A COMPARISON OF ACTIVITY PATTERNS, RESTING ENERGY EXPENDITURE, PERCENT BODY FAT AND DIETARY PATTERNS IN NORMAL WEIGHT CHILDREN

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A Comparison of Activity Patterns, Resting Energy Expenditure, Percent Body Fat and Dietary Patterns in Normal Weight Children

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The purpose of this study was to examine the relationships of resting energy expenditure (REE) to percent body fat, percent abdominal body fat, activity level, and dietary intake in thirty-four normal weight prepubertal children, six to eleven years of age. The relationships of percent body fat and percent abdominal fat to activity level was also examined. The children's REE was measured in the morning, after abstaining from food, beverage (other than water), and physical activity for twelve hours, utilizing indirect calorimetry. Activity level was estimated using reliable activity questionnaires and interviews with parents and the children. The study included previously collected data from dual energy x-ray absorptiometry which was utilized to determine the children's body composition, and seven day food diaries that were analyzed for average energy and nutrient consumption. No strong correlations were found. However, REE was moderately and positively correlated to percent fat (.47), and to percent abdominal body fat (.55). Further research on the relationship between percent body fat and REE will help to understand the role that fat deposition plays on REE of children.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS iii

ABSTRACT iv

LIST OF TABLES vii

Chapter

I. INTRODUCTION 1
Purpose 2
Specific Objectives 2

II. REVIEW OF LITERATURE 4
Introduction 4
REE 4
Activity Level 6
Dietary Intake 9
Distribution of Body Fat 11
Genetics 12

III. METHODOLOGY 14
Subjects 14
Methods 14
Statistical Analysis 17

IV. RESULTS 18
Demographic and Anthropometric Characteristics 18
Dietary Intake 18
Components of REE 21
Relationship Between REE, Activity Level and Percent Body Fat 21
Relationship Between REE and Dietary Intake 24

Relationship Between Activity Level and Body Fat..... 24

V. DISCUSSION..... 28
Relationship Between Percent Body Fat and REE..... 29
Relationship Between Percent Abdominal Fat and REE..... 29
Relationship Between Activity Level and REE..... 29
Relationship Between Dietary Intake and REE..... 30
Relationship Between Activity Level and Percent Body Fat..... 31
Relationship Between Activity Level and Abdominal Body Fat..... 32

REFERENCES..... 34

APPENDICES..... 40

APPENDIX A: Human Subjects Approval..... 41

APPENDIX B: Consent Form..... 43

APPENDIX C: Child's Activity Form..... 46

APPENDIX D: Parents Questionnaires..... 49

LIST OF TABLES

1. Demographic and Anthropometric Characteristics of Children..... 19

2. Dietary Intake of Children..... 20

3. Components of REE..... 22

4. Correlation Coefficients Between REE and Activity Level, Percent Body Fat and Percent Abdominal Body Fat..... 23

5. Correlation Coefficients Between REE and Dietary Intake..... 25

6. Correlation Coefficients Between Activity Level and Percent Body Fat and Percent Abdominal Body Fat..... 26

CHAPTER I

INTRODUCTION

Obesity among school children is a problem that has continued to grow and is linked to multiple health risks (1). The explanation has been primarily based on the concept that excess calories are accumulated as fat and that obese children must have abnormally large caloric intakes. The actual causes of obesity are those that increase caloric intake, decrease caloric expenditure, or create a disturbance of the energy balance. The relationship of resting energy expenditure to the development of obesity in children has received limited attention.

Resting energy expenditure (REE) is the major component of daily energy expenditure. In children REE accounts for 50-60% of total daily energy expenditure (2). Resting energy expenditure in adults is influenced by fat free mass and fat mass and is significantly higher in men than in women (3). However, there is limited data on the physiologic determinants of REE in children (4). The effect of parental body composition is less clearly defined. A decrease in REE was shown in children with one obese parent compared to children with two lean parents (5). The activity level of children has also been shown to be a major factor that contributes to weight gain in children (6). Romanella reported that obese and non-obese children (8-12 years old) had similar physical activity levels (7). However one study has shown that obese children are less active than normal weight children (8). The conflicting data in this area may be

accounted for by the difficulty in estimating physical activity levels in children.

Research has been done on the relationship between fat free mass (6), fat mass (4), physical activity (10), gender (3), and REE (9). However, the effect of regional fat distribution on REE in children has not yet been defined. Research is needed to determine if the location of the deposition of fat has any effect on the REE in children. This would help predict those children that are more likely to become obese, so intervention can be made earlier to prevent the onset of obesity.

PURPOSE

The purpose of this study was to examine the relationships of REE to percent body fat, percent abdominal fat, activity level, and dietary intake in normal weight prepubertal children, six to eleven years of age. The relationships between activity and percent body fat, and percent abdominal fat will also be examined.

The specific objectives of this study are:

1. To determine if a relationship exists between REE and percent body fat in normal weight prepubertal children.
2. To determine if a relationship exists between REE and percent abdominal fat in normal weight prepubertal children.
3. To determine if a relationship exists between REE and activity level in normal weight prepubertal children.

4. To determine if a relationship exists between REE and dietary intake in normal weight prepubertal children.
5. To determine if a relationship exists between activity level and percent body fat in normal weight prepubertal children.
6. To determine if a relationship exists between activity level and percent abdominal fat in normal weight prepubertal children.

CHAPTER II

REVIEW OF LITERATURE

Obesity continues to be a growing problem among our children in the United States (11). According to the third National Health and Nutrition Examination Survey (NHANES III) between 1988 and 1991, the prevalence of overweight children was 10.9% based on the 95th percentile and 22% based on the 85th percentile. The increase was identified among all sex and age groups (11). From 1963 to 1980 obesity increased 54% in six to eleven year olds (12). In Texas, there has been nearly a 100% greater prevalence of obesity in the 1985 population of Texas school children than in the baseline comparison population from 1976-1980 (13). Some say that increased television viewing and decreased activity levels are to blame for the prevalence of obesity (14). These are just two of the factors out of many that need to be investigated.

RESTING ENERGY EXPENDITURE

Resting Energy Expenditure (REE) is the major component of daily energy expenditure. In children, REE accounts for 50-60% of total daily energy expenditure (2) . There are many factors contributing to individual variation in REE, including fat free mass, fat mass, gender, physical fitness, skeletal muscle mechanism and sympathetic nervous system activity (4). Goran et al. (4) found that the effects of fat-free mass, fat mass, and gender on REE in children are similar to those in adults. In adults, REE is

influenced by fat-free mass, fat mass, and is significantly higher in men than in women (3). Therefore the higher REE in young boys suggests that the higher REE in men could not be explained entirely by sex hormones (4). Ferraro et al. (3) measured 24 hr. metabolic rate in a chamber, including basal metabolic rate, sleeping metabolic rate, and body composition in 235 healthy white adults. After adjustment for fat-free mass, fat mass, and age, the 24 hour metabolic rate was significantly lower in women by 124± 38 kcal/day (3).

Maffeis et al. (10) measured the REE in 130 six to ten year old obese and non-obese children. He found fat-free mass to be the best predictor of REE. Utilizing measured REE, and calculated REE that was predicated by current formulas (FAO\WHO\UNO, Robertson and Reid, Fleisch, Talbot, Mayo Clinic), showed that most of these equations tend to overestimate the REE in both genders, especially in overweight children (10). Equations that are used for the measurement of metabolic rate were mostly developed from studies done between 1920 and the 1950's (2).

Technology for measuring REE has improved since then. Ventilated hoods are now used to remove the need for mouthpieces and nose clips. Segal (15) compared the use of mouthpieces, masks and ventilated hoods in adults, but this has not been studied in children. Using a ventilated hood could alleviate the anxiety caused by masks and nosepieces to provide a more accurate measurement of the REE (15). Allowing children to watch videos is another factor that helps to contribute to a more reliable measurement of REE. Dietz et al. (16) showed children moved less when watching television instead of asking the child to sit quietly. Klesges et al. (17) showed energy expenditure was

reduced while watching television in obese and non-obese girls. Bandini et al. (2) found it was not necessary for subjects to be inpatients for recording REE, and overnight measurement was not necessary for a reliable determination of REE as long as the patients followed the protocol for the measurement (i.e., 12 hour fast).

ACTIVITY LEVEL

Low activity levels in children has been shown to be a major factor that contributes to weight gain in children (6). The Committee on Sports Medicine and Fitness of the American Academy of Pediatrics published a paper on the fitness level of preschool children. The committee reported, " Studies of young children suggest that a low physical activity level is a primary factor contributing to excessive fat accumulation" (18). Romanella et al. (7) used forty pairs of biologically related mothers and children. The goal was to identify whether certain maternal factors (adiposity, activity level, and/or attitude toward activity) related to the child's adipose level. No significant relationship between child and maternal activity level, attitude toward physical activity, or adipose tissue level was found. Obese and non-obese children had similar levels of physical activity and attitudes toward activity (7). However, Bullen et al. (8) used a motion picture technique to compare the activity of obese and non-obese adolescent girls while they engaged in three sports at summer camp. On the basis of 27,211 individual observations, they concluded the obese girls were far less active than the non-obese girls even during supervised sport periods (8). Conflicting data in this area may be accounted for by the difficulty in estimating physical activity levels in children.

Fontvieille et al. (19) studied the relationship between physical activity and body

composition in forty-three Pima Indian children and forty-two Caucasian children. A questionnaire was used to determine the activity of the children over the past week and year, and to provide information on time spent on leisure activities. Fontvieille et al. (19) concluded decreased physical activity and increased television viewing may contribute to the development of obesity in Pima Indian children (19). The activity questionnaire has been demonstrated to be both feasible and reliable (20,21).

Baranowshi et al. (22) studied the validity of self reporting of aerobic activity in children in grades three to six. Six different forms were used on which children recorded their aerobic activity. Recorded information was compared to two days of continuous observation of their behavior. The forms were divided into two categories. The first varied the time of reporting: half required reporting by segments of the day; the other half reported the day as a whole. The second group varied the response format (i.e. yes or no, or document the precise number of minutes of physical activity). The segmented day forms resulted in significantly higher agreement with the observers report of activity (22).

Sallis (23) assessed the reliability of several self reported forms that measured the physical activity in children and adolescents. The subjects were 36 fifth grade, 36 eighth grade, and 30 eleventh grade male and female students. Validity improved with age, but validity coefficients were significant at all age groups. The data indicated that physical activity recall of children as young as the fifth grade were of adequate reliability and validity to use in research on physical activity (23).

Riddoch et al. (24) indicated that studies of physical activity of children using self report method showed high level of activity with 60-70% of children taking sufficient

physical activity to obtain optimal health benefits. Goran et al. (25) studied the total energy expenditure in thirty children aged four to six years. The authors concluded that total energy expenditure was approximately 25% lower than current recommendations for energy intake, and combined measurements fat free mass, heart rate and REE explain 86% interindividual variation in total energy expenditure (25). In examining the variations in physical activity related to age and gender of children and adolescents, Sallis (23) found males were about 15-20% percent more active than females. Over the school age years a consistent decline in physical activity was seen with males decreasing about 2.7 percent per year and females decreasing 7.4 percent per year (26). However, a variety of activity thresholds have been used. Studies that report more objective measures report lower levels activity. Boys are normally reported to be more active than girls but this difference is greatly reduced when moderate activity alone is compared, indicating that boys participate in more vigorous exercise than girls (24).

The health effect of low levels of vigorous activity in children is unclear (24). Janaz et al. (27) studied whole-day heart monitoring as a quantitative measure of physical activity in 76 children, age 6-17 years. Two, 12 hour recalls and a simple self rating of usual activity questionnaire were administered. Skinfold measures, peak aerobic activity and sexual maturation were assessed within one month of heart rate monitoring. Whole-day heart rate monitoring was found to be an objective, nonobtrusive method for measuring physical activity and maturation, and is an influential mediating factor for activity in children (27).

Dietary intake of children has been investigated related to the development of obesity (28). More children are eating away from home during the mid 1990's then in the late 1970's. On average, outside food contributes about one-quater of the total calories for six to eleven year olds, increasing to one-third of the total calories for 9-12 year olds. Children are also consuming more beverages and grain-based snack foods and combination foods such as pizza. Children have also been shown to be eating less fat and drinking less milk, according to the data from the first year of the current three-year U.S. Dept. of Agriculture Nationwide Food Consumption Survey (29).

Nutritional data from the Third National Health and Nutrition Examination Survey (NHANES III) suggest that U.S. children's dietary intake has declined in total fat intake as a percent of total calories (33-34.5%) and declined in saturated fat intake (12.2-13.8%) in comparison to NHANES II data (30). Fischer et al. (31) examined the differences in preferences of high fat food, dietary fat intake, anthropometric measurements and parental body mass index among three to five year old children; ten girls and eight boys. The children's food intake at nine eating sessions was measured by using preconsumption and post consumption gram weight of all food served. Fischer et al. (31) suggested that offering a child a nutritionally adequate diet was necessary but not sufficient to ensure dietary quality. Children's food preferences were shown to be the main determinants of macronutrient intake. The strong association between parental adiposity and children's fat preferences suggested that dietary influences may mediate familial patterns of adiposity (31). Salmon (32) also studied the effect of dietary fat

content and the incidence of obesity among *Ad Libitum* fed mice. Graded increments in the fat to carbohydrate ratio of the diet caused a gradual increase in the average mass of body fat maintained by the adult female albino mice. Inter-individual variability in the animals fat mass was greatly magnified by diets with substantial fat content (> 30 % of calories). The incidence of obesity (defined as one third or more of body weight as fat) increased progressively from 0% to 35% when the fat content of the diet was varied from 1% to 64% of its total energy content. The effect of dietary composition on body composition may be a factor contributing to the increased incidence of obesity in affluent populations consuming diets with a substantial fat content (32).

Gazzaniga and Burns (28) examined the relationship between diet composition and body fatness in 48 children (25 girls, 23 boys), aged 9-11 years. Twenty-four hour dietary and activity recalls, indirect calorimetry and anthropometrics were used. Percent body fat was significantly and positively related with intakes of total fat, saturated fat, monounsaturated fat, polyunsaturated fat and negatively with carbohydrate intake and total energy intake adjusted for body weight. Diet composition, independent of total energy intake, REE, and physical activity was suggested to contribute to childhood obesity (33).

Albertson et al. (33) combined three large data bases, the 1977 Nationwide Food Consumption Survey (NFCS), Market Research Corporation of America Census Panel Surveys, and the Michigan State University Nutrient Data Bank, and found that 2-10 year old children had only decreased their caloric intake over a ten year period from an average of 1633 kcal per day in 1978 to a mean of 1613 kcal per day in 1988. The dietary

fat content in the 2-10 year olds was also consistent over the ten year time frame (33).

Accurate estimation of dietary intake is important in nutrition intervention studies. However, validity has created much concern about different methods that are used. Vries et al. (34) studied the underestimation of energy intake by three day records compared with energy intake to maintain body weight in 269 non-obese adults. Calculation of self reported energy intake, from three day food records, were compared with actual intakes needed to maintain body weight in controlled trials lasting six to nine weeks. Body mass index, daily energy intake, and age were not significantly related to the extent of underestimation. The food records systematically underestimated energy need in young, non-obese well educated adults (34).

DISTRIBUTION OF BODY FAT

There are few published studies on the distribution of body fat in children. Central body fat in children is associated with increased health risks such as: cardiovascular risks (35), hypertension (36), and hyperlipidemia (37). Goran et al. (38) studied inter-abdominal adipose tissue using direct measurement with computed tomography imaging in sixteen young children ages (6.4 + 1.2 years; 24.8 + 5.4 kg). Total fat and fat free mass were determined by bioelectrical resistance. Fat distribution was measured from eight individual skinfold measurements, the ratio of three trunk skinfolds to three extremity skinfolds and waist to hip ratio. The data established the existence of intra-abdominal adipose tissues in young children and suggest that individual trunk skinfold measurements and the trunk:extremity skinfold ratio provide a better indication of intra-abdominal adipose tissue than the waist to hip ratio (38). Brambilla et

al. (35) evaluated peripheral and abdominal adipose tissue content by MRI in normal weight and obese children to compare MRI data with simple anthropometric indexes, and to estimate intra-abdominal tissue influence on cardiovascular risk factors. The subjects included 23 obese and 21 normal weight children ages 10-15 years. It was concluded that childhood obesity is predominantly subcutaneous with no difference between the sexes. The data also suggested that intra-abdominal adipose tissue had a relationship to some cardiovascular risk factors (35).

Moussa et al. (1) investigated factors associated with the development of obesity in school children. The subjects included 220 obese and 220 non-obese children, aged 6-18 years. Family history of obesity, diet, physical activity and the mothers education were significant factors for the development of obesity. Systolic and diastolic blood pressure were more strongly correlated with the fatness index (Body Mass Index), than with the fat distribution index (waist/hip) (1). Asayama et al. (39) examined the relationship between biochemical abnormalities, anthropometric indices of overweight, adiposity and body fat distribution in 68 Japanese school children, aged 6-12 years. Body fat distribution was found to be related to certain biochemical complications of childhood obesity, and that androgyny in fat patterns induced metabolic derangements in children (39).

GENETICS

Genetic influences have been found to be important in determining body fatness and distribution (40). Garn et al. (41) found no significant difference in the degree of

parental fatness in the onset of obesity during childhood, adolescence or adulthood in 8468 parent and child matched subjects. Travers et al. (42) observed that children in Tanner's stage two and three of sexual development, with obese parents (>120% of IBW), were significantly fatter than those with lean parents as measured by hydrodensitometry, bioelectric impedance and skinfold thickness. Locard et al. (43) observed that both maternal and paternal BMI were strongly correlated with child obesity at five years of age in French children. Stunkard et al. (44) studied twins who were reared apart, and found strong evidence of genetic influence in Body Mass Index (BMI). Bouchard et al. (40) conducted another study with twins and found genetic influences to be important in determining body fatness and distribution.

Research has been done on the relationship between REE and fat-free mass (9), fat mass (4), physical activity (6), gender (5). However, the effect of regional body fat distribution on REE has not been thoroughly investigated in children. Research is need to determine if the location of the deposition of fat has any effect on REE in children. This would help predict children that are more likely to become obese, so intervention can be made earlier to prevent the onset of obesity.

CHAPTER III

METHODOLOGY

SUBJECTS

The subjects included thirty-four normal weight children. Subjects were recruited from a previous study, 'A comparison of serum lipid, lipoprotein and glucose concentrations in normal weight children of obese and normal weight biological mothers: Relationships to percent body fat and dietary intake' (45). Subjects were recruited as necessary to equal thirty four participants. The children were between the ages of six and eleven years, and had been classified by their parents in Tanner stage one or two of sexual development. Tanner stage one and two occur before the adolescent growth spurt and hormone changes of puberty begin. Children of both genders were used. Subjects for the study were recruited by personal phone calls inviting them to participate. The subjects were provided gift certificates for each part of the study they completed. The children received a five dollar gift certificate for participating in the measurement of their resting energy expenditure, a five dollar gift certificate for filling out the activity questionnaire, and a five dollar gift certificate for their parents filling out their activity questionnaire. The total amount of money to be earned in gift certificates was fifteen dollars.

METHODS

Children's percent body fat and abdominal fat had been determined previously with a whole body scan using dual energy x-ray absorptiometry (DXA) by Lunar Radiation Corporation (Madison, WI) according to the protocol supplied by the manufacturer. The DXA uses minimum radiation (<5 mR), and is suitable for studies involving children (46). The abdominal region on each whole body scan were determined with extended analysis utilizing these guidelines: the lower horizontal border was established at the first lumbar vertebrae (L1); the upper horizontal border was established at the twelfth thoracic vertebrae (T-12); and the lateral borders were established just outside the soft tissue.

Children's resting energy expenditure was measured in the morning utilizing indirect calorimetry. Ventilatory measurements, oxygen consumption (VO_2) and carbon dioxide production (VCO_2) were measured using the Deltatrac metabolic monitor, (Sensormedics, Corp., Anaheim, California). The metabolic cart was calibrated before each testing period against standard air.

The measurement was taken after abstaining from food, beverage (other than water) and physical activity for twelve hours. The children were measured while lying still in a supine position, while viewing non-stressful videos appropriate for their age range. The children were allowed to rest for 5-10 minutes before testing in a relaxed environment. Oxygen consumption and carbon dioxide production was collected by means of an adult-size ventilated canopy for 15 minutes. The first five minutes were used as an equilibration period. Twenty-four hour REE was calculated using the equation of

deWeir (47). Height was measured using a stadiometer (Detecto) in centimeters. Weight was recorded in kilograms on a beam balance scale (Detecto). The children wore light clothing and no shoes. Height and weight were used for the calculation of the Harris-Benedict equation (48).

Activity level was estimated using a questionnaire and interview from both parent and child developed by Fontvielle (19) that assessed the child's daily activities during the past week. The children were interviewed in the presence of their parents. The interview determined activities demanding energy expenditure greater then those required by activities of daily living. A questionnaire was filled out by the parents to determine their child's activity level. The parents were asked to fill out the questionnaire prior to the session. The parents questionnaire required the parent to rank the typical physical activity level of the child, identify the types of activities performed by the child over the past year and to estimate the number of hours per day the child usually spends watching TV (19). The children were then classified into four different categories depending on their activity level: 1-Inactive; no regular activity, 2-Moderate; sporadically involved in recreational activities such as occasional swimming or cycling, 3-Heavy; participates in recreational activities such as swimming, baseball, etc., at least three times per week for thirty to sixty minutes per session, and 4- Vigorous; participated in extensive physical activity for sixty or more minutes at least four days per week.

The children's dietary intake was previously calculated from a seven day food diary. Parents and children were provided with education to assist in the recording of daily food and beverage consumption. The dietary records were analyzed by Nutritionist

IV, Version 2.0, 1992 (n-Squared Computing, Salem, OR) for nutrient content. The analyzed dietary items were total calories, protein, carbohydrate, fat, and fiber.

STATISTICAL ANALYSIS

Spearman Rank order correlation was used to examine the associations between REE and body fat, abdominal body fat, activity level, and dietary intake, and also the relationships of activity level to body fat, and abdominal fat.

CHAPTER IV
RESULTS

DEMOGRAPHIC AND ANTHROPOMETRIC CHARACTERISTICS

Demographic and anthropometric characteristics for the children are presented in Table 1. The mean age of the children was 8.8 ± .27 years (range 6-11 years). The children were Caucasian with one expection. One female was of Hispanic orgin. The subjects included 19 females and 15 males. The mean weight was 28.2 ± 1.1 kg (range 18.1-42.7 kg). The mean height for the children was 130.7 ± 1.6 cm (range 112.6-145.5cm). Body Mass Index (BMI) averaged 16.4 ± 3.1 kg/m^2 (range 13.8-20.8 kg/m^2). The average of the percent body fat for the children was 19 ± 1.2 percent (range 9-37.5 percent). The mean of abdominal body fat percentage for the subjects was 15.1 ± 1.4 percent (range 6.2-42.2 percent).

DIETARY INTAKE

The descriptive statistics for the dietary intake of the children are presented in Table 2. Two of the children did not complete the dietary records. Only 32 children had

Table 1

DEMOGRAPHIC AND ANTHROPOMETRIC CHARACTERISTICS OF CHILDREN

Variable	Mean ± SEM n=34
Age (years)	8.8 ± .27
Weight (kg)	28.2 ± 1.1
Height (cm)	130.7 ± 1.6
Body Mass Index (kg/m^2)	16.4 ± .31
Body Fat (%)	19.0 ± 1.2
Abdominal Body Fat (%)	15.1 ± 1.4

Table 2

DIETARY INTAKE OF CHILDREN

Dietary	Mean ± SEM n=32	Range
Kilocalories	1891 ± 78	1209 - 2770
Carbohydrate (g)	269 ± 12.6	162 - 496
Protein (g)	62 ± 2.0	44 - 89
Fat (g)	68 ± 3.8	35 - 113
Fiber (g)	11 ± 1.0	5 - 31

complete records and were used in dietary intake analysis. The children had a mean kilocalorie intake of 1891 ± 78 (range 1209-2770 kcals). Dietary carbohydrate intake had a mean of 269 ± 12.6 g (range 162-496g). Mean protein intake was 62± 2.0g (range 44-89g). Mean fat intake for the children was 68 ± 3.8g (range 35-113g). The mean fiber intake was 11 ± 1.0g (range 5-31g).

COMPONENTS OF REE

Descriptive statistics for the components of resting energy expenditure are presented in Table 3. The mean for the volume of carbon dioxide exhaled was 149.2 ±3.5L (range 116-195L). The average of the volume of oxygen inhaled was 168.7 ± 4.2L (range 130-217L). The mean for the respiratory quotient of the children was .87 ± .006 (range .81-1.02). The mean resting energy expenditure was 1170 ± 29.6 kilocalories (range 895-1503 kilocalories).

RELATIONSHIP BETWEEN REE AND BODY FAT

The Spearman Rank order correlation coefficients between REE, activity level, percent body fat and percent abdominal fat are presented in Table 4. No strong correlations were found between REE and activity level, percent body fat or percent abdominal fat .

Table 3

COMPONENTS OF RESTING ENERGY EXPENDITURE (REE)

REE Component	Mean ± SEM n=34	Range
Volume of Carbon Dioxide (L)	149.2 ± 3.5	116 - 195
Volume of Oxygen (L)	168.7 ± 4.2	130 - 217
Respiratory Quotient	0.87 ± .006	.81 - 1.02
Resting Energy Expenditure (Kcal)	1170 ± 29.6	895 - 1503

CORRELATION COEFFICIENTS[a] BETWEEN RESTING ENERGY EXPENDITURE (REE) AND ACTIVITY LEVEL, PERCENT BODY FAT AND PERCENT ABDOMINAL BODY FAT

Variable	REE n=34
	r_s
Activity Level	.16
Body Fat (%)	.47
Abdominal Fat (%)	.55

[a] Spearman Rank Order

Resting energy expenditure was weakly and positively correlated with activity level (.16). However, resting energy expenditure was moderately and positively correlated to percent body fat (.47). Resting energy expenditure was also moderately and positively correlated to percent abdominal body fat (.55).

RELATIONSHIP BETWEEN REE AND DIETARY INTAKE

The Spearman Rank order correlation coefficients between resting energy expenditure and dietary intake are presented in Table 6. No strong correlations were found between resting energy expenditure and kilocalories, carbohydrate, protein , fat, and fiber. Kilocalories, carbohydrate, protein, fat and fiber were all weakly correlated with resting energy expenditure in the children. Kilocalories, carbohydrate, protein, fat, and fiber were positively and weakly correlated with REE respectively (.09, .09, .03, .09, .18). .

RELATIONSHIP BETWEEN ACTIVITY LEVEL AND BODY FAT

The Spearman Rank order correlation coefficients between activity level and body fat are presented in Table 5. No strong correlations were found. The activity level of children was weakly and negatively associated with percent body fat (-.05). A weak and

Table 5

CORRELATION COEFFICIENTS[a] BETWEEN RESTING ENERGY EXPENDITURE (REE) AND DIETARY INTAKE

Dietary Nutrient	REE n=32 r_s
Kilocalories	.09
Carbohydrate (g)	.09
Protein (g)	.03
Fat (g)	.09
Fiber (g)	.18

[a] Spearman Rank order

Table 6

CORRELATION COEFFICIENTS[a] BETWEEN ACTIVITY LEVEL AND PERCENT BODY FAT AND PERCENT ABDOMINAL BODY FAT

Variable	Activity Level n = 34 r_s
Body Fat (%)	-.05
Abdominal Fat (%)	-.06

[a] Spearman Rank Order

negative correlation was also found between activity level and percent abdominal fat (-.06).

CHAPTER V

DISCUSSION

There were no strong correlations between REE and dietary intake, percent body fat, percent abdominal fat or activity level. No strong correlations were found between activity level and percent body fat or percent body fat. The mean weight of children in the study was 28.25 ± 1.12 kg, which was slightly higher then the national norm of 27.25 kg for children six to eleven years old. The height of the children was 130.72 ± 1.64 cm which was also slightly higher than the national norm of 128.4 cm (49).

The difficulty of estimating the activity level in children may have influenced the outcome of the study. The questionnaires were validated using older children and may not have been appropriate for the age range of the children. The younger children did not completely understand the comprehensive questions.

The measured energy expenditure was relatively close to the calculated energy expenditure. The Harris-Benedict equation was used to calculate the REE. The formulas that were used are as follows: The formula used for the males was: 66 = 13.8 (weight) + 5 (height) -6.8 (age). The formula used for the females was; 665 + 9.6 (weight) + 1.8 (height) - 4.7 (age).

RELATIONSHIP BETWEEN PERCENT BODY FAT AND REE

The percent body fat was positively and moderately correlated to the resting energy expenditure. This would be expected due to the relationship between body fat and REE (4). As a body surface increases, REE increases. Asayama et al. (39) examined the relationship between biochemical abnormalities, anthropometric indices of overweight, adiposity and body fat distribution. Body fat distribution was found to be related to certain biochemical complications of childhood obesity, and that androgyny in fat patterns induced metabolic derangements in children.

RELATIONSHIP BETWEEN PERCENT ABDOMINAL BODY FAT AND REE

Abdominal body fat was also positively and moderately correlated to REE. There is scarcity of data on the prevalence of abdominal body fat and its relationship to REE in children. The abdominal fat is of particular concern in children because it is associated with increased risk of hyperlipidemia, cardiovascular risk factors, hyperinsulinemia and hypertension (38). Further studies are needed to understand the role fat deposition plays on the REE of children.

RELATIONSHIP BETWEEN ACTIVITY LEVEL AND REE

Activity level was positively and weakly correlated to REE. The difficulty in determining the children's activity level may have influenced the results. The younger

children experienced difficulty answering the questions that were more comprehensive. Some parents may have classified their children as being more active then they actually were. The mean activity level of the children was (2.8) which would classify them in the heavy exercisers category. This category suggest that the children participate in recreational activity at least three times per week for 30-60 minutes per session. All thirty four children in the study were normal weight. The Committee on Sports Medicine and Fitness of the American Academy of Pediatrics reported", Studies of young children suggest that a low physical activity level is a primary factor contributing to excessive fat accumulation" (18).

Romanella et al. (7) found no significant relationship between child and maternal activity level, attitude toward physical activity, or adipose level. Roberts (50) examined data from prospective studies of energy expenditure and obesity, the effects of overfeeding and diet composition on energy expenditure, and studies of the relationship between energy expenditure for physical activity and body composition. The author concluded that low energy expenditure for REE as well as physical activity are a part of a range of mechanisms available for providing surplus energy for rapid weight gain.

RELATIONSHIP BETWEEN DIETARY INTAKE AND REE

Kilocalories, carbohydrate, protein, fat and fiber were all positively and weakly correlated with REE. Nutritional data from the Third National Health and Nutrition Examination Survey (NHANES III) suggest that U.S. children's dietary consumption

of total fat as a percetage of total calories (33-34.5%) and saturated fat intake (12.2-13.8%) has declined in comparison to NHANES II data (36). The dietary consumption of the children in this study was 57 % of the calories consumed came from carbohydrate, 13% from protein, and 32% from fat which was relatively close to the dietary guidelines. The children were consuming an overall healthy diet. The average fiber consumption was 11 ± 1.0g. The recommended daily intake of fiber is 20-35g per day (51). Only three children in the study consumed more than 20g of fiber per day.

Fisher et al. (31) examined the differences in preferences of high fat food, dietary fat intake, anthropometric measurements and parental body mass index among 3-5 year old children. They concluded that offering a child a nutritionally adequate diet was necessary but not sufficient to ensure diet quality.

RELATIONSHIP BETWEEN PERCENT BODY FAT AND ACTIVITY LEVEL

Percent body fat was negatively and weakly correlated to activity level. Moore et al. (52) examined the effect of preschool physical activity on the change in body fatness of children. The data showed that children with low levels of physical activity gained substantially more subcutaneous fat than did more active children. Bullen et al. (8) used a motion picture technique to compare the activity of obese and non-obese adolescent girls while they engaged in three sports at summer camp. They concluded obese girls were far less active than the non-obese girls during supervised sport periods.

RELATIONSHIP BETWEEN PERCENT ABDOMINAL BODY FAT AND ACTIVITY LEVEL

Percent abdominal body fat was negatively and weakly correlated to activity level. The limited information on children's abdominal fat in relation to activity level makes this a topic in need of further investigation. Ramirez and Mueller observed that body fat tends to be localized in truncal or peripheral regions (53).

Obesity in children has also been related to activity level (8). In a study of 4500 children representative of the U.S. population, increase physical activity is associated with a decrease in skinfold thickness (54). However Stefanik et al. (55) did not show a difference in the activity level of obese and non obese boys. The controversial results may be related to the difficulty of assessment of physical activity.

The research that has been reported shows that body fat, activity level, and dietary intake does not play a major role in REE of children. The data also suggests that activity level does not have a strong relationship with percent body fat and abdominal fat.

Further studies with a larger group of children and a better method of assessing activity level should be conducted(Ex. assessing physical activity level with a electronic motion sensor). The opportunity to do multiple REE measurements would also give a more accurate estimation of the child's energy expenditure. Some of the children were anxious and this could have affected the metabolic reading. Two areas that warrant investigation are: 1. The investigation of the activity level and REE of children from

obese and normal weight parents. 2. Investigation of the addition of a regimented exercise schedule in a group of children who are not regular exercisers with a pre and post REE measurement to determine if activity level has an effect on childrens REE.

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APPENDICES

APPENDIX A

HUMAN SUBJECTS APPROVAL

TEXAS WOMAN'S
UNIVERSITY
DENTON DALLAS HOUSTON

HUMAN SUBJECTS
REVIEW COMMITTEE
P.O. BOX 22938
Denton, TX 76204-0938
Phone: 817-898-3377

January 29, 1996

Andrea Bope
C/O Dr. Betty Alford
Nutrition & Food Sciences

Dear Andrea Bope:

The HSRC received notification from Dr. Betty Alford that you were an investigator for the study entitled "Serum Lipid and Lipoprotein Concentrations, Fasting Glucose, Body Composition, Resting Energy Expenditures, Activity Levels and Dietary Intake of Normal Weight Children of Obese and Normal Weight Biological Mothers" and need a letter of approval from the HSRC for your participation on this project.

Because this study was originally approved by the HSRC on August 7, 1995, and you will be conducting a portion of the study which was originally approved with Dr. Alford as the PI, the HSRC is exempting this study from any further review. According to HHS regulations, another review by the Committee is required if your project changes.

Special provisions pertaining to your study are noted below:

_X_ The filing of signatures of subjects with the Human Subjects Review Committee is not required.

_X_ Your study is exempt from further TWU Human Subjects Review because it is part of a larger study that has previously been approved.

____ No special provisions apply.

Sincerely,

JoAnn Engelbrecht

Chair
Human Subjects Review Committee

cc: Graduate School
Dr. Betty Alford, Nutrition and Food Sciences

APPENDIX B

CONSENT FORM

TEXAS WOMAN'S UNIVERSITY
SUBJECT CONSENT TO PARTICIPATE IN RESEARCH

TITLE OF STUDY: Serum Lipid and Lipoprotein Concentrations, Fasting Glucose, Body Composition, Resting Energy Expenditures, Activity Levels and Dietary Intake of Normal Weight Children of Obese and Normal Weight Biological Mothers.

INVESTIGATORS:

1. Dr. Betty Alford (817) 898-2647
2. Coni Francis (817) 898-2709
3. Andrea Bope (817) 898-2636

Consent Form

You and your child are being asked to participate in a research study to determine if blood lipids and glucose, percent body fat, abdominal fat, resting energy expenditure, activity level and dietary intake are different in children of obese biological mothers as compared to children of normal weight biological mothers. You have been selected because you have a biological child between the ages of 6 and 10 years of age that is within the 10th to the 90th percentile range of the National Center for Health Statistics weight curves for gender and age, and your Body Mass Index (BMI) is either 20-25 or greater than or equal to 30. Further, you and your child are not currently taking any medication that would interfere with the lipid or glucose analysis. You and your child have no chronic diseases such as heart disease, diabetes mellitus, cancer or hemophilia, and you do not smoke.

Your participation in this study is voluntary. If you agree to participate, your child's resting energy expenditure will be measured using a metabolic measurement cart. The measurement must be taken in the morning after a twelve hour fast. Your child will be asked to lie down and rest for 20 minutes before the test, and the test will take about 30 minutes. Age appropriate non-stressful videos will be provided for your child to watch during this time. Your child will have a nose clip on and breathe into a hose through a mouth piece. This should not be difficult for your child, but if fear or anxiety occurs, the test will be discontinued. You and your child will be asked about your child's activity level over the past year, including the number of hours your child typically watches television each day.

The information gained in this study will be useful in the prevention of obesity. Obesity affects 25-30% of children and adolescents in the United States. For those persons with obese parents, obesity prevention may require a life long struggle. There is little evidence of long term success in weight reduction therapy, therefore, prevention of obesity may be the most cost effective approach. At the end of the study, you will be mailed a summary of the study results and individual results concerning resting energy expenditure and activity level. A written explanation about how to interpret individual results will be provided.

To safeguard your privacy and the privacy of your child, permanent records will contain only subject numbers. All data will be kept in a locked file in the Department of Nutrition and Food Science until all analyses are complete, and research papers are published, up to five years. The permanent records will then be destroyed by shredding. Only group data will be included in research papers written. There will be no cost to you or your child.

We will try to prevent any problem that could happen because of this research. Please let us know at once if there is a problem and we will help you.

You should understand, however, that TWU does not provide medical services or financial assistance for injuries that might happen because you are taking part in this research.

If you have questions about the research or about your rights as a subject, we want you to ask us. Our phone number is at the top of this form. If you have questions later, or you wish to report a problem, please call us or the Office of Research & Grants Administration at (817) 898-3375.

An offer to answer all my questions regarding the study has been made, and I have been given a copy of the dated and signed consent form. A description of the possible attendant discomfort and risks reasonable to expect have been discussed with me. I understand that my participation in the study is voluntary, and I may terminate my participation in the study at anytime.

I agree to allow the procedures, that have been explained in this document, to be performed on my child.

Parent/Subject Signature _____ Date _____

Child/Subject Signature _____ Date _____

APPENDIX C

CHILD'S ACTIVITY FORM

INTERVIEW WITH CHILD

1. In general, about how many hours per week do you regularly participate in sports and other strenuous leisure activities (excluding time spent walking and time spent in PE classes).

   a. during the past year ☐☐☐ hours/week

   b. during the past week ☐☐☐ hours/week

   c. are you taking PE classes? ☐ yes ☐ no ☐☐☐ hours/week

2. During a typical day (including time spent at school and at home), how many hours do you usually spend in the following activities?

   Sleeping at night ☐☐ hours/day

   Napping during the day ☐☐ hours/day

   Playing ☐☐ hours/day

3. On average, how many hours per day do you watch television and videos or play computer games before or after school?

   Number of hours per day _____

4. During the past 12 months, on how many sports teams such as varsity or junior varsity, intramural or out-of-school teams did you play?

   Number of sports teams _____

5. Were you confined to a bed or chair for more than two weeks as a result of an illness or injury during the past year?

   ☐ yes ☐ no

   If yes, how long did this confinement last? _____

6. Check all activities done more than 10 times in the past year not including the time spent in school physical education classes:

- ☐ Aerobics
- ☐ Baseball
- ☐ Basketball
- ☐ Bicycling (street)
- ☐ Bicycling (trail)
- ☐ Bowling
- ☐ Canoeing
- ☐ Dancing
- ☐ Fishing
- ☐ Frisbee
- ☐ Football
- ☐ Garden or yard work
- ☐ Golf
- ☐ Gymnastics
- ☐ Handball
- ☐ Hiking
- ☐ Hockey
- ☐ Horseback riding
- ☐ Hunting
- ☐ Martial Arts
- ☐ Racquetball
- ☐ Rodeo
- ☐ Running for exercise
- ☐ Skate boarding
- ☐ Skating (ice or roller)
- ☐ Sled riding
- ☐ Soccer
- ☐ Softball
- ☐ Snow Skiing
- ☐ Street Hockey
- ☐ Swimming
- ☐ Tennis
- ☐ Volleyball
- ☐ Walking
- ☐ Water Skiing
- ☐ Weight Lifting
- ☐ Wrestling
- ☐ Other - Please specify below

List each activity that you checked above in the 'activity' box below and then estimate the amount of time spent in each activity.

	Past Year		
Activity	No. Months/year	No. times/week	No. Hours/time

APPENDIX D

PARENTS QUESTIONNAIRE

INTERVIEW WITH PARENT

I = inactive: no regular physical activity

M = moderate: sporadically involved in recreational activities such as occasional swimming or cycling

H = heavy: participates in recreational activities such as swimming, baseball, cycling, soccer, etc., at least three times a week for 30 to 60 minutes per session

V = vigorous: participation in extensive physical activity for 60 or more minutes at least four days per week

1. Using the description given above, write the letter that best describes your child's level of activity ☐

2. Check the type of activities performed by your child during the past year

- ☐ Aerobics
- ☐ Baseball
- ☐ Basketball
- ☐ Bicycling (street)
- ☐ Bicycling (trail)
- ☐ Bowling
- ☐ Canoeing
- ☐ Dancing
- ☐ Fishing
- ☐ Frisbee
- ☐ Football
- ☐ Garden or yard work
- ☐ Golf
- ☐ Gymnastics
- ☐ Handball
- ☐ Hiking
- ☐ Hockey
- ☐ Horseback riding
- ☐ Hunting
- ☐ Martial Arts
- ☐ Racquetball
- ☐ Rodeo
- ☐ Running for exercise
- ☐ Skate boarding
- ☐ Skating (ice or roller)
- ☐ Sled Riding
- ☐ Soccer
- ☐ Softball
- ☐ Snow Skiing
- ☐ Street Hockey
- ☐ Swimming
- ☐ Tennis
- ☐ Volleyball
- ☐ Walking
- ☐ Water Skiing
- ☐ Weight Lifting
- ☐ Wrestling
- ☐ Other - Please specify below

_____

_____

_____

3. On average, how many hours per day does your child watch television? _____