500000	0.19688750	0.3282
	2	1	0.25500000	0.27844097	0.3865
	2	2	0.08600000	0.17610153	0.6384
Wk10-Wk22	1	1	-0.20666667	0.17671697	0.2669
	1	2	-0.14600000	0.13688438	0.3090
	2	1	0.25666667	0.17671697	0.1743
	2	2	0.21500000	0.15304139	0.1877
Wk16-Wk22	1	1	-0.51000000	0.25659523	0.0781
	1	2	-0.39600000	0.11475287	0.0073
	2	1	0.09500000	0.18144023	0.6132
	2	2	0.06000000	0.11475287	0.6137

† Trt: 1 = Special Intervention Group with maximum n=11; 2 = Standard Care Group with maximum n=10; n varies at each time point.

†† Sex: 1 = Boys with maximum n=8; 2 = Girls with maximum n=13; n varies at each time point.

between weeks 0 and 16. The change in BMI between weeks 0 and 10 equaled 1.0045 (P=0.0004) plus 0.0154 (P=0.0085) multiplied by the change in grams of fat between weeks 0 and 10. The change in BMI between weeks 0 and 10 equaled 1.08 (P=0.00065) plus 0.0444 (P=0.03165) multiplied by the change in the percentage of calories from fat between week 0 and ten.

Discussion

Mean initial weights and heights of children from both groups were above the 95th percentiles and 75th percentiles, respectively for males and females of this age (Hamill, 1979). Mean abdominal:hip circumferences for both groups were greater than the mean abdominal:hip circumferences reported for males or females of this age (Forbes, 1990). Abdominal:hip circumferences greater than 0.90 for males and greater than 0.80 for females are indicative of abdominal obesity (Gray and Bray, 1988). Abdominal obesity has been associated with elevated blood pressure levels among children (Shear, 1987: Gutin, 1990). Mean diastolic blood pressure readings of both groups were high normal (Task Force on Blood Pressure Control in Children, 1987).

A high normal blood pressure level may be considered normal if the elevation is due to an excess height or lean body mass for age. Mean heights of children in both groups were less than the height cutoffs used by the Task Force to identify an excessive height, while mean weights for both groups were greater than the weight cutoffs. An excess of lean body mass can be dismissed as an explanation for the elevated blood pressure level based on mean abdominal:hip circumferences, triceps skinfold thicknesses and mean sum of skinfold thicknesses. Mean abdominal:hip ratios for both groups were indicative of abdominal obesity. Mean triceps skinfold thicknesses for both groups were greater than the 95th percentiles for both males and females of this age group (Must, 1991a). Mean sums of skinfolds thicknesses indicated that the mean percentages of body fat for children of either group were greater than 35% (Westrate and Deurenberg, 1989).

Skinfold thicknesses in extremely obese individuals are difficult to measure accurately (Bray and Gray, 1988). Extreme obesity among children is indicated by a sum of skinfolds thickness exceeding 120-140 mm (Westrate and Deurenberg, 1989). Mean sums of skinfolds thicknesses for children in either group were greater than or equal to the lower end of this range. Thus, the skinfold measurements of children in either group may be inaccurate.

A percentage of body fat greater than 30% defines obesity in preadolescent children. Weight loss was identified as the most desirable method to correct high blood pressure among obese children (Task Force on Blood Pressure Control in Children, 1987). Significant improvements were observed among the systolic blood pressure levels and weight statuses of children in the standard care group by follow-up.

Initial mean relative weights of children in both groups were indicative of moderate obesity. Mean relative weights of the children in the standard care group at weeks 10 and 22 would be classified as mildly obese. Mean BMI values of children in both groups remained above the 95th percentile regardless of sex group (Must, 1991b; Hammer, 1991). Thus, initial mean values for BMI and triceps skinfold thicknesses would categorize children in both groups as superobese, while initial mean relative weights would classify these children as moderately obese. As discussed by Marshall and co-workers (1991), inconsistencies exist among the standards used to define obesity.

Compositions of the children's initial diets, regardless of gender were consistent with dietary intake data complied from NHANES II (Carroll, 1983). Initial mean daily intakes of calories, fat and cholesterol fell approximately at the 50th percentile for boys of this age group. Mean intakes of protein and iron among boys fell between the 25th and 50th percentiles, while mean intakes of calcium and carbohydrate fell at approximately the 25th percentiles. Among girls, initial mean intakes of protein, fat, cholesterol and calcium fell at approximately the 50th percentiles for girls of this age group; whereas, initial mean intakes of calories, iron and carbohydrate fell at approximately the 75th percentiles. Mean initial CSI values and Key's scores calculated at week 0 for both groups were in agreement with a typical Western diet (Connor, 1986; Fetcher, 1967).

Discrepancies exist between initial mean total daily caloric intakes and initial mean weights of children in either group. As discussed previously, the initial mean weights of children in either group were above the 95th percentiles for boys or girls of this age group, while the initial mean total daily caloric intake fell approximately at the 50th percentile for boys and at the 75th percentile for girls. Thus, children in either group consumed diets with a caloric density less than the density recommended by the National Research Council (1989). Although the results of three studies verified the accuracy of food record keeping by children (Emmons and Hayes, 1973; Stunkard and Waxman, 1981; Baranowski, 1986), the results of other studies (Livingstone, 1990; Mertz, 1991) indicated that the majority of individuals, regardless of age, sex or weight underreported their food intake by 18 to 20%. Even if an additional 20% of the initial mean total caloric intakes was added, initial mean total caloric intakes would fall at approximately the 75th percentile for boys and between the 75th and 90th percentiles for girls (Carroll, 1983). Although the absolute caloric and nutrient intake values may be inaccurate, the results of the dietary analysis were based on differences among nutrient intakes.

Changes in weight and BMI values also do not agree with the changes in caloric intakes of children in either group. Similar discrepancies have been observed between changes in caloric intake and changes in weight among children (Valoski and Epstein, 1990). A change in caloric intake between 200 and 600 calories per day would be expected to result in weight loss. Children in either group exhibited an increase rather than a decrease in weight during the study. Thus, significant improvements in the weight status of children in the standard care group were due to increases in height rather than decreases in weight. This result supports the study's premise of weight control. Weight maintenance rather than weight loss can be the treatment goal for obese preadolescent children who have not completed their growth in height.

Obesity, even during childhood is associated with poor plasma lipid profiles (Aristimuno, 1984; Freedman, 1985: Unger, 1990), thus weight control treatment for obese children needs to emphasize changes in dietary fat intake. Children in the standard care group were more successful at reducing their dietary fat intake than children in the special intervention group. Children in the standard care group changed the quality of their food selections to a greater extent than children in the special intervention group. Changes in the nutrient densities of protein, fat, cholesterol, calcium, vitamin A, iron and zinc indicated that children in the standard care group used low fat food substitutions to a greater degree than children in the special intervention group. Diets of the standard care group also contained more fruit and vegetables at weeks 10 and 22 than at the start of the study as reflected by changes in the nutrient densities for carbohydrate, dietary fiber, vitamin C, vitamin A and folacin. Although changes in CSI values among the two groups indicated an improvement in the atherogenetic potential of the diets, the Key's scores and P:S ratios of these diets indicated that more changes in dietary fat intake were required.

Children in the special intervention group were more successful at changing their physical activity habits than children in the standard care group. Children in the special intervention group altered their physical activity habits by increasing the amount and intensity of physical activity. Access to a variety of physical activities, encouragement toward physical activity during the exercise breaks, distribution of activity incentives and group support influenced the children in the special intervention group to become more physically active.

Initial activity factors calculated from self-reported activity records were higher than expected. An activity factor of 1.3 reflects a sedentary activity level, while an activity level of 2.2 reflects a heavy activity level (National Research Council, 1989). The higher than expected activity levels may be the result of the instrument used to monitor activity levels or may be due the misconception of obese children toward their activity levels. The latter has been observed in obese children participating in other weight control programs (Hoerr, 1988).

Average amounts of television viewed by children in both groups agreed with data reported for children of this age (AC Nielsen CO, 1990). Weekly activity tallies were designed to monitor changes in the amount of television watched by children in the special intervention group. However, few children in the special intervention group completed the tallies.

Dietary and activity data indicated that children in the standard care group changed the fat and nutrient content of their diets to a greater degree than children in the special intervention group; whereas, children in the special intervention group increased their level of physical activity more than children in the standard care group. The special intervention strategy was a group based program specifically designed to teach children and parents methods to reduce dietary fat intake. The discrepancy between the expectations and the results of this study can be explained in part by the type of child participating in the study and the differences between the intervention strategies.

Other treatment programs for obese children screened their participants before program entry (Minderaa and Witt; 1983, Amador, 1990; Epstein, 1990). These treatment programs used various screening criteria including child's age, intelligence level and desire to lose weight as well as parents' weight, economic and marital status. Children who satisfied program requirements specified previously were accepted for this study.

Approximately 40% of the children recruited for this study lived in single parent families. Parents in both groups were less educated than parents of children recruited for other programs, with parents in the special intervention being slightly less educated than parents in the standard care group. In one treatment program (Epstein, 1990), 33% and 45% of mothers and fathers had completed college, respectively. In the current study, only 9% of the mothers and 18% of the fathers had completed college. Epstein (1990) further selects obese children from families with a socioeconomic background of a least a small businessman and with only one obese parent.

Although the sex of obese parents has been reported not to influence the development or maintenance of obesity among biologic offspring (Garn, 1985), the current study indicates that the success of obesity treatment among preadolescent children may be associated with the weight status of the mother. Mean BMI value of mothers in the special intervention group was greater than 30 kg/m^2, the cutoff value used to identify obesity among adults; whereas, mean BMI value of mothers in the standard care group was less than 30 kg/m^2. Mean BMI values of fathers in both groups also was less than 30 kg/m^2.

As discussed by Hertzler (1981), the success of obesity treatment, particularly among children is influenced the level of family functioning. Many children, regardless of group were members of families who exhibited characteristics usually associated with dysfunctional families (Bruch, 1971; Kinston, 1987; Christoffel and Forsyth, 1989). Several families were referred to the clinic's family therapist or encouraged to seek other professional care. A group based weight control program requires the participants to be able to work in a group setting. Many of families, regardless of group appeared to function poorly within the context of their family unit.

The special intervention program required the participants and parents to be able to function in a group setting and to match the appropriate solutions presented in the program to their specific problems. In contrast, standard care was an individual based program that did not require the participants and parents to function in a group. Furthermore, the solutions to the problems of children in the standard care group were identified and matched by the counselor. An individual based weight control program that provides specific instructions such as the type of care given to the standard care group may be more beneficial for children from poorly functioning families than a group based program.

The success of the standard care group also could have been influenced by the differences in design of the intervention strategies. Counseling sessions for standard care were scheduled at the convenience of children and parents. Program sessions for the special intervention group were held one night per week from 7:00 to 9:00 p.m.. Program attendance was observed to be greater among participants in the standard care group than the special intervention group. Thus, the treatment success of the standard care group may be associated with the greater consistency of care provided by scheduling counseling sessions at the convenience of participants and their families.

Conclusion

Children in the standard care group exhibited significant improvements in relative weight and BMI at the end of the study that continued through the follow-up period. Although other factors may have contributed to the improvement in the weight status of these children, changes in dietary fat intake of children in the standard care group were associated with the changes in their relative weight and BMI values. Children in the standard care group altered the dietary fat and nutrient quality of their diets to a greater extent than children in the special intervention group.

Greater success of the standard care group also could have been related to the level of family functioning, type of individualized counseling provided as standard care, weight status of the mother and convenience of the standard care counseling sessions. Many children who participated in this study lived in families that exhibited characteristics associated with dysfunctional families. The type of care provided to children in the standard care group involved specific dietary and exercise instructions that addressed the specific problems of each child. Counseling sessions were scheduled at the convenience of children and parents in the standard care group. Mean BMI values of mothers and fathers in the standard care group were less than 30 kg/m^2. Thus, children and their families should be screened for the type of weight control care best suited to their needs. Screening criteria would include assessment of family functioning, parent's educational level, parent's weight status, particularly of the mother and child's desire to control weight.

Since children in the special intervention group used the information and materials presented, it can be inferred that obese preadolescent children from dysfunctional families could achieve greater success with individual based counseling incorporating program strategies.

SUMMARY AND CONCLUSIONS

A newly designed special intervention program providing food, nutrition and exercise information featured a low fat normocaloric diet for obese preadolescent children. Program format appeared to satisfy the preferences and needs of children and parents from a variety of racial and educational backgrounds. Children in the special intervention group changed the nutrient quality but not the fat quantity of their diets. These children, as indicated on their program evaluations and confirmed by nutrient analysis increased their consumption of fruits, vegetables, dairy products and meat. However, they did not use low fat food substitutions that were emphasized in the program.

Children in the standard care group initially altered the nutrient quality but not the fat quantity of their diets. After 22 weeks, these children altered the fat quantity as well as the nutrient quality of their diets. These children, as indicated on program evaluations and confirmed by nutrient analysis increased their consumption of fruits, vegetables and low fat meat and dairy products. Changes in the dietary fat intake of children in the standard care group were associated with significant improvements in their relative weight and BMI values.

Similar proportions of children in both groups indicated on program evaluations that their amount of physical activity increased at week ten. More children in the standard care group indicated that their level of physical activity increased at week 22 than children in the special intervention group. Analysis of activity factors confirmed that children in the special intervention group had increased their level of physical activity at weeks 10 and 22. Children in the special intervention group altered their level of physical activity by increasing the amount and intensity of physical activity. The opportunity to participate in a variety of physical activities during the program sessions, group support, and use of activity incentives encouraged these children to increase their level of physical activity. Analysis of activity factors for children in the standard care group increased slightly at week ten compared to baseline. Activity factors for children in this group were lower at week 22 compared to baseline. Inconsistencies between children's perceptions of their level of physical activity and calculated activity factors could be attributed to inherent problems in the instrument used to measure children's activity levels or to children's misconceptions.

The greater improvement in weight status among children in the standard care group compared to the children in the special intervention group were related to the level of family functioning among the study participants, the type of counseling provided to the standard care group, the weight status of the mothers and the convenience of the standard care counseling sessions. Many children who participated in this study lived in families that exhibited characteristics associated with dysfunctional families. The individualized type of counseling provided to children in the standard care group involved specific dietary and exercise instructions that were tailored to the needs of the participants by the counselor. Children and parents in the special intervention were expected to use the nutrition and exercise information presented in the program sessions to evaluate and change their food and exercise behaviors. The mean BMI of mothers in the special intervention group was indicative of obesity, while the mean BMI values of mothers in the standard care group and of fathers in either group were less than 30 kg/m^2. Counseling sessions were scheduled at the convenience of participants and their families in the standard care group, while program sessions of the special intervention strategy were held one evening per week. Program attendance was observed to be greater among participants of the standard care group. Greater compliance to care may have been associated with improvements in weight status indicators of children in the standard care group.

Results of this study suggest that children from dysfunctional families may achieve a greater level of weight control success with individualized care than with a group based program. The quality of the counselor providing the care is an important factor in the successful treatment of obese preadolescent children as indicated by children and parents of the standard care group on their program evaluations. Obese children and their families should be screened for the type of weight control program that would satisfy their needs and abilities. A screening instrument needs to be devised that could identify the type of weight control care best suited for obese children and their respective families. Screening criteria would include assessment of family functioning, parent's educational level, parents' weight status, particularly of the mother and child's desire to lose weight.

The materials and activities that were developed for the special intervention program received high approval ratings from the program participants and parents. As reflected in program evaluations, nutrient analysis, activity factors and changes in weight status, children in the special intervention group used the information and strategies presented in the program's materials and activities. The program materials could be revised for individual based counseling to improve its effectiveness.

Based on the results of this study, the following recommendations are made:

1. Development of a screening instrument to identify weight control care best suited for obese children and their families.

2. Revision of program materials for individual based counseling to improve its effectiveness.

3. Alterations in the special intervention program:

    a. Shorter class length.

        i. Include activities enjoyed by children and parents.
        ii. Hold separate classes on the same evening for children and parents.

4. Development of a new instrument to measure children's activity levels.

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APPENDIX A

APPROVAL FORMS

LAST NAME OF PI	
ANDERSON	
FILE NO.	DATE SUBMITTED
91-034H	3/20/91
ENTERED TO RECORD	
COORDINATOR L. Matzdorff	
DATE 5/8/91	

COLORADO STATE UNIVERSITY

Human Research Committee

PROJECT APPROVAL FORM

Project Title: The Development and Evaluation of a Weight Control Program for Preadolescents

Principal Investigator: Dr. Jennifer Anderson

Co-Investigator: Virginia A. Hammarlund, Martha Stone, Douglas Bright

Department: Food Science and Human Nutrition

Funding Agency: N/A

Funding Agency Deadline Date: N/A

Date of Project Initiation: April 15, 1991

The above project was examined by the Human Research Committee on 5/8/91 with the following recommendation:
Date

- [ ] Project approved with no conditions.
- [x] Project approved with the condition that an approved consent form must be used.
- [ ] Project conditionally approved if the following conditions are met:

____

____

____

____

Chairman
Human Research Committee

5/8/91
Date

UNIVERSITY OF WYOMING

Vice President for Research
P.O. Box 3355
Laramie, Wyoming 82071-3355
(307) 766-5353 • (307) 766-5320

April 23, 1991

Virginia A. Hammarlund
1920 Rollins Avenue
Cheyenne, Wyoming 82001

Dear Ms. Hammarlund:

Your proposed research project, "The Development and Evaluation of a Weight Control Program for Preadolescents," was reviewed by the Institutional Review Board at their meeting April 9, 1991.

The Board approved the project based on the proposal revisions presented to the Board at the meeting.

You may proceed with the project and good luck with the endeavor.

Sincerely,

Roger Wilmot

Roger Wilmot
Chairman, Institutional
Review Board

1920 Rollins Ave
Cheyenne, WY 82001
FAX: 307-638-3616
January 2, 1992

AMA Specialty Journals
515 N State Street
Chicago, IL 60610

Attention: Specialty Journals Department

I am currently a doctoral candidate in the Department of Human Nutrition at Colorado State University, Ft. Collins, Colorado. Part of the requirements for completing a PhD degree includes designing and executing a research project. My research project involves pediatric obesity.

In my dissertation, I refer to the information presented in an article published in the American Journal of Diseases of Children (Gortmaker SL, Dietz WH, Sobol AM, Wehler CA. Increasing Pediatric Obesity in the United States. AJDC 1987;141:535-540). Although the analyses, interpretations, and conclusions of the authors can be obtained from the text, the full impact of their research is best expressed by Table 1. Thus, I request the permission of AMA ~~the authors~~ to use Table 1-Estimates of Prevalence of Obesity and Superobesity in the United States From 1963 to 1980 by Race, Sex, and Age in Children 6 to 17 Years Old from the article Increasing Pediatric Obesity in the United States in my dissertation.

Please send your respond to the enclosed FAX number. Thank you for your time.

Sincerely,

Virginia A. Hammarlund, M.S., R.D.

Virginia A. Hammarlund, M.S., R.D.

PERMISSION GRANTED: Rights granted herein are nonexclusive.

Your credit line must include the name of Publication, issue date, volume and page numbers, as well as, "Copyright 1987, American Medical Association."

ONE EDITION IN ENGLISH ONLY

1-13-92

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JAN 09 1992
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PUBLISHING OPERATIONS

CODE NO.______

COLORADO STATE UNIVERSITY

Consent to Serve as a Subject in Research

I authorize____(print name), to become a subject in the research investigation entitled: **The Development and Evaluation of a Weight Control Program for Preadolescents.**

The nature and general purpose of the project has been satisfactorily explained to me by Virginia A. Hammarlund, M.S., R.D. and I am satisfied that proper precautions are to be observed.

My child is authorized to proceed on the understanding that I can terminate my child's service as a subject in this research at any time without loss of benefits to which my child may otherwise be entitled.

I understand that the health risks associated with a weight loss program may include decrease bone growth, irregular heartbeat, low blood pressure, loss of muscle, fatigue and nausea. Health risks associated with a weight loss program will be minimized by having the health status of each child evaluated before being allowed to participate in this study. The health status of each child will be continuously evaluated throughout the study. Medical supervision and any other type of medical care will be provided by the medical staff of the University of Wyoming Family Practice Residency Program at Cheyenne.

I understand that it is not possible to identify all potential risks in an experimental procedure, but I believe that reasonable safeguards have been taken to minimize both known and the potential, but unknown risks.

I further understand that my child must be accompanied by a parent to each weight control class or consultation. I also understand that my child will require parental assistance to complete their diet and activity records. And, if available as part of my child's medical record and care, I will provide Ms. Hammarlund with a copy of my child's blood cholesterol results.

If a subject is injured in the course of the research investigation and he/she contends that Colorado State University or an employee thereof is at fault for the injury, the subject must file a claim within 180 days of the date of the injury with the State Attorney General and the State Board of Agriculture. The University's legal and financial responsibility, if any, for such injuries is controlled by state law. Your claim will be referred to the Risk Management Liaison Office for review, and you should direct your inquiries to that office

CODE NO_____

(303-491-5257). The University cannot otherwise compensate subjects for their injuries, and subjects must depend on their own health and disability insurance for compensation for injuries sustained in the course of the research investigations which are not the fault of CSU or its employees.

________________________ Signed_____________________________________

Minor's Date of Birth (Parent/Guardian) Date

____

(print name)

I, ____ (print name), consent to serve as a subject in the project called: **The Development and Evaluation of a Weight Control Program for Preadolescents.** I understand that I do not have to participate, but I want to participate in the project that was explained to me by Virginia A. Hammarlund. After I start, I can still stop participating at any time.

Signed_____________________________________

Subject Date

Colorado State University

PROJECT INFORMATION SHEET

Project Title: The Development and Evaluation of a Weight Control Program for Preadolescents

Principal Investigator: Dr. Jennifer Anderson

Co-investigators: Virginia A. Hammarlund, M.S., R.D., Dr. Martha Stone (co-advisor) and Dr. Douglas Bright

Contact Person and Phone Number for Questions/Problems: Virginia A. Hammarlund, M.S., R.D.: (307)-777-7911.

Objectives: The overall goal of the project is to develop an effective weight control program for children age 8 to 11 years. The specific goals of the project include: 1) To design a weight control program for preadolescents that uses a low fat diet and increased physical activity. 2) To monitor the amount of weight gain and the amount of body fat in selected children after adherence to a weight control program. And, if available as part of the children's medical record and care, to monitor the changes in the blood cholesterol of these children. 3) To compare the effectiveness of the proposed weight control program for preadolescent children to traditional methods.

Procedures/Methods to be Used: The following measurements will be obtained from each child at the start of the project, at the conclusion of the project and 3 months after the conclusion of the project: 1) Each child's weight; height; waist, abdominal and hip circumferences; and fatfold thickness of front and back of upper arm, shoulder blades and waist will be measured by a registered dietitian. 2) Each child's blood pressure will be measured by a licensed practical nurse. 3) Each child with the assistance of their parent will complete a 3-day diet record. Each child/parent group will receive instructions on how to complete a 3-day diet record. 4) Each child with the assistance of their parent will complete a 3-day activity record. Each child/parent group will receive instructions on how to complete a 3-day activity record. 5) Each child will complete 3 questionnaires specifically designed to evaluate the child's nutrition knowledge, food selection habits and food preparation habits. 6) Each child and parent will complete separate questionnaires regarding their satisfaction of the program.

Each child/parent group will be assigned to either weight control program 1 or weight control program 2. Weight control program 1 will consist of a 1/2 hour consultation and 2 follow-up appointments with a registered dietitian. The follow-up appointments will be spaced 1 month and 3 months after the initial consultation. Weight control program 2 consists of 10 weekly classes. Classes will be held at the University of Wyoming Family Practice Residency Program at Cheyenne between the hours of 7 and 9 p.m.. Classes will be held 2 evenings per week. Children will be assigned to either of the 2 evenings. One parent will be required to accompany their child to each class. The same parent need not attend all classes.

Both weight control programs will be provided free-of-charge to each child.

Risks: Health risks associated with a weight loss program may include decrease bone growth, irregular heartbeat, low blood pressure, loss of muscle, fatigue and nausea. Health risks associated with a weight control program will be minimized by having the health status of each child evaluated before being allowed to participate in the project. The health status of each child will be continuously evaluated throughout the study. Medical supervision and any other type of medical care including psychological support will be provided by the medical staff of the University of Wyoming Family Practice Residency Program at Cheyenne.

Assurance of Confidentiality: Any information or data obtained during the course of this project shall remain completely confidential. Neither child nor parent will be identified by name in any report or publication that may result from this project.

I agree that each child/parent group has the right to terminate participation in this research project at any time.

____

Investigator Date

APPENDIX B

QUESTIONNAIRES

CODE NO._____

MEDICAL QUESTIONNAIRE

The Development and Evaluation
of a
Weight Control Program for Preadolescents

1. Date of Birth:__________________________.
2. Race:_________________________________.
3. Weight:
   a. Initial Weight:_______lbs._______kg.
   b. Final Weight:_______lbs._______kg.
   c. Follow-up Weight:_______lbs._______kg.
4. Height:
   a. Initial Height:_______cm.
   b. Final Height:_______cm.
   c. Follow-up Height:_______cm.
5. Tricep Skinfold Thickness:
   a. Initial:_______mm. _______mm. _______mm, ave._______mm.
   b. Final:_______mm. _______mm. _______mm, ave._______mm.
   c. Follow-up:_______mm. _______mm, _______mm,ave. _______mm.
6. Bicep Skinfold Thickness:
   a. Initial:_______mm. _______mm. _______mm, ave._______mm.
   b. Final:_______mm. _______mm, _______mm, ave._______mm.
   c. Follow-up:_______mm. _______mm, _______mm,ave. _______mm.

CODE NO._______

7. Suprailiac Skinfold Thickness:
   a. Initial:_______mm. _______mm. _______mm. ave._______mm.
   b. Final:_______mm. _______mm. _______mm. ave._______mm.
   c. Follow-up:_______mm. _______mm. _______mm.ave._______mm.

8. Subscapular Skinfold Thickness:
   a. Initial:_______mm. _______mm. _______mm. ave._______mm.
   b. Final:_______mm. _______mm. _______mm. ave._______mm.
   c. Follow-up:_______mm. _______mm. _______mm.ave._______mm.

9. Waist Circumference:
   a. Initial:_______cm. _______cm. _______cm. ave._______cm.
   b. Final:_______cm. _______cm. _______cm. ave._______cm.
   c. Follow-up:_______cm. _______cm. _______cm. ave._______cm.

10. Abdominal Circumference:
   a. Initial:_______cm. _______cm. _______cm. ave._______cm.
   b. Final:_______cm. _______cm. _______cm. ave._______cm.
   c. Follow-up:_______cm. _______cm. _______cm. ave._______cm.

11. Hip Circumference:
   a. Initial:_______cm. _______cm. _______cm. ave._______cm.
   b. Final:_______cm. _______cm. _______cm. ave._______cm.
   c. Follow-up:_______cm. _______cm. _______cm. ave._______cm.

12. Blood Pressure:
   a. Initial:_____mm Hg._____mm Hg._____mm Hg. ave._____mm Hg.
   b. Final:_____mm Hg._____mm Hg._____mm Hg. ave._____mm Hg.
   c. Follow-up:____mm Hg,_____mm Hg,_____mm Hg,ave____mm Hg.

CODE NO._______

13. For Girls Only: Onset of menarche: _______Y_______N.

14. For Boys Only: Presence of pubic hair: _______Y_______N.

15. List any recent illness or surgery in the past 12 months: ________
____.

16. List any other previous illness or surgery: ____________________
____.

17. Family history and/or personal history of heart disease, hypertension, hyperlipidemia, diabetes or cancer: _______Y_______N.

    If yes, who has (had) the disease and what is (was) the nature of the disease:
    ____
    ____.

18. Are you taking any medication: _______Y_______N. This Includes any over-the-counter drugs and vitamin and mineral supplements.

    If yes, identify the medication: _________________________________,
    and reason for taking the medication: ____________________________.

19. List any allergies including food allergies: _________________________
____.

20. Any dental problems: _______Y_______N.

    If yes, explain the nature of these problems: ________________________
    ____.

21. List any other factor that could interfere with your food consumption, digestion or utilization: ____.

22. List foods disliked/avoided: ____
____.

23. List favorite foods: ____
____.

24. Any recent changes in eating habits: _______Y_______N.

CODE NO.______

If yes, indicate these changes: ____
____.

25. Any recent changes in food preparation habits:_______Y_______N.

    If yes, indicate these changes: ____
    ____.

26. Any recent changes in food buying habits:_______Y_______N.

    If yes, indicate these changes: ____
    ____.

27. Any recent changes in weight:_______Y_______N.

    If yes, indicate the amount of weight change:_______.

28. Have you tried any weight loss program:_______Y_______N.

    If yes, indicate when__________________, type__________________, and the amount of time ____.

29. Any factors of physical handicap that prevent activity or exercise: _____
    ____.

30. Exercise activity:_______hrs/wk.
    a. Walking:_______hrs/wk.
    b. Jogging:_______hrs/wk.
    c. Swimming:_______hrs/wk.
    d. Bicycling:_______hrs/wk.
    e. Competitive sports (football, baseball, soccer):_______hrs/wk.
    f. Other:____hrs/wk.

31. Amount of TV viewing:_______hrs/day, _______hrs/wk.

32. Amount of sleep:_______hrs/day.

ANTHROPOMETRIC DATA
(Parents)

CODE NO._______

Mother's Height: __________.

Mother's Weight: __________.

The highest grade of school completed by the mother: __________.

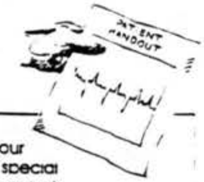
Father's Height: __________.

Father's Weight: __________.

The highest grade of school completed by the father: __________.

ACTIVITY DATA
(Child)

1. Did you use the jump rope provided by the WAHA ? YES NO
2. Did you use the bowling pass provided by Two Bar Bowl ? YES NO
3. Did you use the roller rink pass provided by Roller City ? YES NO
4. Did you use the swimming pass provided by the Municipal Pool of Cheyenne ? YES NO



Keeping a Food Diary

The information you record on your food diary will help your doctor and you design an eating program to meet your special needs. These instructions will help you get the most value out of doing a complete diet history.

Look at the Food Diary on the reverse side. Use the information below to fill it out.

Here are some basic rules to remember:

Write down everything:

Keep your form with you all day long and write down everything you eat or drink. A piece of candy here, a handful of pretzels there, a can of pop, or a small doughnut may not seem like much at the time, but over a week these calories add up!

Do it now:

Do not depend on your memory at the end of the day. Record your eating as you go.

Be specific:

If you ate a cheeseburger, write that down. Make sure to mention gravy on your meat or cheese sauce on your vegetables. If you had french fries, do not say potatoes. The fact that they are fried makes the difference.

Estimate amounts:

If you had a piece of cake, estimate the size (2" x 1" x 2"). If you had a vegetable, was it ¼ cup or 2 cups? When eating meat, record the size or the estimated weight. If the steak label indicated 1½ pounds and you had half of it, record ¾ pounds.

THE "HOW MUCH" COLUMN:

In this space you want to indicate the amount of the particular food item. Estimate the size (in inches), the volume (½ cup), the weight (2 ounces), and/or the number of items (12) of that type of food.

WHAT KIND:

In this column, write down the type of food as specifically as you can. Mention sauces and gravies. Do not forget to put down salad dressing, mayonnaise, butter, sour cream, sugar, and catsup.

TIME:

Indicate the time of day you ate that food.

WHERE:

Indicate what room or part of the house you were in when you ate. Also, list restaurant, fast food chains, or your car.

ALONE OR WITH SOMEONE:

If you ate by yourself, put down "alone." If you were with friends or family members, list them.

PAIRED WITH:

In this column, list any activities you were involved in while you were eating (working, watching TV, ironing, etc.).

MOOD:

How were you feeling at the time you were eating (sad, happy, depressed, etc.)?

HELPFUL HINTS:

1. Do not change your eating habits from normal, unless your doctor has given you specific instructions.
2. Tell the truth. There is nothing to be gained by trying to look good on these forms. Your doctor can help you only if you record what you typically eat.
3. Record what you eat on all days your doctor recommends.
4. **Be sure to bring the completed forms back with you to your next appointment.**

If you have any questions, call your doctor's office.

SAMPLE FOOD DIARY

—FOOD OR DRINK—						
HOW MUCH	WHAT KIND	TIME	WHERE	ALONE OR WITH WHOM	ACTIVITY	MOOD
3	chocolate chip cookies	3:25	Office	alone	working on report	bored
1	cheeseburger	6:15	Burger King	Claire, Jackie	talking	happy
1	regular french fry					
1	vanilla shake					
1 cup	Haagen Daaz Ice Cream	10:00	Kitchen	alone	watching T.V.	tired

CODE NO.______

ACTIVITY RECORD

Activity Category

Resting
Sleeping, reclining

Very light
Seated and standing activities, painting trades, driving, laboratory work, typing, sewing, ironing, cooking, playing cards, playing a musical instrument

Light
Walking on a level surface at 2.5 to 3 mph, garage work, electrical trades, carpentry, restaurant trades, house-cleaning, child care, golf, sailing, table tennis

Moderate
Walking 3.5 to 4 mph, weeding and hoeing, carrying a load, cycling, skiing, tennis, dancing

Heavy
Walking with load uphill, tree felling, heavy manual digging, basketball, climbing, football, soccer

National Research Council (U.S.) Food and Nutrition Board. Subcommittee on the tenth edition of the RDAS. Recommended dietary allowances. Washington, DC; National Academy Press, 1989.

Day	Activity Category	Amount of Time
1	resting	______
	very light	______
	light	______
	moderate	______
	heavy	______
2	resting	______
	very light	______
	light	______
	moderate	______
	heavy	______
3	resting	______
	very light	______
	light	______
	moderate	______
	heavy	______

CODE NO._______

ACTIVITYTALLY

Day 1: Amount of TV viewing:_______hrs/day
Amount of physical activity:_______hrs/day

Day 2: Amount of TV viewing:_______hrs/day
Amount of physical activity:_______hrs/day

Day 3: Amount of TV viewing:_______hrs/day
Amount of physical activity:_______hrs/day

Day 4: Amount of TV viewing:_______hrs/day
Amount of physical activity:_______hrs/day

Day 5: Amount of TV viewing:_______hrs/day
Amount of physical activity:_______hrs/day

Day 6: Amount of TV viewing:_______hrs/day
Amount of physical activity:_______hrs/day

Day 7: Amount of TV viewing:_______hrs/day
Amount of physical activity:_______hrs/day

VERY IMPORTANT OPINIONS
(Child)

1. Did you enjoy the class?

Yes No No Opinion

2. Did you learn something new at today's class?

Yes No No Opinion

What did you learn? ____

____

____

Was it important to you?

Yes No No Opinion

3. Rate the class activities from great to terrible. 1=Great 2=Good 3=Okay 4=Terrible

Activity 1 ____

Activity 2 ____

Activity 3 ____

Activity 4 ____

Activity 5 ____

4. Rate the class handout from Great to Terrible.
1=Great 2=Good 3=Okay 4=Terrible

______________________ ____

Comments:

____

____

VERY IMPORTANT OPINIONS
(Parent)

(Please circle one)

1. Did your child enjoy the class?	Yes	No	No Opinion
2. Did you enjoy the class?	Yes	No	No Opinion
3. Did the class provide your child with useful information?	Yes	No	No Opinion
4. Did the class provide you with useful information?	Yes	No	No Opinion
5. Could the information presented in today's class be easily used by your family?	Yes	No	No Opinion

6. Rank the class activities from most favorite to least favorite with 1=most favorite and 4=least favorite.

   Activity 1 _____

   Activity 2 _____

   Activity 3 _____

   Activity 4 _____

   Activity 5 _____

7. Rate the class handout from 1 to 5 with 1=will use information, 2=will not use information, 3=already use information, 4=undecided, and 5=no opinion

   ______________________________ _____

Comments:

____

____

CODE NO._____

WEIGHT CONTROL PROGRAM FOR CHILDREN
PROGRAM EVALUATION
(CHILD)

1. Did you enjoy the Program ? YES NO NO OPINION

   What did you enjoy most about the Program ? ____________________
   ____.

   What did you enjoy least about the Program ? ____________________
   ____.

2. Rate the classes from most favorite to least favorite class.
   1=most favorite 10=least favorite

   _____ Class 1: Where am I ? Where do I want to be ? Where should I be ?
   Activities: Reasons for enrolling in the Program.
   Growth Chart.
   24-hour diet recall.
   24-hour activity recall.

   _____ Class 2: What do I eat ? What should I eat ? What do I do ? What should I do ?
   Activities: Reasons why we eat.
   Knowing the right size.
   Food groups.
   Food pyramids.
   Balance.

   _____ Class 3: Be a Sport.....Finding the right activities for you !
   Activities: Dr. Skip Ross.
   Activity evaluation.
   Exercise away your calories.
   Activity suggestions.
   Games.

   _____ Class 4: Let's Play Wheel of Fat.
   Activities: Wheel of Fat.
   Fat Budgeting.

   _____ Class 5: Hidden Clues on Food Labels.
   Activities: Buying My Food questionnaire.

Guess my name.
Low-fat foods.

______Class 6: Food signals: When do I eat ? Why do I eat ?
Where do I eat ?
Activities: Shopping questionnaire.
Food signal strategies.

______Class 7: Cooking at Home.
Activities: Fixing My Food questionnaire.
Cooking methods comparison.
Food taste test
Cooking time questionnaire.

______Class 8: Managing the Snack Attack.
Activities: Snack food choices.
Healthy snack choices.
Snack preparation and taste test.

______ Class 9: Navigating Through Fast Food Alley.
Activities: Fast food choices.
Fast food meals.
Fast food taste test.

______ Class 10: Keys To Success.
Activities: Contract reviews.
Fat Rustler's road map game.

3. Rate the class handouts from most favorite to least favorite.
1=most favorite 10=least favorite

______ Class 1: Fat Rustler's Road Map.

______Class 2: Secret Agent's Nutrition Prescription.

______Class 3: Super you.

______Class 4: The Balance of Food.

______Class 5: Hidden Clues....The Search for Low-Fat Foods.

______Class 6: Food Signal Strategies.

______Class 7: Cooking Time Questionnaire.

______Class 8: Managing the Snack Attack.

______Class 9: Navigating Through Fast Food Alley.

______Class 10: Keys To Success.

4. Did you learn something new by participating in the Program ?

YES NO NO OPINION

What did you learn ? ____
____.

Was it important to you ? ____
____.

5. Were the classes: too long, too short, or just right ? (Circle one answer.)

6. Should the Program run: longer than 10 weeks, shorter than 10 weeks, or run for 10 weeks? (Circle one answer.)

7. Have you changed what you eat ? YES NO NO OPINION

If yes, what are the changes: ____________________________________
____.

Have you changed how much you eat ? YES NO NO OPINION

If yes, how has it changed: ______________________________________
____.

8. Have you or your family changed what you buy at the grocery store ?

YES NO NO OPINION

If yes, what are the changes: ____________________________________
____.

Have you or your family changed what you buy at a restaurant (fast food restaurants included)?

YES NO NO OPINION

If yes, what are the changes:____
____.

Will you or your family choose different foods from the school lunch menu ?

YES NO NO OPINION

If yes, what will you do differently ________________________________
____.

9. Have you or your family changed how you cook food at home ?

YES NO NO OPINION

If yes, what are the changes: ____
____.

Have you or your family changed the snacks that you eat ?

YES NO NO OPINION

If yes, what are the changes: ____
____.

Will you or your family change the food that you will eat at school ?

YES NO NO OPINION

If yes, what will the changes be: ____________________________________
____.

10 Has the amount of physical activity you do changed ?

YES NO NO OPINION

If yes, how has it changed: ______________________________

______________________________.

Has the type of physical activity you do changed ?

YES NO NO OPINION

If yes, how has it changed: ______________________________

______________________________.

If yes, what type of physical activities do you do now that you did not do before:

____

____

______________________________.

COMMENTS:

CODE NO._____

WEIGHT CONTROL PROGRAM FOR CHILDREN
PROGRAM EVALUATION
(CHILD)

1. Did you enjoy the Program ? YES NO NO OPINION

   What did you enjoy most about the Program ? ____________________

   ____.

   What did you enjoy least about the Program ? ____________________

   ____.

2. Did you learn something new by participating in the Program ?

   YES NO NO OPINION

   What did you learn ? ____

   ____.

   Was it important to you ? ____________________________________

   ____.

3. Were the classes: too long, too short, or just right ? (Circle one answer.)

4. Should the Program run: longer than 5 months, shorter than 5 months, or run for 5 months ? (Circle one answer.)

5. Have you changed what you eat ? YES NO NO OPINION

   If yes, what are the changes: ____________________________________

   ____.

   Have you changed how much you eat ? YES NO NO OPINION

   If yes, how has it changed: ____________________________________

   ____.

6. Have you or your family changed what you buy at the grocery store ?

YES NO NO OPINION

If yes, what are the changes:____

Have you or your family changed what you buy at a restaurant (fast food restaurants included)?

YES NO NO OPINION

If yes, what are the changes:____

Will you or your family choose different foods from the school lunch menu ?

YES NO NO OPINION

If yes, what will you do differently ____

7. Have you or your family changed how you cook food at home ?

YES NO NO OPINION

If yes, what are the changes: ____

Have you or your family changed the snacks that you eat ?

YES NO NO OPINION

If yes, what are the changes: ____

Will you or your family change the food that you will eat at school ?

YES NO NO OPINION

If yes, what will the changes be: ______________________________
____.

8. Has the amount of physical activity you do changed ?

YES NO NO OPINION

If yes, how has it changed: ______________________________
____.

Has the type of physical activity you do changed ?

YES NO NO OPINION

If yes, how has it changed: ______________________________
____.

If yes, what type of physical activities do you do now that you did not do before:
____
____
____.

COMMENTS:

CODE NO._____

WEIGHT CONTROL PROGRAM FOR CHILDREN
PROGRAM EVALUATION
(PARENT)

1. Did your child enjoy the Program ? YES NO NO OPINION

   Did you enjoy the Program ? YES NO NO OPINION

   What did your child enjoy most about the Program ? ____________________

   ____.

   What did you enjoy most about the Program ? ____________________

   ____.

   What did your child enjoy least about the Program ? ____________________

   ____.

   What did you enjoy least about the Program ? ____________________

   ____.

2. Rate the classes from most favorite to least favorite class.
   1=most favorite 10=least favorite

   _____ Class 1: Where am I ? Where do I want to be ? Where should I be ?
   Activities: Reasons for enrolling in the Program.
   Growth Chart.
   24-hour diet recall.
   24-hour activity recall.

   _____ Class 2: What do I eat ? What should I eat ? What do I do ? What should I do ?
   Activities: Reasons why we eat.
   Knowing the right size.
   Food groups.
   Food pyramids.
   Balance.

   _____ Class 3: Be a Sport.....Finding the right activities for you !
   Activities: Dr. Skip Ross.
   Activity evaluation.
   Exercise away your calories.
   Activity suggestions.

Games.

_____ Class 4: Let's Play Wheel of Fat.
Activities: Wheel of Fat.
Fat Budgeting.

_____ Class 5: Hidden Clues on Food Labels.
Activities: Buying My Food questionnaire.
Guess my name.
Low-fat foods.

_____ Class 6: Food signals: When do I eat ? Why do I eat ?
Where do I eat ?
Activities: Shopping questionnaire.
Food signal strategies.

_____ Class 7: Cooking at Home.
Activities: Fixing My Food questionnaire.
Cooking methods comparison.
Food taste test
Cooking time questionnaire.

_____ Class 8: Managing the Snack Attack.
Activities: Snack food choices.
Healthy snack choices.
Snack preparation and taste test.

_____ Class 9: Navigating Through Fast Food Alley.
Activities: Fast food choices.
Fast food meals.
Fast food taste test.

_____ Class 10: Keys To Success.
Activities: Contract reviews.
Fat Rustler's road map game.

3. Rate the class handouts from most favorite to least favorite.
1=most favorite 10=least favorite

_____ Class 1: Fat Rustler's Road Map.

_____ Class 2: Secret Agent's Nutrition Prescription.

_____ Class 3: Super you.

_____Class 4: The Balance of Food.

_____Class 5: Hidden Clues....The Search for Low-Fat Foods.

_____Class 6: Food Signal Strategies.

_____Class 7: Cooking Time Questionnaire.

_____Class 8: Managing the Snack Attack.

_____Class 9: Navigating Through Fast Food Alley.

_____Class 10: Keys To Success.

4. Did your child learn something new by participating in the Program ?

   YES NO NO OPINION

   What did your child learn ?_______________________________________
   ____.

   Was it important to your child ? ___________________________________
   ____.

   Did you learn something new by participating in the Program ?

   YES NO NO OPINION

   What did you learn ? ____
   ____.

   Was it important to you? ____
   ____.

5. Were the classes: too long, too short, or just right ? (Circle one answer.)

6. Should the Program run: longer than 10 weeks, shorter than 10 weeks, or run for 10 weeks? (Circle one answer.)

7. Has your child changed what he/she eats ? YES NO NO OPINION

   If yes, what are the changes: _______________________________________
   ____.

Have you changed what you eat ? YES NO NO OPINION

If yes, what are the changes: ______________________________
____.

Has your child changed how much he/she eats ? YES NO NO OPINION

If yes, how has it changed ? ______________________________
____.

Have you changed how much you eat ? YES NO NO OPINION

If yes, how has it changed: ______________________________
____.

8. Have you or your child changed what you buy at the grocery store ?

YES NO NO OPINION

If yes, what are the changes: ______________________________
____.

Have you or your child changed the type of food selected at a restaurant (fast food restaurants included) ?

YES NO NO OPINION

If yes, what are the changes: ______________________________
____.

Will you or your child choose different foods from the school lunch menu ?

YES NO NO OPINION

If yes, what will you do differently ______________________________
____.

9. Have you or your child changed how you cook food at home ?

YES NO NO OPINION

If yes, what are the changes: ______________________________
____.

Have you or your child changed the snacks he/she eats ?

YES NO NO OPINION

If yes, what are the changes: ____

____.

Have you changed the snacks that you eat ?

YES NO NO OPINION

If yes, what are the changes: ____

____.

Will you or your child change the food that he/she will eat at school ?

YES NO NO OPINION

If yes, what will the changes be: ____

____.

10. Has the amount of physical activity your child does changed ?

YES NO NO OPINION

If yes, how has it changed: ____

____.

Has the amount of physical activity you do changed ?

YES NO NO OPINION

If yes, how has it changed: ____

____.

Has the type of physical activity your child does changed ?

YES NO NO OPINION

If yes, how has it changed: ____

____.

If yes, what type of physical activities does your child do now that he/she did not do before: ____

____.

Has the type of physical activity you do changed ?

YES NO NO OPINION

If yes, how has it changed: ____

____.

If yes, what type of physical activities do you do now that you did not do before:

____

____

____.

COMMENTS:

CODE NO._____

WEIGHT CONTROL PROGRAM FOR CHILDREN
PROGRAM EVALUATION
(PARENT)

1. Did your child enjoy the Program ? YES NO NO OPINION

   Did you enjoy the Program ? YES NO NO OPINION

   What did your child enjoy most about the Program ? ____________________

   ____.

   What did you enjoy most about the Program ? ____________________

   ____.

   What did your child enjoy least about the Program ? ____________________

   ____.

   What did you enjoy least about the Program ? ____________________

   ____.

2. Did your child learn something new by participating in the Program ?

   YES NO NO OPINION

   What did your child learn ?______________________________

   ____.

   Was it important to your child ? __________________________

   ____.

   Did you learn something new by participating in the Program ?

   YES NO NO OPINION

   What did you learn ? ________________________________

   ____.

   Was it important to you? ______________________________

   ____.

3. Were the classes: too long, too short, or just right ? (Circle one answer.)

4. Should the Program run: longer than 5 months, shorter than 5 months, or run for 5 months ? (Circle one answer.)

5. Has your child changed what he/she eats ? YES NO NO OPINION

   If yes, what are the changes: ______________________________

   ____

   Have you changed what you eat ? YES NO NO OPINION

   If yes, what are the changes: ______________________________

   ____

   Has your child changed how much he/she eats ? YES NO NO OPINION

   If yes, how has it changed ? ______________________________

   ____

   Have you changed how much you eat ? YES NO NO OPINION

   If yes, how has it changed: ______________________________

   ____

6. Have you or your child changed what you buy at the grocery store ?

   YES NO NO OPINION

   If yes, what are the changes: ______________________________

   ____

   Have you or your child changed the type of food selected at a restaurant (fast food restaurants included) ?

   YES NO NO OPINION

   If yes, what are the changes: ______________________________

   ____

   Will you or your child choose different foods from the school lunch menu ?

   YES NO NO OPINION

If yes, what will you do differently ______________________________
____.

7. Have you or your child changed how you cook food at home ?

YES NO NO OPINION

If yes, what are the changes: ______________________________
____.

Have you or your child changed the snacks he/she eats ?

YES NO NO OPINION

If yes, what are the changes: ______________________________
____.

Have you changed the snacks that you eat ?

YES NO NO OPINION

If yes, what are the changes: ______________________________
____.

Will you or your child change the food that he/she will eat at school ?

YES NO NO OPINION

If yes, what will the changes be: ______________________________
____.

8. Has the amount of physical activity your child does changed ?

YES NO NO OPINION

If yes, how has it changed: ______________________________
____.

Has the amount of physical activity you do changed ?

YES NO NO OPINION

If yes, how has it changed: ______________________________
____.

Has the type of physical activity your child does changed ?

YES NO NO OPINION

If yes, how has it changed: ____.

If yes, what type of physical activities does your child do now that he/she did not do before: ____.

Has the type of physical activity you do changed ?

YES NO NO OPINION

If yes, how has it changed: ____.

If yes, what type of physical activities do you do now that you did not do before: ____.

COMMENTS:

APPENDIX C

TABLES

TABLE C1. Frequency of Children's Responses on Overall Program Evaluation by Intervention.

Question	Response	Frequency of Response: Special Intervention Group Week 10	Special Intervention Group Week 22	Standard Care Group Week 10	Standard Care Group Week 22
1. Did you enjoy the Program?	n	10	11	6	10
	yes	8	9	5	10
	no	1	1	1	0
	no opinion	1	1	0	0
2. What did you enjoy most about the Program?	n	10	10	5	10
	a. Everything.	0	1	1	1
	b. Food demonstrations.	2	2	0	0
	c. Learning.	1	0	0	0
	d. Prizes.	1	1	0	0
	e. Games, particularly Wheel of Fat.	1	1	0	0
	f. Playtime (exercise break) and food demonstrations.	3	2	0	0
	g. The instructor.	1	0	1	3
	h. Learning how to lose weight.	1	1	1	1
	i. Exercise coupons and food demonstrations.	0	1	0	0
	j. Secret Agent Nutrition Prescription.	0	1	0	0
	k. Learning the nutrient value of food.	0	0	2	2
	l. Learning how to eat right.	0	0	0	1
	m. Trying new foods and fun.	0	0	0	1
	n. Having someone to talk to about your weight.	0	0	0	1

		Frequency of Response			
		Special Intervention Group		Standard Care Group	
Question	Response	Week 10	Week 22	Week 10	Week 22
3. What did you enjoy least about the Program?	n	10	9	5	10
	a. The work.	1	1	0	2
	b. Limiting foods from the "other" group.	1	0	0	0
	c. Coming to class, sometimes.	1	0	0	0
	d. Measurements.	4	2	1	0
	e. Food pyramids.	1	0	0	0
	f. Nothing.	1	1	2	3
	g. Class length.	1	1	0	0
	h. Everything.	0	1	0	0
	i. Parents talking.	0	1	0	0
	j. Last class.	0	1	0	0
	k. Food signal strategies.	0	1	0	0
	l. Tests.	0	0	1	1
	m. Compliance.	0	0	1	0
	n. Waiting.	0	0	0	1
	o. The time.	0	0	0	1
	p. Changing food habits.	0	0	0	1
	q. Realizing the difference between current weight and healthy weight.	0	0	0	1
4. Did you learn something new by participating in the Program?	n	10	11	6	11
	yes	7	7	6	11
	no	3	2	0	0
	no opinion	0	2	0	0

Question	Response	Frequency of Response			
		Special Intervention Group		Standard Care Group	
		Week 10	Week 22	Week 10	Week 22
5. What did you learn?	n	6	7	6	9
	a. To eat the right amount and type of food.	3	2	3	4
	b. Many things/everything I ever wanted to know.	1	0	1	0
	c. To watch my food (fat and/or calorie) intake.	1	0	0	1
	d. About food.	1	1	0	0
	e. How to read labels and what to eat.	0	2	2	0
	f. Nothing.	0	1	0	0
	g. How to control my weight.	0	1	0	1
	h. The importance of sports and eating right.	0	0	0	1
	i. Food measurements, especially 5g = 1t.	0	0	0	1
	j. The nutrient value of foods/ some foods have more nutrients than others.	0	0	0	1
6. Have you changed what you eat?	n	10	11	6	11
	yes	4	8	6	10
	no	4	1	0	1
	no opinion	2	2	0	0
6a. If yes, what are the changes?	n	3	6	5	8
	a. What I eat has changed, especially for snacks.	1	0	1	1
	b. Eat less foods from the "other" group.	1	0	0	0

Question	Response	Frequency of Response: Special Intervention Group Week 10	Week 22	Standard Care Group Week 10	Week 22
	c. I am eating better.	1	0	0	0
	d. I control what I eat... I read labels...I eat lighter.	0	1	0	0
	e. I eat less fatty foods.	0	3	0	2
	f. I eat foods from each food group...I eat less second helpings.	0	1	0	0
	g. I eat healthy foods.	0	1	0	0
	h. I eat less snack foods.	0	0	1	0
	i. I eat less sugary foods.	0	0	1	0
	j. I eat less...I eat smaller servings.	0	0	1	1
	k. When I'm full I stop eating.	0	0	1	0
	l. I eat more fruits and vegetables.	0	0	0	1
7. Have you changed how much you eat?	n	10	11	6	11
	yes	5	7	5	9
	no	4	3	1	2
	no opinion	1	1	0	0
7a. If yes, how has it changed?	n	4	7	4	9
	a. Food servings are measured... we use measuring cups and spoons.	1	1	1	1
	b. Don't eat as much/eat less/ eat smaller portions.	1	4	2	1
	c. Not as many second helpings.	1	1	0	0
	d. I eat healthier foods.	1	0	0	0

Question	Response	Frequency of Response: Special Intervention Group		Standard Care Group	
		Week 10	Week 22	Week 10	Week 22
	e. I eat lite foods.	0	1	0	0
	f. I eat less junk food.	0	0	1	0
	g. I eat less fat.	0	0	1	0
	h. I eat when I am hungry... I am not always hungry.	0	0	0	1
8. Have you or your family changed what you buy at the grocery store?	n	10	11	6	10
	yes	5	5	4	8
	no	2	2	1	0
	no opinion	3	3	1	2
8a. If yes, what are the changes?	n	3	6	3	6
	a. We go past the candy aisle.	1	0	0	0
	b. We read labels...we don't buy high fat foods...We buy low-fat foods.	2	2	1	3
	c. We use a shopping list.	0	1	0	0
	d. Dad agrees with the diet changes.	0	1	0	0
	e. We buy diet and/or lite foods.	0	2	0	1
	f. We buy different snacks.	0	0	2	0
	g. We don't buy or buy less junk food.	0	0	0	2

		Frequency of Response			
		Special Intervention Group		Standard Care Group	
Question	Response	Week 10	Week 22	Week 10	Week 22
9. Have you or your family changed what you buy at a restaurant (fast food restaurants included)?	n	10	11	6	10
	yes	4	4	2	3
	no	4	4	2	4
	no opinion	2	3	2	3
9a. If yes, what are the changes?	n	3	4	4	2
	a. We don't buy as much.	1	1	0	1
	b. We eat at home rather than eat at restaurants.	1	0	2	0
	c. We buy less french fries , and more salads...we buy low-fat foods.	3	2	2	1
	d. Inconsistent changes.	0	1	0	0
10. Will you or your family choose different foods from the school lunch menu?	n	10	10	6	10
	yes	3	3	3	3
	no	5	4	0	5
	no opinion	2	3	3	2
10a. If yes, what will you do differently?	n	2	3	4	3
	a. Pack my lunch.	2	3	3	2
	b. Eat less or avoid fatty foods.	0	0	1	1

Question	Response	Frequency of Response: Special Intervention Group Week 10	Week 22	Standard Care Group Week 10	Week 22
11. Have you or your family changed how you cook food at home?	n	10	11	6	10
	yes	4	4	4	6
	no	3	2	0	3
	no opinion	3	5	2	1
11a. If yes, what are the changes?	n	4	4	3	5
	a. Everything.	1	0	0	0
	b. We have changed how we cook at home a little.	1	0	0	0
	c. We don't fry foods...we don't eat greasy foods.	1	2	1	2
	d. We use low-fat cooking methods.	1	1	1	1
	e. We only make one serving/ family member.	0	1	0	0
	f. We cook with oil instead of butter, shortening or lard.	0	0	1	1
	g. We use less fat when cooking.	0	0	0	1
12. Have you or your family changed the snacks that you eat?	n	10	11	6	10
	yes	5	4	4	6
	no	3	3	1	4
	no opinion	2	4	1	0
12a. If yes, what are the changes?	n	3	4	4	5
	a. We eat healthy stuff.	1	1	0	1
	b. We eat less peanut butter.	1	0	0	0
	c. We eat fruit as snacks.	1	1	1	0
	d. We eat smaller servings.	0	1	1	0

		Frequency of Response			
		Special Intervention Group		Standard Care Group	
Question	Response	Week 10	Week 22	Week 10	Week 22
	e. We eat more unbuttered popcorn and diet snacks.	0	1	0	0
	f. We eat less junk snacks like Twinkies.	0	0	1	0
	g. We eat less sugary snacks.	0	0	1	0
	h. We eat fruits and vegetables as snacks.	0	0	0	2
	i. We eat low-fat snacks.	0	0	0	1
	j. We eat different foods for snacks.	0	0	0	1
13. Will you or your family change the food that you will eat at school?	n	9	10	5	9
	yes	3	0	3	3
	no	4	7	0	3
	no opinion	2	3	2	3
13a. If yes, what will the changes be?	n	3	0	2	2
	a. Eat healthier foods...foods with less sugar and less fat.	1	0	2	0
	b. Will pack more low-fat foods in my sack lunch.	1	0	0	0
	c. Will pack my lunch.	1	0	0	0
	d. Will be choosier about the lunches eaten at school.	0	0	0	2
14. Has the amount of physical activity you do changed?	n	9	10	5	9
	yes	5	4	3	6
	no	2	1	0	0
	no opinion	2	5	2	3

Question	Response	Special Intervention Group Week 10	Special Intervention Group Week 22	Standard Care Group Week 10	Standard Care Group Week 22
14a. If yes, how has it changed?	n	4	5	3	5
	a. Increased.	1	2	2	1
	b. Walk and/or ride my bike to school.	0	1	0	1
	c. More swimming and/or roller skating.	0	1	0	0
	d. Play basketball and run more.	0	1	0	1
	e. I play sports for longer periods of time.	0	0	0	1
	f. I play instead of eat.	0	0	1	1
15. Has the type of physical activity you do changed?	n	9	11	5	9
	yes	2	4	2	5
	no	2	2	2	1
	no opinion	5	5	1	3
15a. If yes, how has it changed?	n	2	4	2	4
	a. Increased amount.	1	1	0	1
	b. I exercise longer.	1	0	0	0
	c. More intense.	0	1	0	0
	d. More running games.	0	1	0	0
	e. Basketball.	0	1	0	1
	f. More swimming.	0	0	1	0
	g. More walking and playing.	0	0	1	0
	h. More jump rope.	0	0	0	1
	i. Play more sports.	0	0	0	1

		Frequency of Response			
		Special Intervention Group		Standard Care Group	
Question	Response	Week 10	Week 22	Week 10	Week 22
15b. If yes, what type of physical activities do you do now that you did not do before?	n	3	5	3	4
	a. Sports that require running and more bike riding.	1	0	0	0
	b. More bike riding and/or walking.	1	1	1	0
	c. Skip-it.	1	0	0	0
	d. Basketball.	0	1	0	1
	e. Many activities, like skip-it, bike riding, walking, skating.	0	1	0	0
	f. More tag.	0	1	0	0
	g. Team sports (soccer, flag football, basketball.	0	1	0	0
	h. Swimming, skating and bowling.	0	0	1	1
	i. More bike riding and jump rope.	0	0	1	1
	j. Basketball and softball.	0	0	0	1

TABLE C2. Frequency of Parental Response on Overall Program Evaluation.

Question	Response	Special Intervention Group Week 10	Special Intervention Group Week 22	Standard Care Group Week 10	Standard Care Group Week 22
1. Did your child enjoy the Program?	n	10	11	9	11
	yes	10	10	9	11
	no	0	0	0	0
	no opinion	0	1	0	0
2. Did you enjoy the Program?	n	10	11	9	11
	yes	10	9	8	11
	no	0	1	1	0
	no opinion	0	1	0	0
3. What did your child enjoy most about the Program?	n ,	10	8	9	11
	a. How to control his/her food intake.	1	0	0	0
	b. The food demonstrations.	1	3	0	0
	c. Prizes.	1	0	0	·0
	d. The information.	2	0	0	1
	e. Playtime.	3	1	0	0
	f. The instructor.	1	0	3	1
	g. Learning how to lose weight.	1	0	1	2
	h. Socializing (working together, child participation and fun atmosphere).	0	2	1	1
	i. Increased self-esteem due to change in appearance.	0	1	0	0

Question		Response	Special Intervention Group Week 10	Special Intervention Group Week 22	Standard Care Group Week 10	Standard Care Group Week 22
			Frequency of Response			
	j.	Learning about different foods and healthy food choices.	0	1	1	2
	k.	Individual attention.	0	0	3	4
4. What did you enjoy most about the Program?	n		8	9	9	11
	a.	The information.	6	6	1	3
	b.	Handouts.	1	0	0	0
	c.	Learning how to read a food label.	1	0	0	1
	d.	Learning how to choose and prepare health foods.	0	1	0	1
	e.	Outside reinforcement of healthy lifestyle habits.	0	1	0	0
	f.	Cooking demonstrations.	0	1	0	0
	g.	Watching my child lose weight, stop gaining weight and/or take care of him/herself.	0	0	3	2
	h.	Having my child realize the effects of his/her food and exercise habits.	0	0	1	1
	i.	Information was useful for entire family.	0	0	1	0
	j.	(Individualized) help was available.	0	0	2	2
	k.	Watching my child learn about food and being able to help him.	0	0	1	1

			Frequency of Response			
			Special Intervention Group		Standard Care Group	
Question		Response	Week 10	Week 22	Week 10	Week 22
5. What did your child enjoy least about the Program?	n		10	8	6	8
	a.	Length of Program session.	2	1	0	0
	b.	Anthropometric measurements.	4	1	2	2
	c.	Information.	2	0	0	0
	d.	Food pyramids.	1	1	0	0
	e.	Diet records.	1	0	0	0
	f.	Changing his/her habits.	0	1	0	0
	g.	Paperwork.	0	1	1	5
	h.	Program length and homework.	0	1	0	0
	i.	Structured portion of each Program.	0	1	0	0
	j.	Learning.	0	1	0	0
	k.	Changing food and exercise habits, particularly changing his/her snack habits.	0	0	2	0
	l.	Worrying about failure.	0	0	1	1
6. What did you enjoy least about the Program?	n		7	6	4	4
	a.	Dr. Ross' talk.	1	0	0	0
	b.	Working in groups - wanted more individual attention.	1	0	0	0
	c.	Waiting.	2	0	0	0
	d.	Class length.	2	3	0	0
	e.	Evening classes - missed favorite TV programs.	1	1	0	0
	f.	Difficulty transferring knowledge into practice.	0	1	1	0
	g.	Guilt.	0	1		

		Frequency of Response			
		Special Intervention Group		Standard Care Group	
Question	Response	Week 10	Week 22	Week 10	Week 22
	h. Paperwork.	0	0	1	2
	i. Keeping appointments on busy days.	0	0	1	1
	j. Trying to change your child's eating habits.	0	0	1	0
	k. Measurements.	0	0	0	1
7. Did your child learn something new by participating in the Program?	n	10	11	9	11
	yes	7	9	9	11
	no	3	1	0	0
	no opinion	0	1	0	0
7a. What did your child learn?	n	7	9	9	9
	a. How to select foods based on foods groups and food labels.	6	6	7	8
	b. Healthy lifestyle includes diet and exercise.	1	1	0	0
	c. Exercise will not cause the development of large muscles.	0	1	2	1
	d. How to prepare healthy foods.	0	1	0	0
8. Did you learn something new by participating in the Program?	n	10	10	9	11
	yes	10	9	8	9
	no	0	1	0	1
	no opinion	0	0	1	1

Question	Response	Frequency of Response			
		Special Intervention Group		Standard Care Group	
		Week 10	Week 22	Week 10	Week 22
8a. What did you learn?	n	10	9	8	8
	a. How to select foods based on food labels.	4	2	3	1
	b. Nutrient value of foods vary.	1	3	2	5
	c. Parental support is necessary for children to make changes and lose weight.	3	1	2	2
	d. Weight control requires diet and exercise.	1	3	0	0
	e. Can eat while trying to lose weight.	1	0	0	0
	f. New cooking methods.	0	0	1	0
9. Has your child changed what he/she eats?	n	10	11	9	11
	yes	6	8	9	10
	no	0	0	0	0
	no opinion	4	3	0	1
9a. If yes, what are the changes?	n	6	8	7	10
	a. Eats healthy foods.	4	3	1	3
	b. Decreased amount and/or decreased serving sizes.	1	0	0	2
	c. Eats less fatty and fried foods/eats more fruits, vegetables and other low-fat foods.	1	4	3	1
	d. Eats more light and/or fat-free foods	0	1	0	0

		Frequency of Response			
		Special Intervention Group		Standard Care Group	
Question	Response	Week 10	Week 22	Week 10	Week 22
	e. Eats less sweets and junk food.	0	0	2	2
	f. Changed snack choices.	0	0	1	2
10. Have you changed what you eat?	n	10	11	9	11
	yes	8	7	8	9
	no	0	0	0	1
	no opinion	2	4	1	1
10a. If yes, what are the changes?	n	8	7	8	9
	a. Eat more low-fat foods (fruits, vegetables, grains, lean meats) and less/no fried foods.	5	5	4	7
	b. Eat less food.	3	0	0	1
	c. Eat healthier foods (food labels).	0	2	1	0
	d. Eat less sweets and junk foods.	0	0	1	1
	e. Recently prescribed bland diet.	0	0	1	0
	f. Eat Weight Watcher foods.	0	0	1	0
11. Has your child changed how much he/she eats?	n	10	10	9	10
	yes	8	7	8	8
	no	0	1	0	0
	no opinion	2	2	1	2

		Frequency of Response			
		Special Intervention Group		Standard Care Group	
Question	Response	Week 10	Week 22	Week 10	Week 22
11a. If yes, how has it changed?	n	6	7	7	8
	a. Eats less by eating smaller portions of food and/or by eliminating second helpings of food.	6	5	6	7
	b. Eats less snacks (junk food).	0	1	1	1
	c. Sometimes.	0	1	0	0
12. Have you changed how much you eat?	n	10	10	9	10
	yes	7	6	6	5
	no	0	0	0	1
	no opinion	3	4	3	4
12a. If yes, how has it changed?	n	7	6	5	5
	a. Eat smaller portions.	7	5	2	3
	b. Sometimes.	0	1	0	0
	c. Eat less fatty and sugary foods.	0	0	1	0
	d. Eat Weight Watcher foods.	0	0	1	1
	e. Eat less high fat foods.	0	0	1	1
13. Have you or your child changed what you buy at the grocery store?	n	10	10	9	11
	yes	5	6	8	9
	no	0	1	0	0
	no opinion	5	3	1	2

Question	Response	Frequency of Response: Special Intervention Group Week 10	Special Intervention Group Week 22	Standard Care Group Week 10	Standard Care Group Week 22
13a. If yes, what are the changes?	n	5	6	8	9
	a. Buy more low-fat foods (lean meats, fruits, vegetables and grains) and less junk foods, snack foods, ice cream and cookies - based on food labels.	4	5	8	9
	b. Buy less cookies.	1	0	0	0
	c. Buy fat-free and/or low-calorie foods.	0	1	0	0
14. Have you or your child changed the type of food selected at a restaurant (fast food restaurants included)?	n	10	11	9	11
	yes	5	5	5	5
	no	1	2	1	0
	no opinion	4	4	3	6
14a. If yes, what are the changes?	n	5	5	5	5
	a. Eat less frequently at fast food restaurants.	1	0	0	0
	b. Do not order french fries.	1	0	0	0
	c. Eat more salads and chicken and less/no fried foods.	3	4	5	5
	d. Do not eat at restaurants.	0	1	0	0

Question	Response	Frequency of Response: Special Intervention Group Week 10	Special Intervention Group Week 22	Standard Care Group Week 10	Standard Care Group Week 22
15. Will you or your child choose different foods from the school lunch menu?	n	10	9	9	10
	yes	5	4	6	5
	no	0	1	1	0
	no opinion	5	4	2	5
15a. If yes, what will you do differently?	n	5	4	5	5
	a. Will prepare a sack lunch for my child.	3	3	2	3
	b. Will request school not to serve second helpings of food to my child.	1	0	0	0
	c. Will evaluate foods on menu for nutritional value. Will prepare a sack lunch for my child, if necessary.	1	1	3	2
16. Have you or your child changed how you cook food at home?	n	10	11	9	10
	yes	5	6	5	6
	no	0	1	0	0
	no opinion	5	4	4	4
16a. If yes, what are the changes?	n	5	6	5	6
	a. No/less fried foods and/or use low-fat cooking methods.	4	5	3	2
	b. Use oil in place of butter, shortening or lard.	1	0	1	0
	c. Cook with fruits and vegetables.	0	1	0	0

		Frequency of Response			
		Special Intervention Group		Standard Care Group	
Question	Response	Week 10	Week 22	Week 10	Week 22
	d. Use less fat in food preparation.	0	0	1	4
17. Have you or your child changed the snacks he/she eats?	n	10	10	9	11
	yes	8	8	9	9
	no	0	0	0	0
	no opinion	2	2	0	2
17a. If yes, what are the changes?	n	7	8	8	8
	a. Eats more fruits, vegetables and grains for snacks.	3	6	4	5
	b. Eats less cookies and/or candy for snacks.	1	0	0	0
	c. Eats low-fat foods for snacks.	2	0	2	2
	d. Eats less chips and regular soda for snacks.	1	1	2	1
	e. Eats smaller portions.	0	1	0	0
18. Have you changed the snacks you eat?	n	10	10	9	11
	yes	4	5	7	5
	no	0	1	1	0
	no opinion	6	4	1	6
18a. If yes, what are the changes?	n	4	5	6	5
	a. Eat more low-fat snacks, particularly more fruits and vegetables for snacks.	3	4	4	5
	b. Eat less snacks.	1	1	1	0

		Frequency of Response			
		Special Intervention Group		Standard Care Group	
Question	Response	Week 10	Week 22	Week 10	Week 22
	c. Eat less chocolate.	0	0	1	0
19. Will you or your child change the food he/she will eat at school?	n	10	9	9	8
	yes	5	5	6	4
	no	1	0	1	0
	no opinion	4	4	2	4
19a. If yes, what will the changes be?	n	5	5	6	4
	a. No second helpings.	1	1	0	0
	b. More fruits and vegetables.	2	0	2	2
	c. Smaller servings.	1	0	0	0
	d. More particular about foods selected for sack lunch.	1	4	4	2
20. Has the amount of physical activity your child does changed?	n	10	11	9	11
	yes	5	6	8	11
	no	0	1	0	0
	no opinion	5	4	1	0
20a. If yes, how has it changed?	n	5	6	8	11
	a. Increased activity; less time spent sitting, watching TV or playing Nintendo.	5	4	3	8
	b. Understands importance of increasing physical activity but lacks motivation.	0	1	0	0
	c. Joined local YMCA.	0	1	0	0

Question	Response	Frequency of Response: Special Intervention Group Week 10	Special Intervention Group Week 22	Standard Care Group Week 10	Standard Care Group Week 22
	d. Has more energy now.	0	0	1	1
	e. More bike riding and walking.	0	0	3	1
	f. More walking and participation in team sports.	0	0	1	0
	g. Participates in team sports.	0	0	1	1
21. Has the amount of physical activity you do changed?	n	10	11	9	10
	yes	4	3	4	2
	no	0	1	0	0
	no opinion	6	7	5	8
21a. If yes, how has it changed?	n	4	3	3	2
	a. Increased.	4	2	2	1
	b. More walking.	0	1	1	1
22. Has the type of physical activity your child does changed?	n	10	10	9	11
	yes	5	5	5	9
	no	0	1	0	0
	no opinion	5	4	4	2
22a. If yes, how has it changed?	n	5	5	4	7
	a. Increased amount of physical activity.	3	0	1	1
	b. More swimming and bike riding.	1	0	0	1

		Frequency of Response			
		Special Intervention Group		Standard Care Group	
Question	Response	Week 10	Week 22	Week 10	Week 22
	c. Participates in a greater variety of activities and watches less TV.	1	0	0	2
	d. More outdoor activities.	0	1	1	0
	e. Less physical activity since the start of school.	0	1	0	0
	f. More walking.	0	3	1	1
	g. More running.	0	0	1	0
	h. Participates in more vigorous exercises.	0	0	0	2
22b. If yes, what type of physical activities does your child do now that he/she did not do before?	n	5	4	5	9
	a. Bike riding, walking and team sports.	2	1	2	1
	b. Walking.	2	1	0	1
	c. Jump rope, swimming, aerobics and walking.	1	0	2	1
	d. More outdoor activities.	0	1	0	0
	e. Basketball and skip-it.	0	1	0	2
	f. Swimming and roller skating.	0	0	0	1
	g. Football and wrestling.	0	0	1	0
	h. School team sports.	0	0	0	3
23. Has the type of physical activity you do changed?	n	10	10	9	11
	yes	2	1	3	1
	no	0	1	0	0
	no opinion	8	8	6	10

		Frequency of Response			
		Special Intervention Group		Standard Care Group	
Question	Response	Week 10	Week 22	Week 10	Week 22
23a. If yes, how has it changed?	n	2	1	3	1
	a. Increased.	2	0	1	1
	b. More walking.	0	1	0	0
	c. More bike riding and walking.	0	1	2	0
23b. If yes, what type of physical activities do you do now that you did not do before?	n	2			1
	a. Walking and bike riding.	2	0	2	1
	b. Swimming and stationary cycling.	0	0	1	0

APPENDIX D

STATISTICAL DOCUMENTATION

Identification of Dependent Variable Names

1. Diff1 = relative $weight_{wk\ 0}$ - relative $weight_{wk\ 10}$.
2. Diff2 = relative $weight_{wk\ 10}$ - relative $weight_{wk\ 22}$.
3. Diff3 = relative $weight_{wk\ 0}$ - relative $weight_{wk\ 22}$.
4. Diff4 = $BMI_{wk\ 0}$ - $BMI_{wk\ 10}$.
5. Diff5 = $BMI_{wk\ 10}$ - $BMI_{wk\ 22}$.
6. Diff6 = $BMI_{wk\ 0}$ - $BMI_{wk\ 22}$.
7. Diff7 = sum of $skinfolds_{wk\ 0}$ - sum of $skinfolds_{wk\ 10}$.
8. Diff8 = sum of $skinfolds_{wk\ 10}$ - sum of $skinfolds_{wk\ 22}$.
9. Diff9 = sum of $skinfolds_{wk\ 0}$ - sum of $skinfolds_{wk\ 22}$.
10. Diff10 = g, $fat_{wk\ 0}$ - g, $fat_{wk\ 4}$.
11. Diff11 = g, $fat_{wk\ 0}$ - g, $fat_{wk\ 10}$.
12. Diff12 = g, $fat_{wk\ 0}$ - g, $fat_{wk\ 16}$.
13. Diff13 = g, $fat_{wk\ 0}$ - g, $fat_{wk\ 22}$.
14. Diff14 = g, $fat_{wk\ 4}$ - g, $fat_{wk\ 10}$.
15. Diff15 = g, $fat_{wk\ 4}$ - g, $fat_{wk\ 16}$.
16. Diff16 = g, $fat_{wk\ 4}$ - g, $fat_{wk\ 22}$.
17. Diff17 = g, $fat_{wk\ 10}$ - g, $fat_{wk\ 16}$.
18. Diff18 = g, $fat_{wk\ 10}$ - g, $fat_{wk\ 22}$.
19. Diff19 = g, $fat_{wk\ 16}$ - g, $fat_{wk\ 22}$.
20. Diff20 = systolic blood $pressure'_{wk\ 0}$ - systolic blood $pressure_{wk\ 10}$.
21. Diff21 = systolic blood $pressure_{wk\ 10}$ - systolic blood $pressure_{wk\ 22}$.

22. Diff22 = systolic blood pressure$_{wk\ 0}$ - systolic blood pressure$_{wk\ 22}$.

23. Diff23 = diastolic blood pressure$_{wk\ 0}$ - diastolic blood pressure$_{wk\ 10}$.

24. Diff24 = diastolic blood pressure$_{wk\ 10}$ - diastolic blood pressure$_{wk\ 22}$.

25. Diff25 = diastolic blood pressure$_{wk\ 0}$ - diastolic blood pressure$_{wk\ 22}$.

26. Diff26 = activity factor$_{wk\ 0}$ - activity factor$_{wk\ 4}$.

27. Diff27 = activity factor$_{wk\ 0}$ - activity factor$_{wk\ 10}$.

28. Diff28 = activity factor$_{wk\ 0}$ - activity factor$_{wk\ 16}$.

29. Diff29 = activity factor$_{wk\ 0}$ - activity factor$_{wk\ 22}$.

30. Diff30 = activity factor$_{wk\ 4}$ - activity factor$_{wk\ 10}$.

31. Diff31 = activity factor$_{wk\ 4}$ - activity factor$_{wk\ 16}$.

32. Diff32 = activity factor$_{wk\ 4}$ - activity factor$_{wk\ 22}$.

33. Diff33 = activity factor$_{wk\ 10}$ - activity factor$_{wk\ 16}$.

34. Diff34 = activity factor$_{wk\ 10}$ - activity factor$_{wk\ 22}$.

35. Diff35 = activity factor$_{wk\ 16}$ - activity factor$_{wk\ 22}$.

36. Diff36 = total calories$_{wk\ 0}$ - total calories$_{wk\ 4}$.

37. Diff37 = total calories$_{wk\ 0}$ - total calories$_{wk\ 10}$.

38. Diff38 = total calories$_{wk\ 0}$ - total calories$_{wk\ 16}$.

39. Diff39 = total calories$_{wk\ 0}$ - total calories$_{wk\ 22}$.

40. Diff40 = total calories$_{wk\ 4}$ - total calories$_{wk\ 10}$.

41. Diff41 = total calories$_{wk\ 4}$ - total calories$_{wk\ 16}$.

42. Diff42 = total calories$_{wk\ 4}$ - total calories$_{wk\ 22}$.

43. Diff43 = total calories$_{wk\ 10}$ - total calories$_{wk\ 16}$.

44. Diff44 = total calories$_{wk\ 10}$ - total calories$_{wk\ 22}$.

45. Diff45 = total calories$_{wk\ 16}$ - total calories$_{wk\ 22}$.

46. Diff46 = percent fat calories$_{wk\ 0}$ - percent fat calories$_{wk\ 4}$.

47. Diff47 = percent fat calories$_{wk\ 0}$ - percent fat calories$_{wk\ 10}$.

48. Diff48 = percent fat calories$_{wk\ 0}$ - percent fat calories$_{wk\ 16}$.

49. Diff49 = percent fat calories$_{wk\ 0}$ - percent fat calories$_{wk\ 22}$.

50. Diff50 = percent fat calories$_{wk\ 4}$ - percent fat calories$_{wk\ 10}$.

51. Diff51 = percent fat calories$_{wk\ 4}$ - percent fat calories$_{wk\ 16}$.

52. Diff52 = percent fat calories$_{wk\ 4}$ - percent fat calories$_{wk\ 22}$.

53. Diff53 = percent fat calories$_{wk\ 10}$ - percent fat calories$_{wk\ 16}$.

54. Diff54 = percent fat calories$_{wk\ 10}$ - percent fat calories$_{wk\ 22}$.

55. Diff55 = percent fat calories$_{wk\ 16}$ - percent fat calories$_{wk\ 22}$.

56. Diff56 = nutrition knowledge questionnaire$_{time\ 1}$ - nutrition knowledge questionnaire$_{time\ 2}$.

57. Diff57 = nutrition knowledge questionnaire$_{time\ 2}$ - nutrition knowledge questionnaire$_{time\ 3}$.

58. Diff58 = nutrition knowledge questionnaire$_{time\ 1}$ - nutrition knowledge questionnaire$_{time\ 3}$.

59. Diff59 = food preparation questionnaire$_{time\ 1}$ - food preparation questionnaire$_{time\ 2}$.

60. Diff60 = food preparation questionnaire$_{time\ 2}$ - food preparation questionnaire$_{time\ 3}$.

61. Diff61 = food preparation questionnaire$_{time\ 1}$ - food preparation questionnaire$_{time\ 3}$.

62. Diff62 = food selection questionnaire$_{time\ 1}$ - food selection questionnaire$_{time\ 2}$.

63. Diff63 = food selection questionnaire$_{time\ 2}$ - food selection questionnaire$_{time\ 3}$.

64. Diff64 = food selection questionnaire$_{time\ 1}$ - food selection questionnaire$_{time\ 3}$.

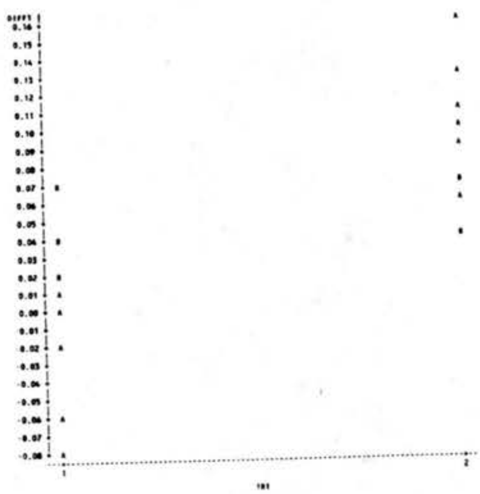
Identification of Treatment Groups

Treatment 1 = Special Intervention Group with a maximum number of eleven.

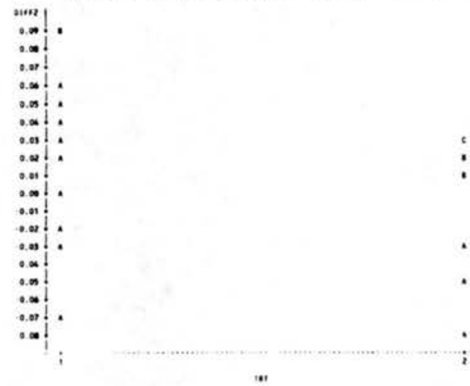
Treatment 2 = Standard Care Group with a maximum number of ten.

Plots of Differences by Treatment Group

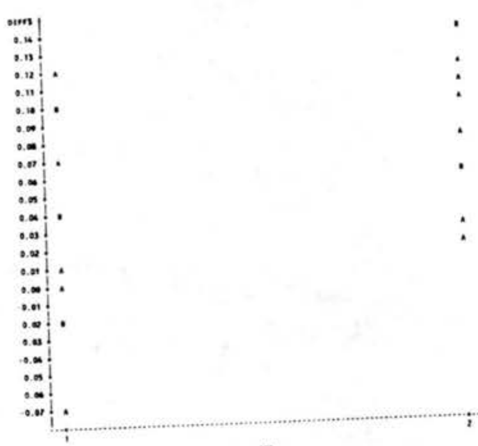
Plot of DIFF1*TRT. Legend: A = 1 obs, B = 2 obs, etc.



Plot of DIFF2*TRT. Legend: A = 1 obs, B = 2 obs, etc.



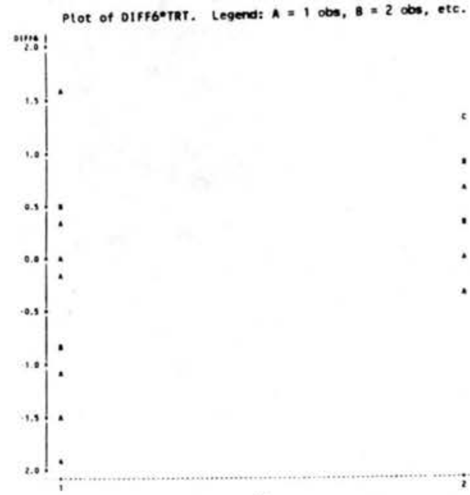
Plot of DIFF3*TRT. Legend: A = 1 obs, B = 2 obs, etc.

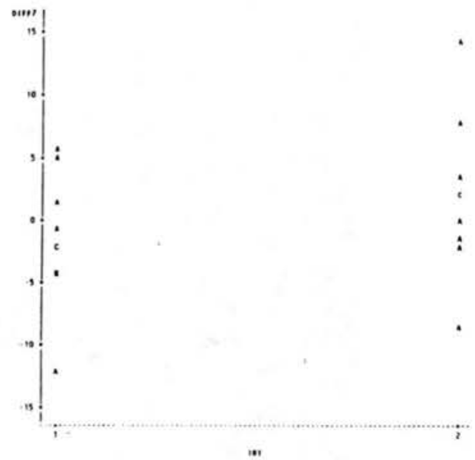


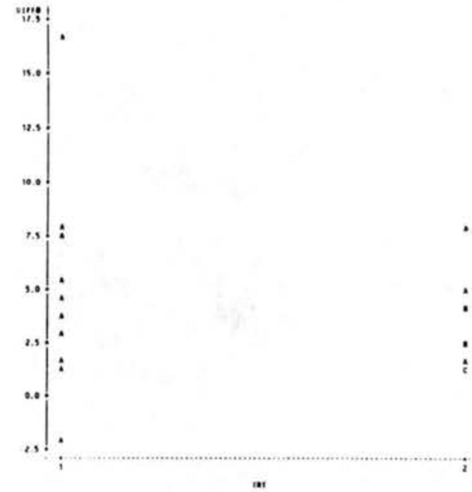
Plot of DIFF4*TRT. Legend: A = 1 obs, B = 2 obs, etc.

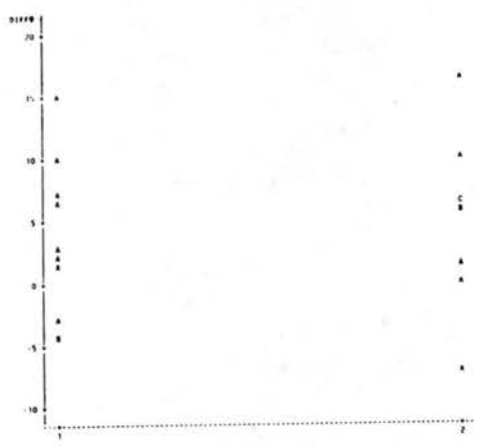
Plot of DIFF5*TRT. Legend: A = 1 obs, B = 2 obs, etc.

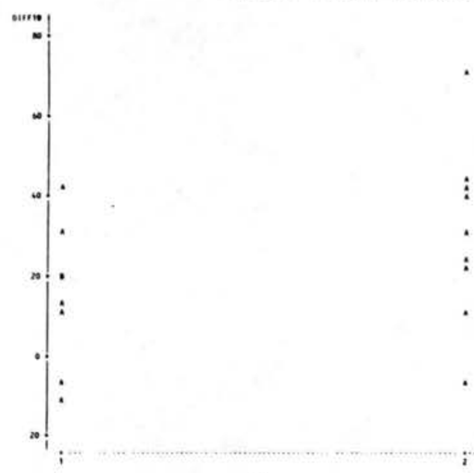
Plot of DIFF6*TRT. Legend: A = 1 obs, B = 2 obs, etc.

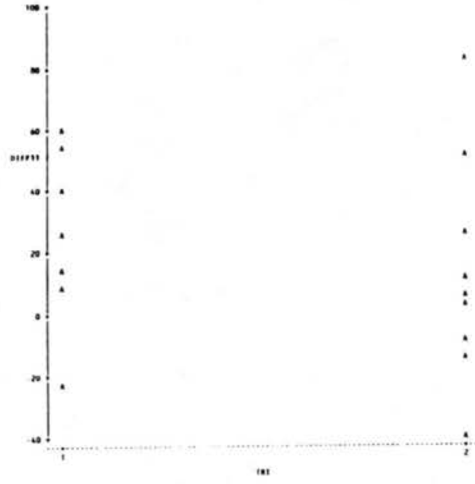


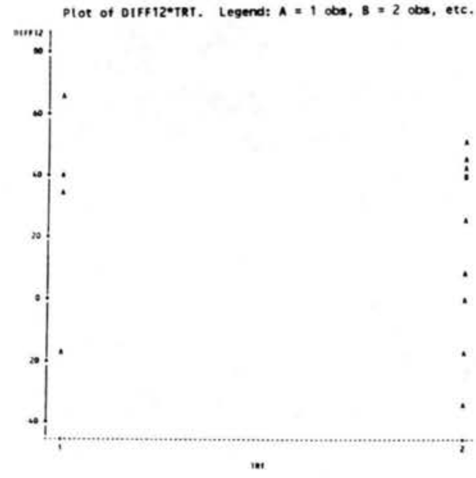

Plot of DIFF7*TRT. Legend: A = 1 obs, B = 2 obs, etc.

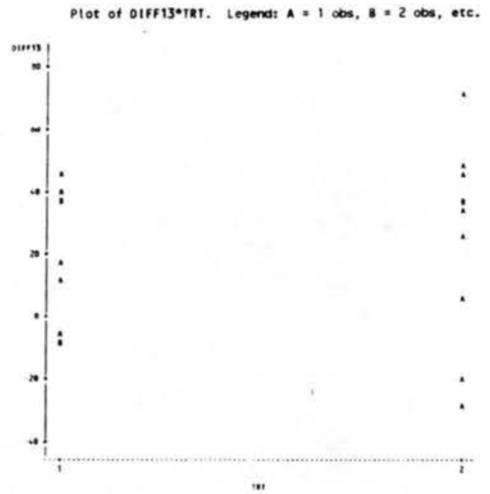

Plot of DIFF8*TRT. Legend: A = 1 obs, B = 2 obs, etc.

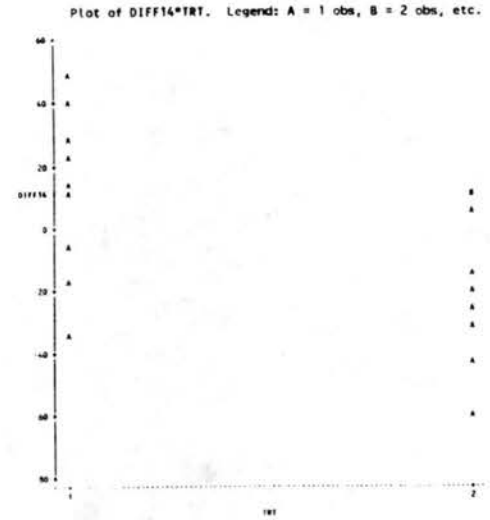

Plot of DIFF9*TRT. Legend: A = 1 obs, B = 2 obs, etc.

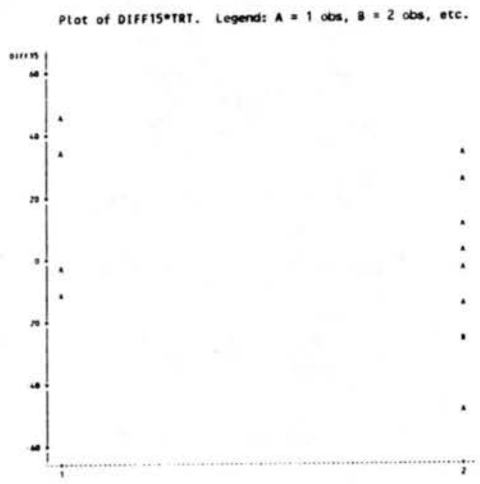

Plot of DIFF10*TRT. Legend: A = 1 obs, B = 2 obs, etc.

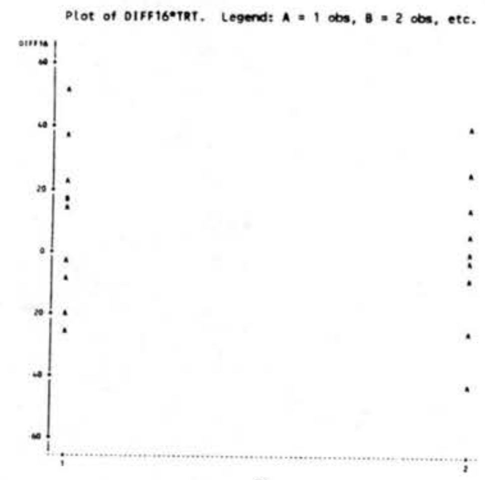

Plot of DIFF11*TRT. Legend: A = 1 obs, B = 2 obs, etc.

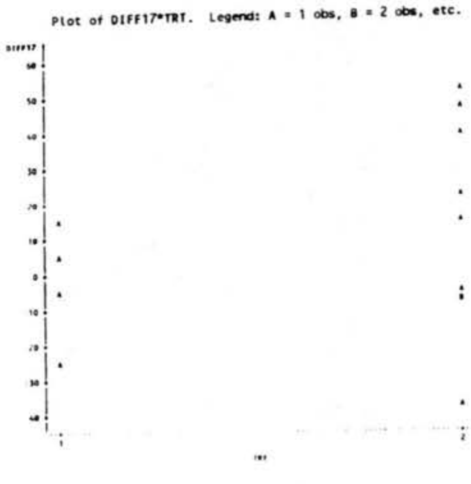

Plot of DIFF12*TRT. Legend: A = 1 obs, B = 2 obs, etc.

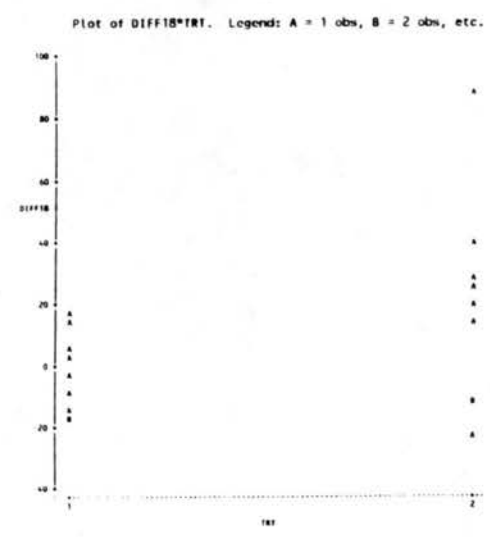

Plot of DIFF13*TRT. Legend: A = 1 obs, B = 2 obs, etc.


Plot of DIFF14*TRT. Legend: A = 1 obs, B = 2 obs, etc.

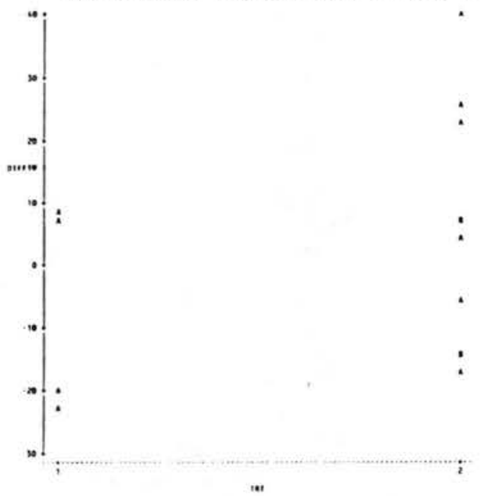

Plot of DIFF15*TRT. Legend: A = 1 obs, B = 2 obs, etc.


Plot of DIFF16*TRT. Legend: A = 1 obs, B = 2 obs, etc.

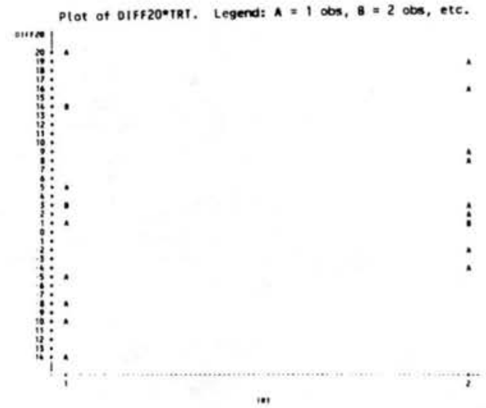

Plot of DIFF17*TRT. Legend: A = 1 obs, B = 2 obs, etc.


Plot of DIFF18*TRT. Legend: A = 1 obs, B = 2 obs, etc.

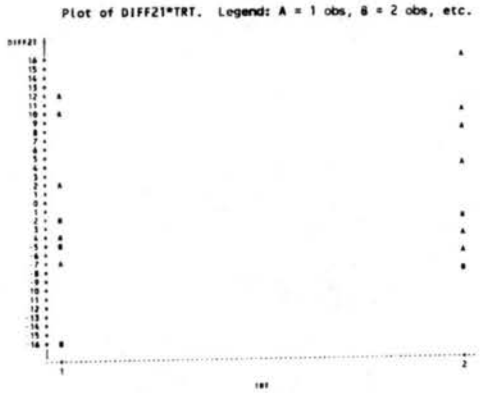
Plot of DIFF19*TRT. Legend: A = 1 obs, B = 2 obs, etc.



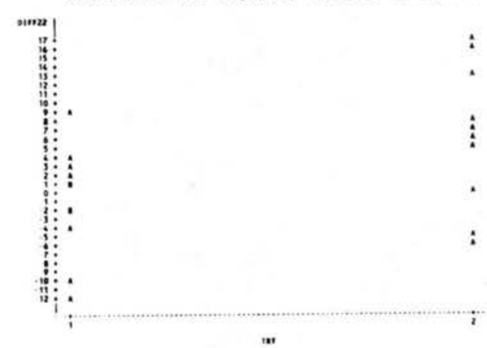
Plot of DIFF20*TRT. Legend: A = 1 obs, B = 2 obs, etc.



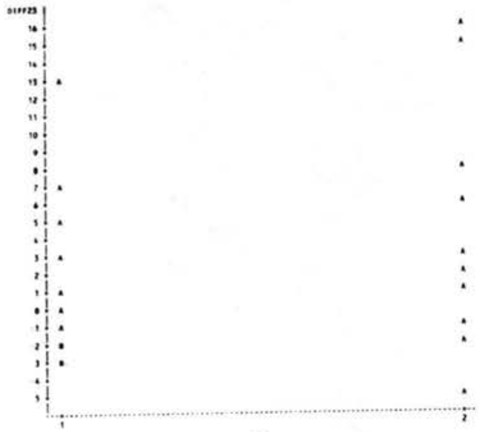
Plot of DIFF21*TRT. Legend: A = 1 obs, B = 2 obs, etc.



Plot of DIFF22*TRT. Legend: A = 1 obs, B = 2 obs, etc.



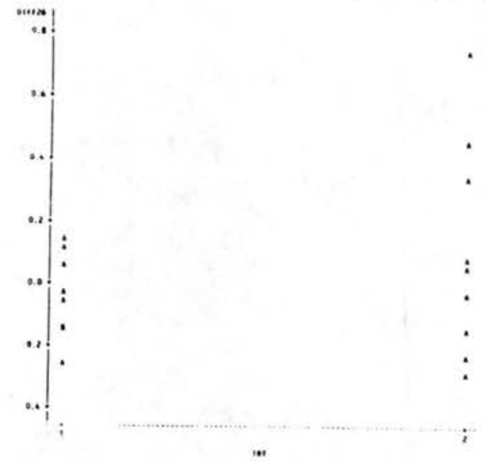
Plot of DIFF23*TRT. Legend: A = 1 obs, B = 2 obs, etc.



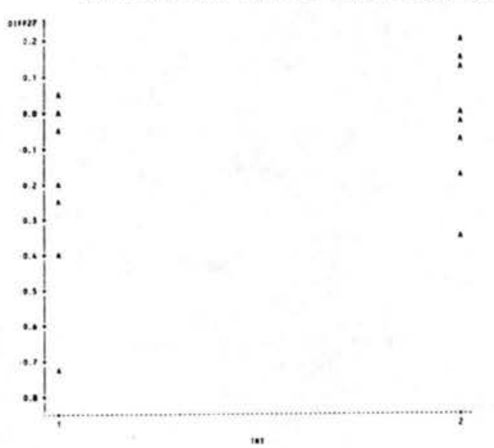
Plot of DIFF24*TRT. Legend: A = 1 obs, B = 2 obs, etc.

Plot of DIFF25*TRT. Legend: A = 1 obs, B = 2 obs, etc.

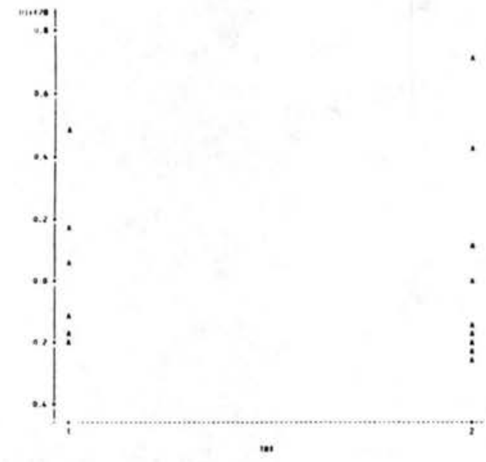
Plot of DIFF26*TRT. Legend: A = 1 obs, B = 2 obs, etc.



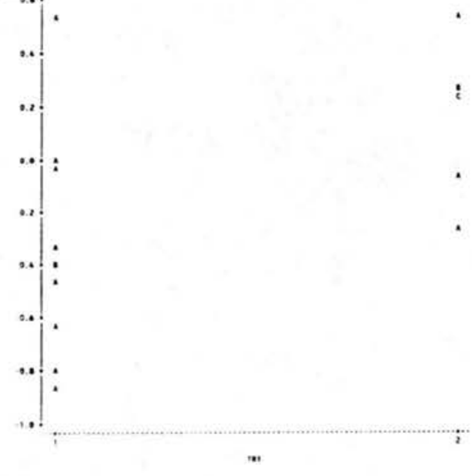
Plot of DIFF27*TRT. Legend: A = 1 obs, B = 2 obs, etc.



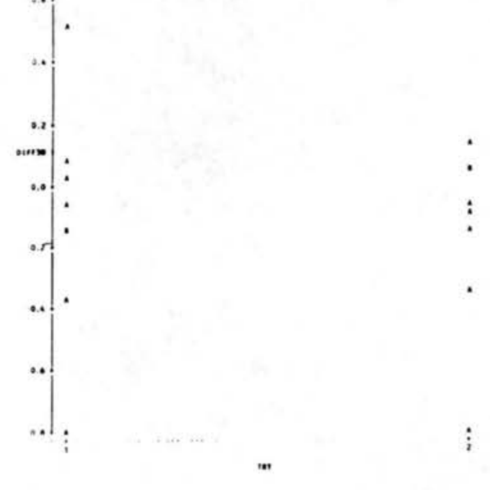
Plot of DIFF28*TRT. Legend: A = 1 obs, B = 2 obs, etc.



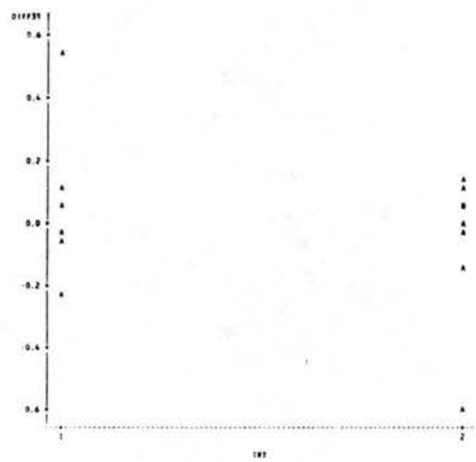
Plot of DIFF29*TRT. Legend: A = 1 obs, B = 2 obs, etc.



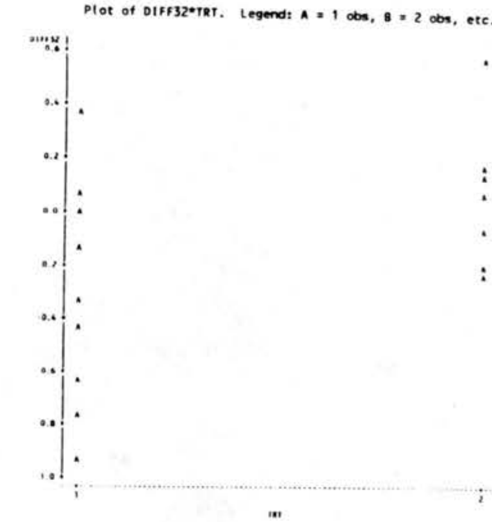
Plot of DIFF30*TRT. Legend: A = 1 obs, B = 2 obs, etc.



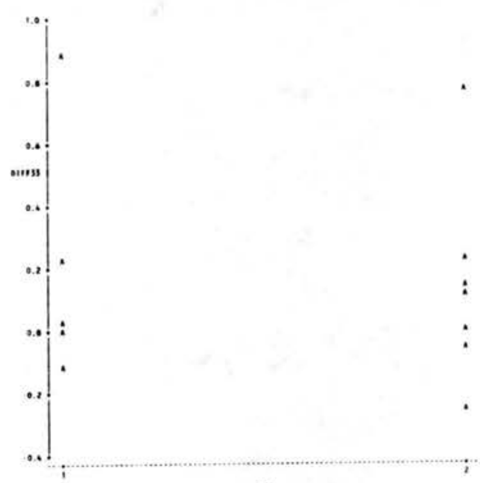
Plot of DIFF31*TRT. Legend: A = 1 obs, B = 2 obs, etc.



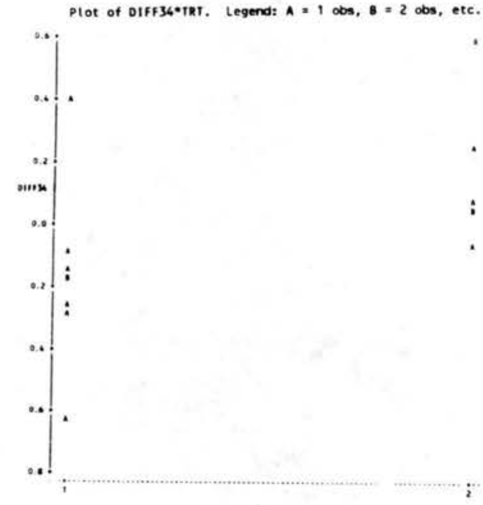
Plot of DIFF32*TRT. Legend: A = 1 obs, B = 2 obs, etc.



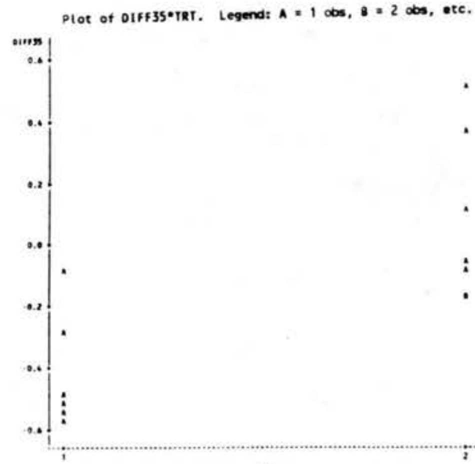
Plot of DIFF33*TRT. Legend: A = 1 obs, B = 2 obs, etc.



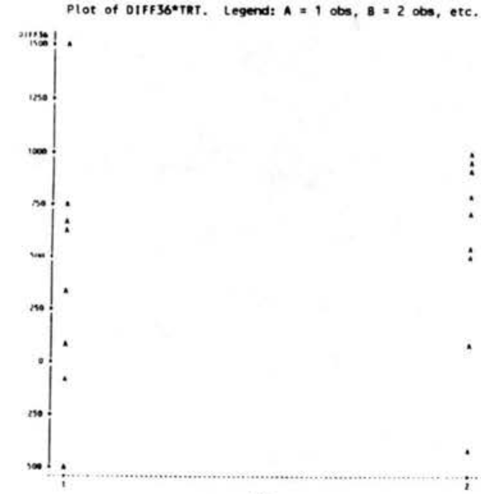
Plot of DIFF34*TRT. Legend: A = 1 obs, B = 2 obs, etc.

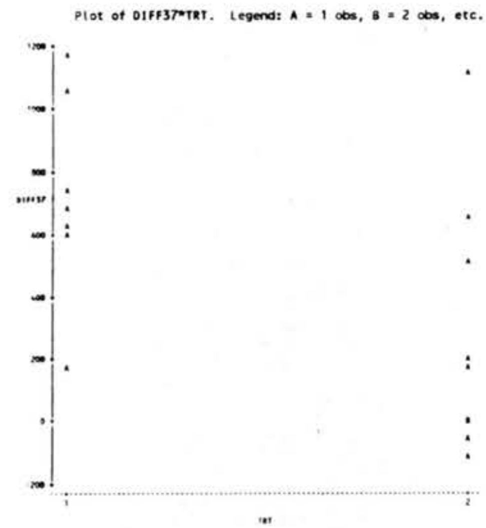


Plot of DIFF35*TRT. Legend: A = 1 obs, B = 2 obs, etc.

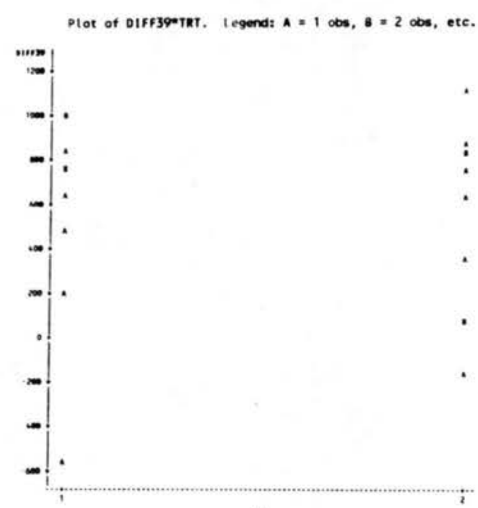


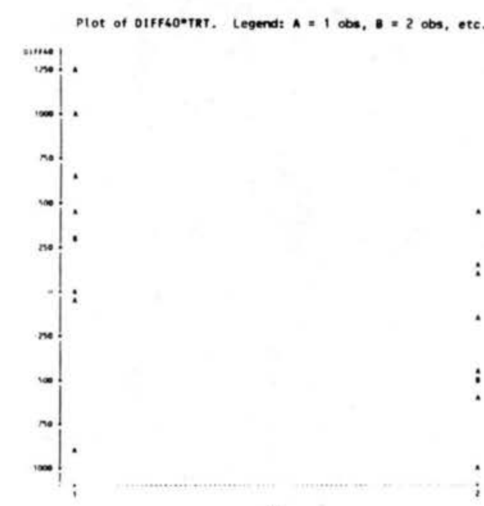
Plot of DIFF36*TRT. Legend: A = 1 obs, B = 2 obs, etc.

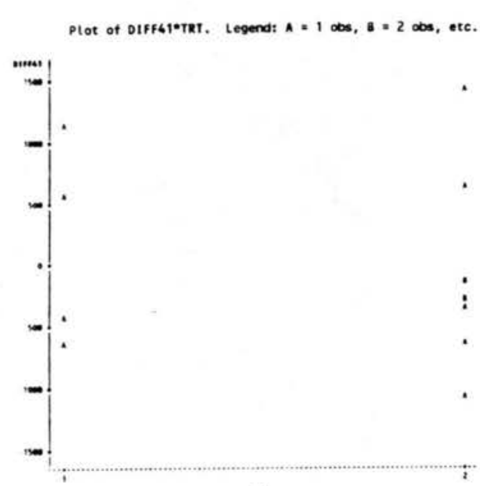


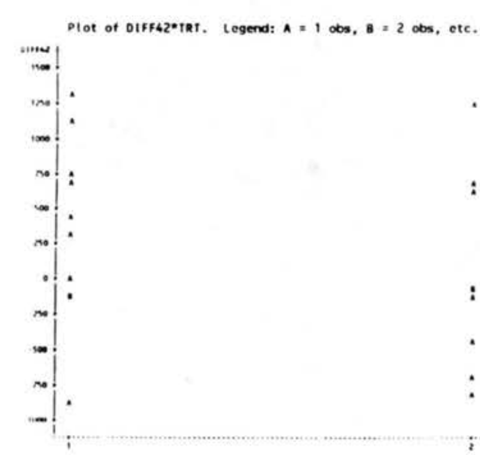

Plot of DIFF37*TRT. Legend: A = 1 obs, B = 2 obs, etc.


Plot of DIFF38*TRT. Legend: A = 1 obs, B = 2 obs, etc.

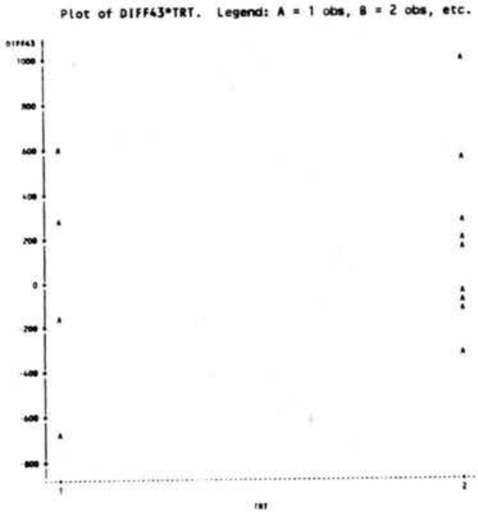

Plot of DIFF39*TRT. Legend: A = 1 obs, B = 2 obs, etc.


Plot of DIFF40*TRT. Legend: A = 1 obs, B = 2 obs, etc.

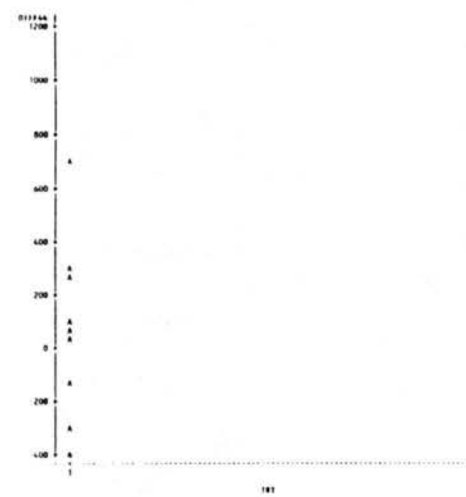

Plot of DIFF41*TRT. Legend: A = 1 obs, B = 2 obs, etc.


Plot of DIFF42*TRT. Legend: A = 1 obs, B = 2 obs, etc.

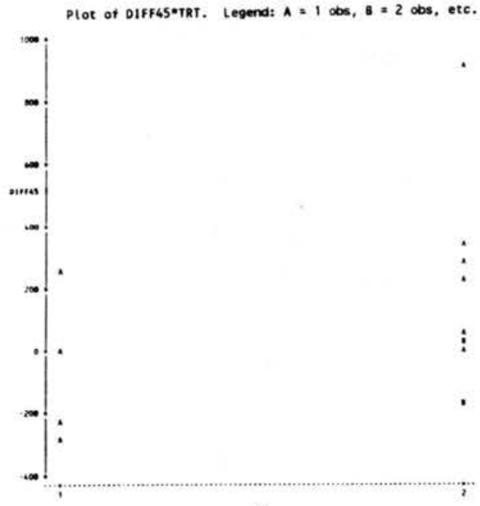
Plot of DIFF43*TRT. Legend: A = 1 obs, B = 2 obs, etc.



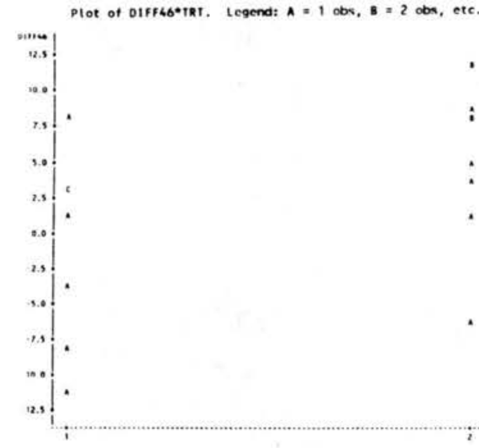
Plot of DIFF44*TRT. Legend: A = 1 obs, B = 2 obs, etc.



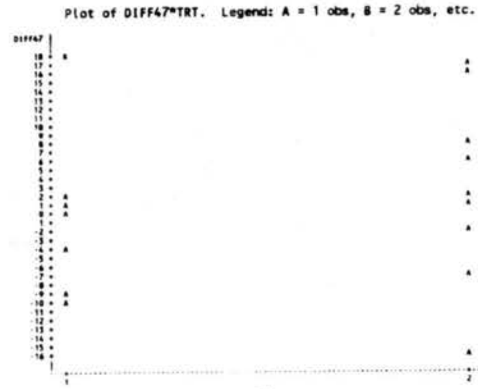
Plot of DIFF45*TRT. Legend: A = 1 obs, B = 2 obs, etc.



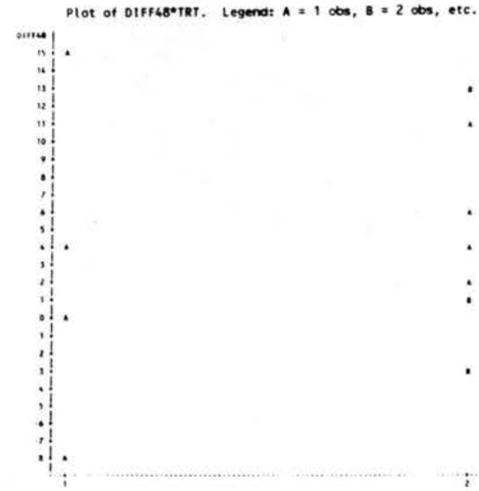
Plot of DIFF46*TRT. Legend: A = 1 obs, B = 2 obs, etc.



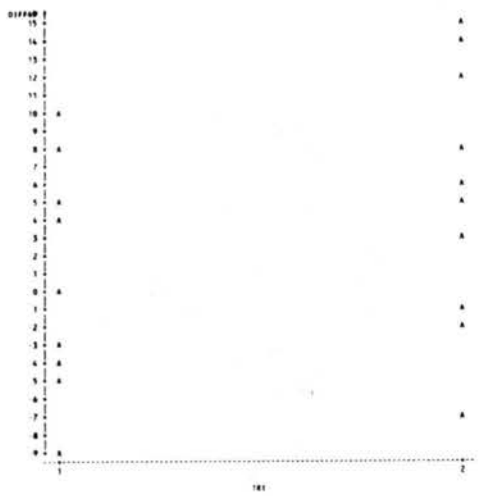
Plot of DIFF47*TRT. Legend: A = 1 obs, B = 2 obs, etc.



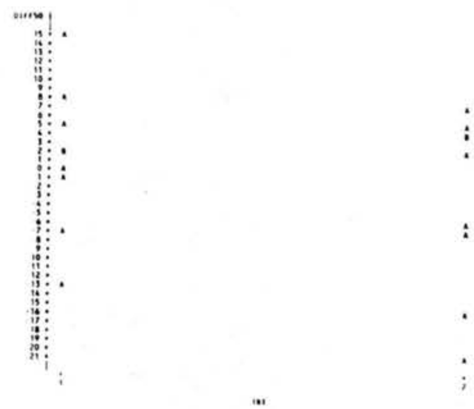
Plot of DIFF48*TRT. Legend: A = 1 obs, B = 2 obs, etc.



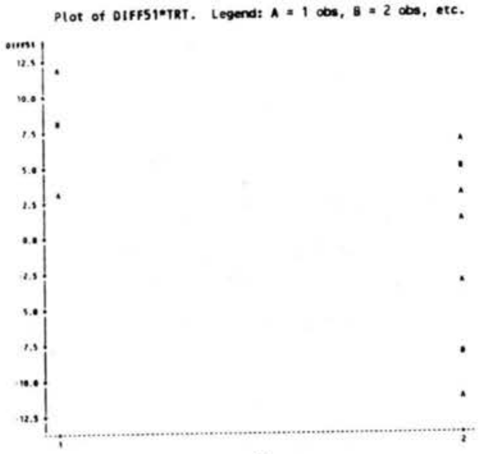
Plot of DIFF49*TRT. Legend: A = 1 obs, B = 2 obs, etc.



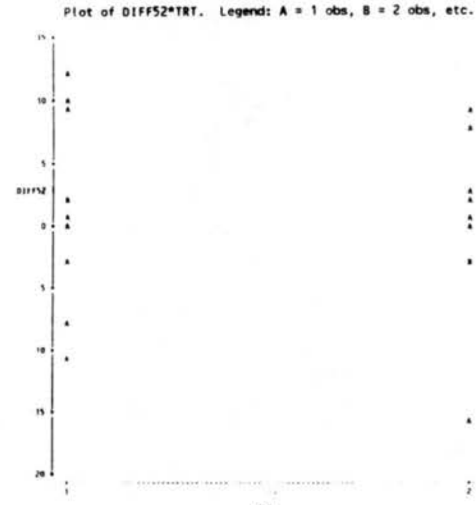
Plot of DIFF50*TRT. Legend: A = 1 obs, B = 2 obs, etc.



Plot of DIFF51*TRT. Legend: A = 1 obs, B = 2 obs, etc.



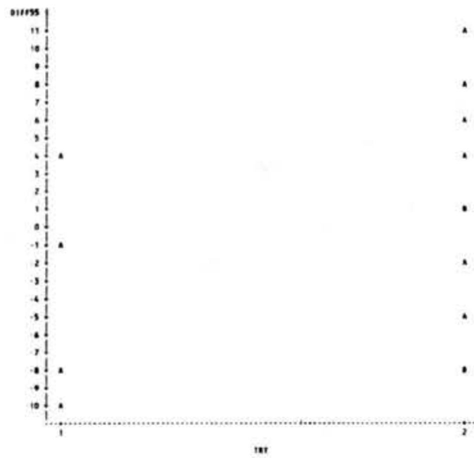
Plot of DIFF52*TRT. Legend: A = 1 obs, B = 2 obs, etc.



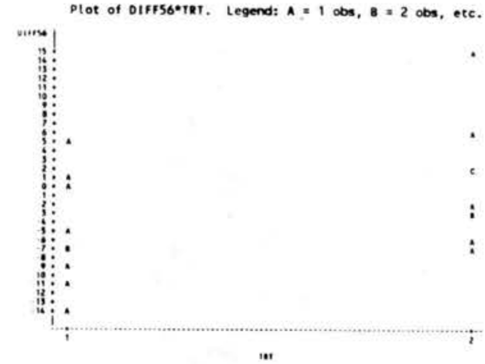
Plot of DIFF53*TRT. Legend: A = 1 obs, B = 2 obs, etc.

Plot of DIFF54*TRT. Legend: A = 1 obs, B = 2 obs, etc.

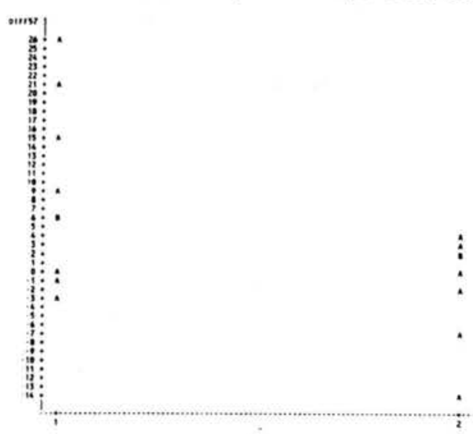
Plot of DIFF55*TRT. Legend: A = 1 obs, B = 2 obs, etc.



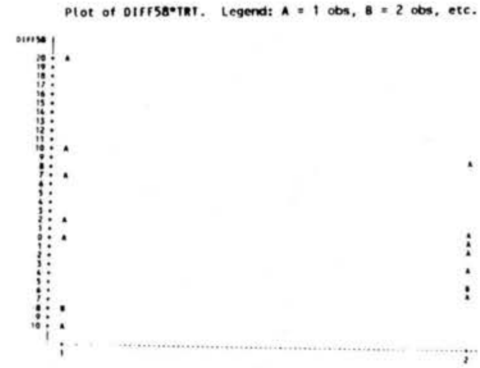
Plot of DIFF56*TRT. Legend: A = 1 obs, B = 2 obs, etc.



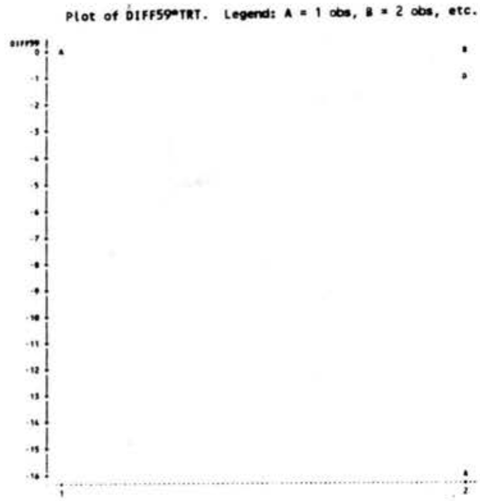
Plot of DIFF57*TRT. Legend: A = 1 obs, B = 2 obs, etc.



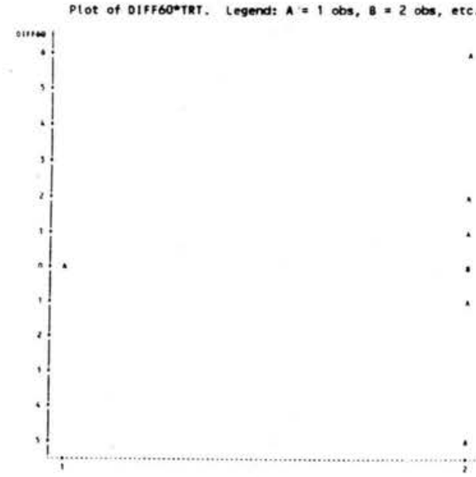
Plot of DIFF58*TRT. Legend: A = 1 obs, B = 2 obs, etc.



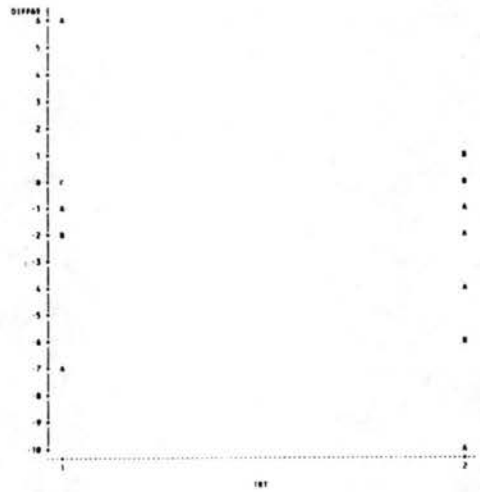
Plot of DIFF59*TRT. Legend: A = 1 obs, B = 2 obs, etc.



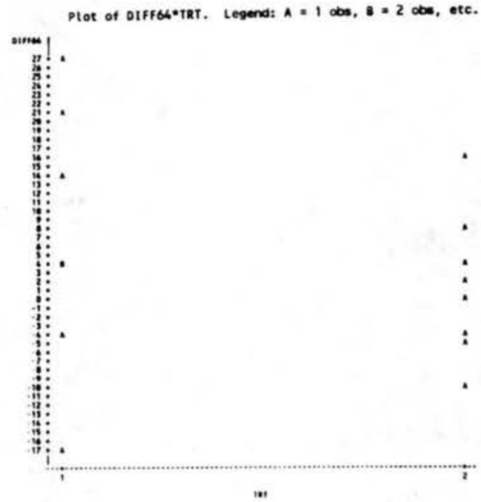
Plot of DIFF60*TRT. Legend: A = 1 obs, B = 2 obs, etc.



Plot of DIFF61*TRT. Legend: A = 1 obs, B = 2 obs, etc.



Plot of DIFF64*TRT. Legend: A = 1 obs, B = 2 obs, etc.



Analysis of Variance Tables
Produced by
General Linear Models Procedure

General Linear Models Procedure

Dependent Variable: DIFF1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.03741548	0.01247183	6.96	0.0029
TRT	1	0.03416682	0.03416682	19.07	0.0004
SEX	1	0.00228153	0.00228153	1.27	0.2747
TRT*SEX	1	0.00425506	0.00425506	2.38	0.1417
Error	17	0.03045119	0.00179125		
Corrected Total	20	0.06786667			

R-Square	C.V.	Root MSE	DIFF1 Mean
0.551309	90.69240	0.04232312	0.04666667

General Linear Models Procedure

Dependent Variable: DIFF2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.00320595	0.00106865	0.47	0.7077
TRT	1	0.00313251	0.00313251	1.38	0.2571
SEX	1	0.00000016	0.00000016	0.00	0.9935
TRT*SEX	1	0.00002663	0.00002663	0.01	0.9152
Error	17	0.03871786	0.00227752		
Corrected Total	20	0.04192381			

R-Square	C.V.	Root MSE	DIFF2 Mean
0.076471	400.8764	0.04772338	0.01190476

General Linear Models Procedure

Dependent Variable: DIFF3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.02005238	0.00668413	2.43	0.1009
TRT	1	0.01660847	0.01660847	6.03	0.0251
SEX	1	0.00224377	0.00224377	0.81	0.3793
TRT*SEX	1	0.00360847	0.00360847	1.31	0.2681
Error	17	0.04680476	0.00275322		
Corrected Total	20	0.06685714			

R-Square	C.V.	Root MSE	DIFF3 Mean
0.299929	89.58489	0.05247115	0.05857143

General Linear Models Procedure

Dependent Variable: DIFF4

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	13.50226190	4.50075397	6.60	0.0037
TRT	1	12.41521183	12.41521183	18.21	0.0005
SEX	1	0.58285889	0.58285889	0.85	0.3681
TRT*SEX	1	2.02315301	2.02315301	2.97	0.1031
Error	17	11.59011905	0.68177171		
Corrected Total	20	25.09238095			

R-Square	C.V.	Root MSE	DIFF4 Mean
0.538102	234.3188	0.82569468	0.35238095

General Linear Models Procedure

Dependent Variable: DIFF5

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.47523810	0.49174603	0.66	0.5881
TRT	1	1.16571429	1.16571429	1.56	0.2281
SEX	1	0.27453782	0.27453782	0.37	0.5520
TRT*SEX	1	0.06453782	0.06453782	0.09	0.7722
Error	17	12.67428571	0.74554622		
Corrected Total	20	14.14952381			

R-Square	C.V.	Root MSE	DIFF5 Mean
0.104261	-442.2550	0.86345018	-0.19523810

General Linear Models Procedure

Dependent Variable: DIFF6

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	6.42845238	2.14281746	3.02	0.0583
TRT	1	5.97235469	5.97235469	8.43	0.0099
SEX	1	0.05735469	0.05735469	0.08	0.7794
TRT*SEX	1	1.36500175	1.36500175	1.93	0.1830
Error	17	12.04297619	0.70841036		
Corrected Total	20	18.47142857			

R-Square	C.V.	Root MSE	DIFF6 Mean
0.348021	535.6089	0.84167117	0.15714286

General Linear Models Procedure

Dependent Variable: DIFF7

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	148.68842857	49.56280952	1.65	0.2184
TRT	1	88.33587302	88.33587302	2.93	0.1060
SEX	1	24.19240635	24.19240635	0.80	0.3833
TRT*SEX	1	53.10262857	53.10262857	1.76	0.2028
Error	16	481.69357143	30.10584821		
Corrected Total	19	630.38200000			

R-Square	C.V.	Root MSE	DIFF7 Mean
0.235870	3227.576	5.48687964	0.17000000

General Linear Models Procedure

Dependent Variable: DIFF8

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	26.15402381	8.71800794	0.52	0.6741
TRT	1	11.46026825	11.46026825	0.68	0.4202
SEX	1	2.63733492	2.63733492	0.16	0.6967
TRT*SEX	1	5.66400159	5.66400159	0.34	0.5689
Error	16	267.89797619	16.74362351		
Corrected Total	19	294.05200000			

R-Square	C.V.	Root MSE	DIFF8 Mean
0.088944	101.7885	4.09189730	4.02000000

General Linear Models Procedure

Dependent Variable: DIFF9

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	161.17835714	53.72611905	1.49	0.2550
TRT	1	36.16115714	36.16115714	1.00	0.3315
SEX	1	42.80515714	42.80515714	1.19	0.2920
TRT*SEX	1	93.45226825	93.45226825	2.59	0.1269
Error	16	576.75964286	36.04747768		
Corrected Total	19	737.93800000			

R-Square	C.V.	Root MSE	DIFF9 Mean
0.218417	143.2925	6.00395517	4.19000000

General Linear Models Procedure

Dependent Variable: DIFF10

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1533.80334314	511.26778105	1.16	0.3638
TRT	1	980.05671891	980.05671891	2.22	0.1604
SEX	1	198.85940547	198.85940547	0.45	0.5142
TRT*SEX	1	187.46209204	187.46209204	0.42	0.5264
Error	13	5749.47783333	442.26752564		
Corrected Total	16	7283.28117647			

R-Square	C.V.	Root MSE	DIFF10 Mean
0.210592	88.95563	21.03015753	23.64117647

General Linear Models Procedure

Dependent Variable: DIFF11

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	3325.52200000	1108.50733333	1.04	0.4096
TRT	1	37.93567391	37.93567391	0.04	0.8534
SEX	1	972.66784783	972.66784783	0.91	0.3580
TRT*SEX	1	2222.44176087	2222.44176087	2.09	0.1741
Error	12	12776.81550000	1064.73462500		
Corrected Total	15	16102.33750000			
	R-Square	C.V.	Root MSE		DIFF11 Mean
	0.206524	178.1858	32.63027160		18.31250000

General Linear Models Procedure

Dependent Variable: DIFF12

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	999.81928571	499.90964286	0.50	0.6212
TRT	1	749.77350000	749.77350000	0.75	0.4063
SEX	1	647.47350000	647.47350000	0.64	0.4393
TRT*SEX	0	0.00000000	.	.	.
Error	11	11059.19500000	1005.38136364		
Corrected Total	13	12059.01428571			
	R-Square	C.V.	Root MSE		DIFF12 Mean
	0.082911	137.0088	31.70774927		23.14285714

General Linear Models Procedure

Dependent Variable: DIFF13

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	2496.19254386	832.06418129	1.22	0.3375
TRT	1	764.16484848	764.16484848	1.12	0.3070
SEX	1	204.75272727	204.75272727	0.30	0.5921
TRT*SEX	1	2173.23757576	2173.23757576	3.18	0.0947
Error	15	10248.05166667	683.20344444		
Corrected Total	18	12744.24421053			
	R-Square	C.V.	Root MSE		DIFF13 Mean
	0.195868	117.0182	26.13816069		22.33684211

General Linear Models Procedure

Dependent Variable: DIFF14

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	5830.25144444	1943.41714815	2.95	0.0691
TRT	1	2981.44042105	2981.44042105	4.53	0.0516
SEX	1	1168.18755556	1168.18755556	1.77	0.2042
TRT*SEX	1	466.57141520	466.57141520	0.71	0.4141
Error	14	9220.25300000	658.58950000		
Corrected Total	17	15050.50444444			
	R-Square	C.V.	Root MSE		DIFF14 Mean
	0.387379	-871.5735	25.66299866		-2.94444444

General Linear Models Procedure

Dependent Variable: DIFF15

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1466.12050000	733.06025000	0.95	0.4189
TRT	1	741.35605556	741.35605556	0.96	0.3500
SEX	1	144.36355556	144.36355556	0.19	0.6745
TRT*SEX	0	0.00000000	.	.	.
Error	10	7712.71950000	771.27195000		
Corrected Total	12	9178.84000000			
	R-Square	C.V.	Root MSE		DIFF15 Mean
	0.159728	1542.877	27.77178334		1.80000000

General Linear Models Procedure

Dependent Variable: DIFF16

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	880.39683083	293.46561028	0.44	0.7257
TRT	1	321.35553195	321.35553195	0.49	0.4967
SEX	1	390.26699725	390.26699725	0.59	0.4546
TRT*SEX	1	1.83069905	1.83069905	0.00	0.9588
Error	15	9935.09264286	662.33950952		
Corrected Total	18	10815.48947368			

R-Square	C.V.	Root MSE	DIFF16 Mean
0.081401	436.5921	25.73595752	5.89473684

General Linear Models Procedure

Dependent Variable: DIFF17

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	714.74123077	357.37061538	0.44	0.6569
TRT	1	629.44200000	629.44200000	0.77	0.4001
SEX	1	8.27755556	8.27755556	0.01	0.9217
TRT*SEX	0	0.00000000	.	.	.
Error	10	8150.78800000	815.07880000		
Corrected Total	12	8865.52923077			

R-Square	C.V.	Root MSE	DIFF17 Mean
0.080620	335.5738	28.54958494	8.50769231

General Linear Models Procedure

Dependent Variable: DIFF18

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	2675.07250000	891.69083333	1.30	0.3125
TRT	1	1400.44802632	1400.44802632	2.05	0.1745
SEX	1	230.82814327	230.82814327	0.34	0.5706
TRT*SEX	1	432.00007310	432.00007310	0.63	0.4402
Error	14	9580.76750000	684.34053571		
Corrected Total	17	12255.84000000			

R-Square	C.V.	Root MSE	DIFF18 Mean
0.218269	317.7316	26.15990321	8.23333333

General Linear Models Procedure

Dependent Variable: DIFF19

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	441.51845238	220.75922619	0.57	0.5800
TRT	1	392.19266667	392.19266667	1.02	0.3348
SEX	1	2.20416667	2.20416667	0.01	0.9411
TRT*SEX	0	0.00000000	.	.	.
Error	11	4240.69583333	385.51780303		
Corrected Total	13	4682.21428571			

R-Square	C.V.	Root MSE	DIFF19 Mean
0.094297	954.4601	19.63460728	2.05714286

General Linear Models Procedure

Dependent Variable: DIFF20

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	154.11904762	51.37301587	0.55	0.6552
TRT	1	23.19607843	23.19607843	0.25	0.6247
SEX	1	12.38725490	12.38725490	0.13	0.7203
TRT*SEX	1	85.78431373	85.78431373	0.92	0.3515
Error	17	1588.83333333	93.46078431		
Corrected Total	20	1742.95238095			

R-Square	C.V.	Root MSE	DIFF20 Mean
0.088424	267.1286	9.66751180	3.61904762

General Linear Models Procedure

Dependent Variable: DIFF21

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	232.29761905	77.43253968	1.06	0.3931
TRT	1	130.38672969	130.38672969	1.78	0.1997
SEX	1	0.38672969	0.38672969	0.01	0.9429
TRT*SEX	1	155.68084734	155.68084734	2.13	0.1631
Error	17	1244.94047619	73.23179272		
Corrected Total	20	1477.23809524			

R-Square	C.V.	Root MSE	DIFF21 Mean
0.157251	-718.8348	8.55755764	-1.19047619

General Linear Models Procedure

Dependent Variable: DIFF22

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	275.53571429	91.84523810	1.68	0.2090
TRT	1	263.57300420	263.57300420	4.82	0.0423
SEX	1	8.39653361	8.39653361	0.15	0.7000
TRT*SEX	1	10.33771008	10.33771008	0.19	0.6692
Error	17	929.60714286	54.68277311		
Corrected Total	20	1205.14285714			

R-Square	C.V.	Root MSE	DIFF22 Mean
0.228633	304.4909	7.39478013	2.42857143

General Linear Models Procedure

Dependent Variable: DIFF23

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	94.26190476	31.42063492	0.84	0.4890
TRT	1	17.48179272	17.48179272	0.47	0.5026
SEX	1	1.01120448	1.01120448	0.03	0.8711
TRT*SEX	1	56.48179272	56.48179272	1.52	0.2351
Error	17	633.54761905	37.26750700		
Corrected Total	20	727.80952381			

R-Square	C.V.	Root MSE	DIFF23 Mean
0.129515	210.1622	6.10471187	2.90476190

General Linear Models Procedure

Dependent Variable: DIFF24

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	83.44047619	27.81349206	0.61	0.6170
TRT	1	21.32370448	21.32370448	0.47	0.5029
SEX	1	60.73546919	60.73546919	1.33	0.2640
TRT*SEX	1	6.79429272	6.79429272	0.15	0.7040
Error	17	773.79761905	45.51750700		
Corrected Total	20	857.23809524			

R-Square	C.V.	Root MSE	DIFF24 Mean
0.097336	1288.000	6.74666636	0.52380952

General Linear Models Procedure

Dependent Variable: DIFF25

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	197.55952381	65.85317460	1.31	0.3051
TRT	1	77.42034314	77.42034314	1.53	0.2322
SEX	1	77.42034314	77.42034314	1.53	0.2322
TRT*SEX	1	24.09681373	24.09681373	0.48	0.4988
Error	17	857.58333333	50.44607843		
Corrected Total	20	1055.14285714			

R-Square	C.V.	Root MSE	DIFF25 Mean
0.187235	207.1574	7.10254028	3.42857143

General Linear Models Procedure

Dependent Variable: DIFF26

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.39530539	0.13176846	2.25	0.1310
TRT	1	0.10885223	0.10885223	1.86	0.1959
SEX	1	0.15454579	0.15454579	2.64	0.1283
TRT*SEX	1	0.12540816	0.12540816	2.14	0.1671
Error	13	0.76134167	0.05856474		
Corrected Total	16	1.15664706			

R-Square	C.V.	Root MSE	DIFF26 Mean
0.341768	632.9271	0.24200154	0.03823529

General Linear Models Procedure

Dependent Variable: DIFF27

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.26030667	0.08676889	1.64	0.2365
TRT	1	0.20007204	0.20007204	3.78	0.0777
SEX	1	0.00189493	0.00189493	0.04	0.8533
TRT*SEX	1	0.10392876	0.10392876	1.97	0.1884
Error	11	0.58145333	0.05285939		
Corrected Total	14	0.84176000			

R-Square	C.V.	Root MSE	DIFF27 Mean
0.309241	-201.6769	0.22991171	-0.11400000

General Linear Models Procedure

Dependent Variable: DIFF28

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.07262333	0.02420778	0.22	0.8777
TRT	1	0.00425000	0.00425000	0.04	0.8464
SEX	1	0.06213235	0.06213235	0.58	0.4642
TRT*SEX	1	0.00013235	0.00013235	0.00	0.9727
Error	11	1.18855000	0.10805000		
Corrected Total	14	1.26117333			

R-Square	C.V.	Root MSE	DIFF28 Mean
0.057584	1049.073	0.32870960	0.03133333

General Linear Models Procedure

Dependent Variable: DIFF29

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.47029778	0.49009926	3.98	0.0305
TRT	1	1.37922292	1.37922292	11.19	0.0048
SEX	1	0.00047906	0.00047906	0.00	0.9512
TRT*SEX	1	0.29050012	0.29050012	2.36	0.1470
Error	14	1.72506333	0.12321881		
Corrected Total	17	3.19536111			

R-Square	C.V.	Root MSE	DIFF29 Mean
0.460135	-311.2540	0.35102537	-0.11277778

General Linear Models Procedure

Dependent Variable: DIFF30

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.40594042	0.13531347	1.33	0.3118
TRT	1	0.00495042	0.00495042	0.05	0.8294
SEX	1	0.40098375	0.40098375	3.93	0.0709
TRT*SEX	1	0.00040042	0.00040042	0.00	0.9511
Error	12	1.22485333	0.10207111		
Corrected Total	15	1.63079375			

R-Square	C.V.	Root MSE	DIFF30 Mean
0.248922	-254.3170	0.31948570	-0.12562500

General Linear Models Procedure

Dependent Variable: DIFF31

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.24236333	0.08078778	1.50	0.2731
TRT	1	0.05640026	0.05640026	1.05	0.3298
SEX	1	0.05640026	0.05640026	1.05	0.3298
TRT*SEX	1	0.06695410	0.06695410	1.25	0.2905
Error	10	0.53758667	0.05375867		
Corrected Total	13	0.77995000			

R-Square	C.V.	Root MSE	DIFF31 Mean
0.310742	-4637.183	0.23185915	-0.00500000

General Linear Models Procedure

Dependent Variable: DIFF32

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.87088333	0.29029444	2.18	0.1440
TRT	1	0.61815641	0.61815641	4.63	0.0524
SEX	1	0.29815641	0.29815641	2.23	0.1608
TRT*SEX	1	0.00020769	0.00020769	0.00	0.9692
Error	12	1.60161667	0.13346806		
Corrected Total	15	2.47250000			

R-Square	C.V.	Root MSE	DIFF32 Mean
0.352228	-239.5625	0.36533280	-0.15250000

General Linear Models Procedure

Dependent Variable: DIFF33

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.05683000	0.01894333	0.12	0.9444
TRT	1	0.00361846	0.00361846	0.02	0.8824
SEX	1	0.01736205	0.01736205	0.11	0.7465
TRT*SEX	1	0.01216205	0.01216205	0.08	0.7865
Error	8	1.24047000	0.15505875		
Corrected Total	11	1.29730000			

R-Square	C.V.	Root MSE	DIFF33 Mean
0.043806	238.6515	0.39377500	0.16500000

General Linear Models Procedure

Dependent Variable: DIFF34

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.61202000	0.20400667	2.18	0.1483
TRT	1	0.60853025	0.60853025	6.50	0.0271
SEX	1	0.00032328	0.00032328	0.00	0.9542
TRT*SEX	1	0.00937801	0.00937801	0.10	0.7576
Error	11	1.03055333	0.09368667		
Corrected Total	14	1.64257333			

R-Square	C.V.	Root MSE	DIFF34 Mean
0.372598	1639.729	0.30608278	0.01866667

General Linear Models Procedure

Dependent Variable: DIFF35

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.77253769	0.25751256	3.91	0.0485
TRT	1	0.59248474	0.59248474	9.00	0.0150
SEX	1	0.00328474	0.00328474	0.05	0.8282
TRT*SEX	1	0.01168474	0.01168474	0.18	0.6834
Error	9	0.59257000	0.06584111		
Corrected Total	12	1.36510769			

R-Square	C.V.	Root MSE	DIFF35 Mean
0.565917	-166.7869	0.25659523	-0.15384615

General Linear Models Procedure

Dependent Variable: DIFF36

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	297137.80784314	99045.93594771	0.31	0.8167
TRT	1	182931.82189055	182931.82189055	0.58	0.4616
SEX	1	154702.44875622	154702.44875622	0.49	0.4977
TRT*SEX	1	111611.22487562	111611.22487562	0.35	0.5636
Error	13	4131867.13333333	317835.93333333		
Corrected Total	16	4429004.94117647			

R-Square	C.V.	Root MSE	DIFF36 Mean
0.067089	113.9063	563.76939730	494.94117647

General Linear Models Procedure

Dependent Variable: DIFF37

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	974242.55000000	324747.51666667	2.19	0.1420
TRT	1	445289.87826087	445289.87826087	3.00	0.1087
SEX	1	94925.35652174	94925.35652174	0.64	0.4392
TRT*SEX	1	156032.13913043	156032.13913043	1.05	0.3252
Error	12	1778989.20000000	148249.10000000		
Corrected Total	15	2753231.75000000			

R-Square	C.V.	Root MSE	DIFF37 Mean
0.353854	81.89977	385.03129743	470.12500000

General Linear Models Procedure

Dependent Variable: DIFF38

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	528212.88095238	264106.44047619	1.02	0.3913
TRT	1	528094.01666667	528094.01666667	2.05	0.1804
SEX	1	90404.01666667	90404.01666667	0.35	0.5660
TRT*SEX	0	0.00000000	.	.	.
Error	11	2839764.83333333	258160.43939394		
Corrected Total	13	3367977.71428572			

R-Square	C.V.	Root MSE	DIFF38 Mean
0.156834	101.5900	508.09491180	500.14285714

General Linear Models Procedure

Dependent Variable: DIFF39

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	240083.78947368	80027.92982456	0.36	0.7834
TRT	1	3840.48484848	3840.48484848	0.02	0.8973
SEX	1	61793.45454545	61793.45454545	0.28	0.6062
TRT*SEX	1	190608.00000000	190608.00000000	0.86	0.3697
Error	15	3343368.00000000	222891.20000000		
Corrected Total	18	3583451.78947369			

R-Square	C.V.	Root MSE	DIFF39 Mean
0.066998	84.74405	472.11354566	557.10526316

General Linear Models Procedure

Dependent Variable: DIFF40

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1722241.46666667	574080.48888889	1.69	0.2138
TRT	1	1548979.72397661	1548979.72397661	4.57	0.0506
SEX	1	2398.39064327	2398.39064327	0.01	0.9341
TRT*SEX	1	12293.05730994	12293.05730994	0.04	0.8517
Error	14	4743163.03333333	338797.35952381		
Corrected Total	17	6465404.50000000			

R-Square	C.V.	Root MSE	DIFF40 Mean
0.266378	2066.496	582.06302023	28.16666667

General Linear Models Procedure

Dependent Variable: DIFF41

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	223426.37307692	111713.18653846	0.18	0.8409
TRT	1	220920.20000000	220920.20000000	0.35	0.5679
SEX	1	26913.33888889	26913.33888889	0.04	0.8408
TRT*SEX	0	0.00000000	.	.	.
Error	10	6335010.55000000	633501.05500000		
Corrected Total	12	6558436.92307692			

R-Square	C.V.	Root MSE	DIFF41 Mean
0.034067	-5716.608	795.92779509	-13.92307692

General Linear Models Procedure

Dependent Variable: DIFF42

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	720687.11729323	240229.03909774	0.48	0.6991
TRT	1	625483.32890195	625483.32890195	1.26	0.2798
SEX	1	158603.43172971	158603.43172971	0.32	0.5806
TRT*SEX	1	105014.88674256	105014.88674256	0.21	0.6525
Error	15	7461155.51428572	497410.36761905		
Corrected Total	18	8181842.63157895			

R-Square	C.V.	Root MSE	DIFF42 Mean
0.088084	351.8958	705.27325741	200.42105263

General Linear Models Procedure

Dependent Variable: DIFF43

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	82930.37692308	41465.18846154	0.19	0.8306
TRT	1	54322.93888889	54322.93888889	0.25	0.6294
SEX	1	2296.93888889	2296.93888889	0.01	0.9205
TRT*SEX	0	0.00000000	.	.	.
Error	10	2192586.70000000	219258.67000000		
Corrected Total	12	2275517.07692308			

R-Square	C.V.	Root MSE	DIFF43 Mean
0.036445	356.3969	468.25064869	131.38461538

General Linear Models Procedure

Dependent Variable: DIFF44

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	477825.47777778	159275.15925926	0.84	0.4924
TRT	1	158086.40467836	158086.40467836	0.84	0.3756
SEX	1	77382.40467836	77382.40467836	0.41	0.5323
TRT*SEX	1	133056.79064327	133056.79064327	0.70	0.4152
Error	14	2642380.13333333	188741.43809524		
Corrected Total	17	3120205.61111111			

R-Square	C.V.	Root MSE	DIFF44 Mean
0.153139	227.1272	434.44382617	191.27777778

General Linear Models Procedure

Dependent Variable: DIFF45

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	156784.59523810	78392.29761905	0.79	0.4779
TRT	1	156774.81666667	156774.81666667	1.58	0.2348
SEX	1	26000.01666667	26000.01666667	0.26	0.6188
TRT*SEX	0	0.00000000	.	.	.
Error	11	1091412.83333333	99219.34848485		
Corrected Total	13	1248197.42857143			

R-Square	C.V.	Root MSE	DIFF45 Mean
0.125609	343.9840	314.99102921	91.57142857

General Linear Models Procedure

Dependent Variable: DIFF46

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	361.08725490	120.36241830	4.21	0.0275
TRT	1	82.81815920	82.81815920	2.90	0.1124
SEX	1	180.99726368	180.99726368	6.34	0.0257
TRT*SEX	1	4.01218905	4.01218905	0.14	0.7139
Error	13	371.38333333	28.56794872		
Corrected Total	16	732.47058824			

R-Square	C.V.	Root MSE	DIFF46 Mean
0.492972	189.2985	5.34489932	2.82352941

General Linear Models Procedure

Dependent Variable: DIFF47

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	87.03750000	29.01250000	0.26	0.8563
TRT	1	65.81739130	65.81739130	0.58	0.4615
SEX	1	26.30434783	26.30434783	0.23	0.6392
TRT*SEX	1	34.51304348	34.51304348	0.30	0.5918
Error	12	1364.90000000	113.74166667		
Corrected Total	15	1451.93750000			

R-Square	C.V.	Root MSE	DIFF47 Mean
0.059946	741.9112	10.66497382	1.43750000

General Linear Models Procedure

Dependent Variable: DIFF48

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	12.50000000	6.25000000	0.11	0.8934
TRT	1	12.15000000	12.15000000	0.22	0.6471
SEX	1	3.75000000	3.75000000	0.07	0.7986
TRT*SEX	0	0.00000000	.	.	.
Error	11	603.50000000	54.86363636		
Corrected Total	13	616.00000000			

R-Square	C.V.	Root MSE	DIFF48 Mean
0.020292	185.1750	7.40699915	4.00000000

General Linear Models Procedure

Dependent Variable: DIFF49

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	103.70614035	34.56871345	0.65	0.5972
TRT	1	100.18939394	100.18939394	1.87	0.1912
SEX	1	1.28030303	1.28030303	0.02	0.8791
TRT*SEX	1	0.91666667	0.91666667	0.02	0.8976
Error	15	802.08333333	53.47222222		
Corrected Total	18	905.78947368			

R-Square	C.V.	Root MSE	DIFF49 Mean
0.114493	235.4863	7.31247032	3.10526316

General Linear Models Procedure

Dependent Variable: DIFF50

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	329.66111111	109.88703704	1.41	0.2800
TRT	1	40.24590643	40.24590643	0.52	0.4835
SEX	1	236.31608187	236.31608187	3.04	0.1030
TRT*SEX	1	14.28099415	14.28099415	0.18	0.6746
Error	14	1087.28333333	77.66309524		
Corrected Total	17	1416.94444444			

R-Square	C.V.	Root MSE	DIFF50 Mean
0.232656	-933.1059	8.81266675	-0.94444444

General Linear Models Procedure

Dependent Variable: DIFF51

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	357.81923077	178.90961538	7.07	0.0122
TRT	1	58.93888889	58.93888889	2.33	0.1579
SEX	1	145.80000000	145.80000000	5.76	0.0373
TRT*SEX	0	0.00000000	.	.	.
Error	10	252.95000000	25.29500000		
Corrected Total	12	610.76923077			

R-Square	C.V.	Root MSE	DIFF51 Mean
0.585850	297.1926	5.02941348	1.69230769

General Linear Models Procedure

Dependent Variable: DIFF52

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	212.52932331	70.84310777	1.44	0.2699
TRT	1	0.84700698	0.84700698	0.02	0.8973
SEX	1	202.22489901	202.22489901	4.12	0.0606
TRT*SEX	1	1.34058024	1.34058024	0.03	0.8710
Error	15	736.62857143	49.10857143		
Corrected Total	18	949.15789474			

R-Square	C.V.	Root MSE	DIFF52 Mean
0.223914	887.6484	7.00775081	0.78947368

General Linear Models Procedure

Dependent Variable: DIFF53

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	14.37307692	7.18653846	0.10	0.9067
TRT	1	6.42222222	6.42222222	0.09	0.7723
SEX	1	13.33888889	13.33888889	0.18	0.6774
TRT*SEX	0	0.00000000	.	.	.
Error	10	726.55000000	72.65500000		
Corrected Total	12	740.92307692			

R-Square	C.V.	Root MSE	DIFF53 Mean
0.019399	443.2371	8.52379024	1.92307692

General Linear Models Procedure

Dependent Variable: DIFF54

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	106.86111111	35.62037037	0.60	0.6236
TRT	1	41.11842105	41.11842105	0.70	0.4180
SEX	1	5.32894737	5.32894737	0.09	0.7683
TRT*SEX	1	34.80263158	34.80263158	0.59	0.4554
Error	14	826.75000000	59.05357143		
Corrected Total	17	933.61111111			

R-Square	C.V.	Root MSE	DIFF54 Mean
0.114460	601.4060	7.68463216	1.27777778

General Linear Models Procedure

Dependent Variable: DIFF55

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	62.41666667	31.20833333	0.67	0.5306
TRT	1	40.01666667	40.01666667	0.86	0.3733
SEX	1	3.26666667	3.26666667	0.07	0.7958
TRT*SEX	0	0.00000000	.	.	.
Error	11	511.08333333	46.46212121		
Corrected Total	13	573.50000000			

R-Square	C.V.	Root MSE	DIFF55 Mean
0.108835	-1363.263	6.81631288	-0.50000000

General Linear Models Procedure

Dependent Variable: DIFF56

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1319.78679337	439.92893112	1.93	0.1675
TRT	1	307.68830628	307.68830628	1.35	0.2630
SEX	1	24.65584686	24.65584686	0.11	0.7465
TRT*SEX	1	445.34623387	445.34623387	1.96	0.1821
Error	15	3412.35648148	227.49043210		
Corrected Total	18	4732.14327485			

R-Square	C.V.	Root MSE	DIFF56 Mean
0.278898	-373.7908	15.08278595	-4.03508772

General Linear Models Procedure

Dependent Variable: DIFF57

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	4011.89737784	1337.29912595	4.94	0.0167
TRT	1	3729.26739980	3729.26739980	13.77	0.0026
SEX	1	548.68800259	548.68800259	2.03	0.1782
TRT*SEX	1	1318.59758424	1318.59758424	4.87	0.0460
Error	13	3521.75621693	270.90432438		
Corrected Total	16	7533.65359477			

R-Square	C.V.	Root MSE	DIFF57 Mean
0.532530	190.9938	16.45917144	8.61764706

General Linear Models Procedure

Dependent Variable: DIFF58

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	3177.60038029	1059.20012676	4.13	0.0315
TRT	1	1945.99621362	1945.99621362	7.60	0.0174
SEX	1	661.04924393	661.04924393	2.58	0.1342
TRT*SEX	1	2951.06944595	2951.06944595	11.52	0.0053
Error	12	3073.95343915	256.16278660		
Corrected Total	15	6251.55381944			

R-Square	C.V.	Root MSE	DIFF58 Mean
0.508290	1269.825	16.00508627	1.26041667

General Linear Models Procedure

Dependent Variable: DIFF59

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	718.68836292	359.34418146	0.75	0.5180
TRT	1	356.26232742	356.26232742	0.75	0.4272
SEX	1	613.02479572	613.02479572	1.28	0.3086
TRT*SEX	0	0.00000000	.	.	.
Error	5	2387.82051282	477.56410256		
Corrected Total	7	3106.50887574			

R-Square	C.V.	Root MSE	DIFF59 Mean
0.231349	-227.2737	21.85324009	-9.61538462

General Linear Models Procedure

Dependent Variable: DIFF60

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	515.90236686	257.95118343	2.81	0.1519
TRT	1	99.85207101	99.85207101	1.09	0.3446
SEX	1	513.52493660	513.52493660	5.60	0.0643
TRT*SEX	0	0.00000000	.	.	.
Error	5	458.57988166	91.71597633		
Corrected Total	7	974.48224852			

R-Square	C.V.	Root MSE	DIFF60 Mean
0.529412	663.9946	9.57684584	1.44230769

General Linear Models Procedure

Dependent Variable: DIFF61

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	686.63708087	228.87902696	1.19	0.3494
TRT	1	478.01926870	478.01926870	2.48	0.1373
SEX	1	352.84858140	352.84858140	1.83	0.1971
TRT*SEX	1	175.33378850	175.33378850	0.91	0.3560
Error	14	2693.54043393	192.39574528		
Corrected Total	17	3380.17751479			

R-Square	C.V.	Root MSE	DIFF61 Mean
0.203136	-196.7115	13.87067934	-7.05128205

General Linear Models Procedure

Dependent Variable: DIFF64

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	7061.43479984	2353.81159995	1.61	0.2427
TRT	1	5667.98007352	5667.98007352	3.88	0.0744
SEX	1	3123.85659773	3123.85659773	2.14	0.1714
TRT*SEX	1	4560.05533406	4560.05533406	3.12	0.1048
Error	11	16053.90408244	1459.44582568		
Corrected Total	14	23115.33888228			

R-Square	C.V.	Root MSE	DIFF64 Mean
0.305487	276.9695	38.20269396	13.79310345

Production of Pearson Correlation Coefficients
by
Correlation Analysis

TRT=2

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	DIFF10	DIFF11	DIFF12	DIFF13	DIFF14	DIFF15	DIFF16	DIFF17	DIFF18	DIFF19
DIFF1	0.35462 0.3491 9	0.56345 0.1141 9	0.62443 0.0536 10	0.45192 0.1898 10	0.50463 0.1659 9	0.16116 0.6787 9	-0.04349 0.9115 9	-0.27177 0.4793 9	-0.40633 0.2778 9	-0.24587 0.4935 10
DIFF2	-0.75397 0.0189 9	-0.91620 0.0005 9	-0.57435 0.0825 10	-0.67163 0.0334 10	-0.65927 0.0534 9	0.08804 0.8218 9	-0.06288 0.8723 9	0.61786 0.0762 9	0.44088 0.2349 9	-0.18292 0.6130 10
DIFF3	-0.38485 0.3064 9	-0.35661 0.3462 9	0.04759 0.8961 10	-0.19602 0.5873 10	-0.17350 0.6553 9	0.21467 0.5791 9	-0.09332 0.8113 9	0.33116 0.3840 9	0.05832 0.8815 9	-0.38706 0.2692 10
DIFF4	0.69113 0.0392 9	0.76198 0.0170 9	0.45187 0.1898 10	0.45281 0.1888 10	0.49003 0.1805 9	-0.32088 0.3998 9	-0.31163 0.4143 9	-0.68408 0.0421 9	-0.59707 0.0896 9	0.02308 0.9495 10
DIFF5	-0.82591 0.0061 9	-0.84295 0.0043 9	-0.38137 0.2769 10	-0.56908 0.0860 10	-0.48631 0.1844 9	0.39652 0.2907 9	0.14942 0.7012 9	0.74761 0.0206 9	0.47240 0.1991 9	-0.31822 0.3702 10
DIFF6	-0.22977 0.5520 9	-0.16466 0.6720 9	0.08997 0.8048 10	-0.15381 0.6714 10	-0.03275 0.9333 9	0.12381 0.7510 9	-0.18876 0.6267 9	0.13581 0.7275 9	-0.11764 0.7631 9	-0.38531 0.2715 10
DIFF7	0.45238 0.2215 9	0.56289 0.1146 9	0.37119 0.2910 10	0.32928 0.3528 10	0.41491 0.2668 9	-0.02226 0.9547 9	-0.06211 0.8739 9	-0.35966 0.3418 9	-0.35390 0.3501 9	-0.04924 0.8925 10
DIFF8	-0.38687 0.3037 9	-0.33354 0.3804 9	-0.23802 0.5078 10	-0.30348 0.3940 10	-0.13780 0.7237 9	-0.22640 0.5580 9	-0.33352 0.3804 9	-0.08633 0.8252 9	-0.14867 0.7027 9	-0.11598 0.7497 10
DIFF9	0.31303 0.4121 9	0.43937 0.2367 9	0.27522 0.4415 10	0.21216 0.5562 10	0.36031 0.3408 9	-0.09820 0.8016 9	-0.17341 0.6555 9	-0.38175 0.3107 9	-0.39713 0.2899 9	-0.08764 0.8098 10

TRT=2

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	DIFF26	DIFF27	DIFF28	DIFF29	DIFF30	DIFF31	DIFF32	DIFF33	DIFF34	DIFF35
DIFF1	0.25817 0.5024 9	0.50341 0.2035 8	-0.14733 0.7052 9	0.33631 0.4153 8	-0.10265 0.8089 8	-0.83243 0.0103 8	-0.48021 0.2754 7	-0.48182 0.2736 7	-0.33954 0.4562 7	0.34490 0.4487 7
DIFF2	0.06984 0.8583 9	0.09643 0.8203 8	0.37149 0.3249 9	0.07098 0.8674 8	-0.04846 0.9093 8	0.55178 0.1562 8	-0.07944 0.8656 7	0.61381 0.1426 7	0.09594 0.8379 7	-0.76570 0.0448 7
DIFF3	0.27950 0.4664 9	0.52817 0.1784 8	0.21244 0.5832 9	0.40743 0.3164 8	-0.13634 0.7475 8	-0.23460 0.5760 8	-0.52011 0.2314 7	0.20779 0.6548 7	-0.21526 0.6430 7	-0.53152 0.2195 7
DIFF4	0.41841 0.2624 9	0.20936 0.6188 8	-0.06739 0.8632 9	0.38498 0.3463 8	-0.38617 0.3447 8	-0.91443 0.0015 8	-0.48581 0.2690 7	-0.32539 0.4764 7	-0.03021 0.9487 7	0.43720 0.3266 7
DIFF5	-0.21915 0.5710 9	0.09502 0.8229 8	0.08911 0.8197 9	-0.11104 0.7935 8	0.28595 0.4924 8	0.58113 0.1308 8	0.17263 0.7113 7	0.31055 0.4978 7	-0.06815 0.8846 7	-0.58503 0.1677 7
DIFF6	0.22913 0.5532 9	0.40859 0.3149 8	0.02703 0.9450 9	0.44760 0.2661 8	-0.12039 0.7764 8	-0.42915 0.2887 8	-0.47742 0.2786 7	-0.03265 0.9446 7	-0.14245 0.7606 7	-0.14561 0.7554 7
DIFF7	0.18998 0.6244 9	0.18205 0.6661 8	-0.34437 0.3641 9	0.22711 0.5886 8	-0.19185 0.6490 8	-0.86033 0.0061 8	-0.21913 0.6369 7	-0.47183 0.2851 7	0.02564 0.9565 7	0.60920 0.1465 7
DIFF8	0.57238 0.1073 9	0.08634 0.8389 8	0.73303 0.0246 9	0.73376 0.0383 8	-0.61840 0.1022 8	0.12348 0.7708 8	-0.35815 0.4302 7	0.79326 0.0333 7	0.42397 0.3431 7	-0.41366 0.3563 7
DIFF9	0.37936 0.3140 9	0.20541 0.6256 8	-0.08837 0.8211 9	0.47877 0.2301 8	-0.39939 0.3270 8	-0.80513 0.0159 8	-0.33545 0.4620 7	-0.18909 0.6847 7	0.17137 0.7133 7	0.44268 0.3199 7

TRT=2

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	DIFF36	DIFF37	DIFF38	DIFF39	DIFF40	DIFF41	DIFF42	DIFF43	DIFF44	DIFF45
DIFF1	-0.06619 0.8656 9	0.46012 0.2127 9	0.50510 0.1365 10	0.20341 0.5730 10	0.49090 0.1796 9	0.25842 0.5020 9	0.07376 0.8504 9	-0.07320 0.8515 9	-0.34008 0.3705 9	-0.45846 0.1827 10
DIFF2	-0.55102 0.1241 9	-0.99042 0.0001 9	-0.50665 0.1351 10	-0.30441 0.3925 10	-0.32933 0.3868 9	0.07185 0.8543 9	0.21846 0.5723 9	0.49873 0.1717 9	0.60549 0.0840 9	0.32660 0.3570 10
DIFF3	-0.55388 0.1218 9	-0.51033 0.1604 9	0.00063 0.9986 10	-0.09013 0.8044 10	0.11344 0.7714 9	0.28152 0.4630 9	0.25941 0.5003 9	0.38979 0.2997 9	0.26273 0.4946 9	-0.12055 0.7401 10
DIFF4	0.32263 0.3971 9	0.65967 0.0532 9	0.36548 0.2990 10	0.04649 0.8985 10	0.26590 0.4892 9	-0.07897 0.8400 9	-0.28707 0.4539 9	-0.44111 0.2346 9	-0.64474 0.0608 9	-0.46541 0.1753 10
DIFF5	-0.67266 0.0471 9	-0.87787 0.0019 9	-0.36418 0.3009 10	-0.15966 0.6595 10	-0.09866 0.8006 9	0.25078 0.5151 9	0.39972 0.2865 9	0.56978 0.1092 9	0.65214 0.0570 9	0.31330 0.3781 10
DIFF6	-0.48372 0.1871 9	-0.33673 0.3756 9	0.00004 0.9999 10	-0.14791 0.6834 10	0.19887 0.6080 9	0.23134 0.5492 9	0.16975 0.6624 9	0.20257 0.6012 9	0.05920 0.8798 9	-0.19642 0.5865 10
DIFF7	0.05335 0.8916 9	0.50678 0.1638 9	0.19647 0.5864 10	0.05448 0.8812 10	0.40826 0.2753 9	0.06061 0.8769 9	-0.02817 0.9426 9	-0.34383 0.3649 9	-0.40890 0.2745 9	-0.21105 0.5584 10
DIFF8	-0.26977 0.4827 9	-0.54970 0.1252 9	-0.15271 0.6736 10	-0.39851 0.2540 10	-0.22060 0.5684 9	-0.04253 0.9135 9	-0.17027 0.6614 9	0.16785 0.6660 9	-0.04029 0.9180 9	-0.30882 0.3853 10
DIFF9	-0.03870 0.9213 9	0.31144 0.4146 9	0.13642 0.7071 10	-0.08559 0.8141 10	0.32586 0.3921 9	0.04507 0.9083 9	-0.08506 0.8277 9	-0.28048 0.4648 9	-0.41450 0.2673 9	-0.31038 0.3828 10

TRT=2

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	DIFF46	DIFF47	DIFF48	DIFF49	DIFF50	DIFF51	DIFF52	DIFF53	DIFF54	DIFF55
DIFF1	0.22903 0.5533 9	0.39504 0.2927 9	0.11517 0.7514 10	0.16924 0.6402 10	0.28441 0.4583 9	-0.16513 0.6711 9	-0.13298 0.7331 9	-0.43086 0.2470 9	-0.43744 0.2390 9	0.07991 0.8263 10
DIFF2	-0.45619 0.2171 9	-0.73124 0.0252 9	-0.46037 0.1806 10	-0.83888 0.0024 10	-0.50803 0.1626 9	-0.02318 0.9528 9	-0.47494 0.1964 9	0.53792 0.1352 9	0.18294 0.6376 9	-0.49814 0.1428 10
DIFF3	-0.22072 0.5682 9	-0.33042 0.3851 9	-0.31035 0.3828 10	-0.60225 0.0654 10	-0.22122 0.5673 9	-0.15933 0.6822 9	-0.54102 0.1325 9	0.12554 0.7476 9	-0.20106 0.6039 9	-0.37625 0.2839 10
DIFF4	0.51575 0.1553 9	0.64016 0.0633 9	0.08699 0.8111 10	0.40655 0.2437 10	0.37824 0.3155 9	-0.43174 0.2459 9	-0.07434 0.8492 9	-0.72751 0.0263 9	-0.49566 0.1748 9	0.36717 0.2966 10
DIFF5	-0.56944 0.1095 9	-0.71220 0.0313 9	-0.27593 0.4403 10	-0.79880 0.0056 10	-0.42328 0.2563 9	0.25735 0.5038 9	-0.34145 0.3685 9	0.64969 0.0582 9	0.19801 0.6096 9	-0.62441 0.0536 10
DIFF6	-0.10999 0.7782 9	-0.14359 0.7125 9	-0.24699 0.4915 10	-0.51380 0.1287 10	-0.08810 0.8217 9	-0.19552 0.6142 9	-0.53946 0.1339 9	-0.04619 0.9061 9	-0.35222 0.3526 9	-0.33741 0.3404 10
DIFF7	0.37223 0.3239 9	0.40490 0.2797 9	0.09501 0.7940 10	0.22785 0.5267 10	0.21293 0.5823 9	-0.24865 0.5188 9	-0.08635 0.8252 9	-0.41364 0.2684 9	-0.31641 0.4068 9	0.16305 0.6527 10
DIFF8	-0.12076 0.7570 9	-0.12583 0.7470 9	-0.52294 0.1209 10	-0.39758 0.2552 10	-0.06326 0.8715 9	-0.48983 0.1807 9	-0.44623 0.2286 9	-0.28766 0.4529 9	-0.30236 0.4291 9	0.04544 0.9008 10
DIFF9	0.32422 0.3947 9	0.35453 0.3492 9	-0.08964 0.8055 10	0.08181 0.8222 10	0.18742 0.6292 9	-0.40904 0.2743 9	-0.23520 0.5424 9	-0.50259 0.1679 9	-0.41222 0.2702 9	0.17286 0.6330 10

TRT=2

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	DIFF56	DIFF57	DIFF58	DIFF59	DIFF60	DIFF61	DIFF62	DIFF63	DIFF64
DIFF1	-0.00088 0.9981 10	-0.38186 0.3506 8	-0.54213 0.1651 8	0.03086 0.9476 7	-0.31903 0.4855 7	-0.07835 0.8297 10	0.27853 0.5041 8	. 0	0.27853 0.5041 8
DIFF2	-0.46331 0.1775 10	0.68293 0.0619 8	0.07569 0.8586 8	-0.06257 0.8940 7	-0.06107 0.8965 7	-0.06779 0.8524 10	-0.17814 0.6730 8	. 0	-0.17814 0.6730 8
DIFF3	-0.41796 0.2294 10	0.32001 0.4397 8	-0.46190 0.2492 8	-0.03924 0.9334 7	-0.35034 0.4411 7	-0.13189 0.7164 10	0.06209 0.8839 8	. 0	0.06209 0.8839 8
DIFF4	0.09535 0.7933 10	-0.56463 0.1448 8	-0.57975 0.1320 8	0.31688 0.4886 7	-0.31343 0.4937 7	0.19288 0.5934 10	0.03441 0.9355 8	. 0	0.03441 0.9355 8
DIFF5	-0.28137 0.4310 10	0.65928 0.0753 8	0.30194 0.4673 8	-0.26028 0.5729 7	0.04608 0.9219 7	-0.26514 0.4591 10	0.08329 0.8446 8	. 0	0.08329 0.8446 8
DIFF6	-0.24323 0.4983 10	0.07676 0.8566 8	-0.47505 0.2342 8	0.02152 0.9635 7	-0.32776 0.4730 7	-0.09519 0.7936 10	0.15751 0.7095 8	. 0	0.15751 0.7095 8
DIFF7	0.26993 0.4507 10	-0.52546 0.1811 8	-0.27802 0.5050 8	0.02167 0.9632 7	-0.32245 0.4806 7	-0.17759 0.6236 10	0.49993 0.2071 8	. 0	0.49993 0.2071 8
DIFF8	-0.26666 0.4564 10	-0.04748 0.9111 8	-0.47486 0.2344 8	-0.08753 0.8520 7	0.00961 0.9837 7	-0.03750 0.9181 10	-0.02256 0.9577 8	. 0	-0.02256 0.9577 8
DIFF9	0.16772 0.6433 10	-0.51729 0.1892 8	-0.43461 0.2819 8	-0.00609 0.9897 7	-0.32461 0.4775 7	-0.18412 0.6106 10	0.47939 0.2294 8	. 0	0.47939 0.2294 8

Multiple Regression Analysis
for Dependent Variables:
Change in Relative Weight Between Weeks 0 and 10
and
Change in Body Mass Index Between Weeks 0 and 10

Model: MODEL1
Dependent Variable: DIFF1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.00531	0.00531	5.113	0.0536
Error	8	0.00830	0.00104		
C Total	9	0.01361			

Root MSE	0.03222	R-square	0.3899
Dep Mean	0.08700	Adj R-sq	0.3136
C.V.	37.03069		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	0.070846	0.01244318	5.694	0.0005
DIFF12	1	0.000809	0.00035775	2.261	0.0536

Model: MODEL1
Dependent Variable: DIFF4

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	2.48501	2.48501	9.691	0.0170
Error	7	1.79499	0.25643		
C Total	8	4.28000			

Root MSE	0.50639	R-square	0.5806
Dep Mean	1.20000	Adj R-sq	0.5207
C.V.	42.19882		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	1.004521	0.18009704	5.578	0.0008
DIFF11	1	0.015365	0.00493578	3.113	0.0170

Model: MODEL1
Dependent Variable: DIFF4

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	1.75397	1.75397	4.860	0.0633
Error	7	2.52603	0.36086		
C Total	8	4.28000			

Root MSE	0.60072	R-square	0.4098
Dep Mean	1.20000	Adj R-sq	0.3255
C.V.	50.05983		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	1.076655	0.20790843	5.179	0.0013
DIFF47	1	0.044404	0.02014114	2.205	0.0633