THE RELATIONSHIP BETWEEN DIET QUALITY AND ADIPOSITY IN ADOLESCENT GIRLS

By

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Abstract

This study examines the relationship between diet quality and total body and regional body fat. Adolescent obesity is becoming a major public challenge in the United States. Obesity is a multifactorial disease that, if developed in early years of life, can track into later years. Persistent obesity is associated with an increased risk of developing type-2 diabetes, heart disease and some cancers. Diet quality and patterns seen in adolescence are important to understand since they can promote fat gain and development of obesity. Anthropometric measures were obtained using standard protocols and body composition measures were obtained using dual energy x-ray absorptiometry (DXA). The validated Youth Healthy Eating Index (YHEI) was used to assess diet quality via 14 different components. Multiple linear regressions suggested that the components of the YHEI of fried foods, margarine and butter use, snack foods and dairy were all significantly and directly related to the body composition measures of total percent body fat, android percent fat and BMI. Total YHEI score was significantly and inversely related to the body composition measures. In conclusion, this study suggests that diet quality is a good predictor of body composition, including regional and total adiposity.

Introduction

Obesity is a major public health challenge affecting one third of adults and seventeen percent of children in the United States (1). Obesity is a multifactorial disease, largely caused by modifiable lifestyle factors such as physical activity and energy dense diets. The rapid weight gain contributing to childhood obesity increases the likelihood of being overweight or obese in later years of life (2). As obesity persists, it is strongly associated with increased risk of chronic diseases such as type-2 diabetes, heart disease and some cancers (3). It is important to gain an understanding of dietary quality through patterns in which certain food groups and nutrients are consumed in children, since behaviors of poor dietary patterns tend to track and persist into adulthood contributing to greater prevalence of chronic diseases. Diet quality is important to examine when studying body composition because it can promote fat gain. Consuming energy dense foods will increase total caloric intake, resulting in fat accumulation if not balanced by equal energy expenditure. A diet high in fruits and vegetables will lead to lower calories consumed and potentially less accumulation of fat. A high fat diet will contain more energy than one consisting of a larger proportion of carbohydrate or protein since fat has more calories per gram.

Diet quality has been assessed in adults via multiple dietary indices in order to observe the association between diet quality and all-cause mortality, heart disease, cancer, type-2 diabetes, neurodegenerative disease and other health issues. In most cases, high scores on the diet indices are associated with significant reductions in the adverse health outcomes, and thus, better health (4). Indices of diet quality have been more recently used in pediatric populations to study the association of dietary patterns with child weight. The findings are promising since diet quality has been shown to be a predictor for child weight (5).

As noted, indices used to assess diet quality and obesity in conjunction with physical activity have been performed in pediatric populations. Some of these studies use logistic regressions to calculate the independent effects that diet quality and physical activity have on body weight (6). Other studies have examined the relationship between diet quality and obesity using body mass index (BMI) and waist circumference as anthropometric indices that are surrogates for body composition (7-8). These studies are limited in their ability to estimate risk since anthropometric measurements are indirect measures and do not accurately represent body composition components such as body fat, which is the component that contributes to risk when excessive amounts are present. The present study improves upon past work by using dual energy x-ray absorptiometry (DXA) to directly measure total body percent fat and percent android fat to accurately represent components of body composition. Android fat is a measure of central adiposity and is important to consider since previous work has shown that regional, especially truncal (visceral) adipose tissue, is the fat depot associated with cardio-metabolic risk factors such as unfavorable plasmid lipid and lipoprotein levels (9). Indirect measures such as the BMI is also included, making it possible to compare the relationships of diet quality with direct and indirect measures of body composition.

Methods

Study Design

The analysis reported herein used cross-sectional data from 576 adolescent girls participating in the "Soft Tissue and Bone Development in Adolescent Girls" (STAR) study and The Jump-In: Building Better Bones study. The STAR study is designed to investigate associations of whole body and regional adiposity, insulin resistance (IR), and inflammation with bone mass, vBMD, bone structure and strength in a large sample (N=450) of young (~ 9 -12 y of age) pre-menarcheal girls. The Jump-In study investigates the association between a 2-year structured jumping intervention and bone development adolescent girls. The studies are limited to girls since females have approximately 10 times greater risk of osteoporosis than males; thus to control sample size, cost, and maximize power, it restricts the studies to the gender with greatest future risk.

Participants are recruited through the pediatric practices of Dr. Mark Wheeler (co-investigator), Pediatric Endocrinology Section Chief, Steele Children's Research Center, Arizona Health Sciences Center and Dr. Jessica Shultz (consultant), Children's Medical Center in Tucson, Arizona. *In toto*, they serve >2,000 girls in the age range of interest with ~40% being overweight or obese. Participants are also recruited through local elementary schools in the Sunnyside Unified School District of Tucson of Tucson Unified School District in Tucson, Arizona. Recruitment is ongoing.

Dietary Assessment

Energy and nutrient intakes (fat, carbohydrate, protein, calcium, magnesium, vitamin D, etc.) were assessed using the semi-quantitative Harvard Youth/Adolescent Questionnaire (YAQ) (Appendix) derived from the Nurses' Health Study Food Frequency Questionnaire (FFQ). The YAQ has been validated to measure the eating habits and nutrient intakes of multiethnic girls and boys between the ages of 10 to 18 years (77-80). Its overall validity coefficient($r = 0.54$) is similar to ones for adult FFQ, and it has high correlation coefficients against 24-hr recalls for energy (0.51) and bone-related micronutrients (e.g., calcium, magnesium, Vitamin D; $r = 0.48$-0.67). When validated, mean energy intakes from YAQ were within 1% of the mean energy values calculated using 24-hr recalls. Mean energy values using the FFQ were also similar to mean energy values reported in national surveys (NFCS and NHANES II) for this age group.

The YAQ is a 152-item, self-administered questionnaire that requires approximately 20 minutes to complete. One hundred thirty one individual food items are represented and response categories for frequency of consumption vary on the basis of each food (compared to typical FFQs that have the same responses for all foods). The questionnaire also provides information on food selection, types of meals consumed (e.g. eating breakfast, eating out, fast food use, meals prepared at home) and nutrients consumed in vitamin and mineral supplements. The YAQ is self-administered during a laboratory visit with assistance available from a trained technician. Technicians undergo training, standardization, and certification including interview techniques before collecting data. Participants are instructed to complete the YAQ to reflect the previous year. Completed questionnaires are sent to Harvard University for analysis. Frequency factors are used to determine the number of daily serving sizes for each component specified by the YHEI based on data collected from the YAQs. Individual YHEI components can be determined based on the daily serving sizes and then summed together to obtain a total YHEI score.

Youth Healthy Eating Index (YHEI)

The youth healthy eating index is a measure of diet quality that is used to assess if children and adolescents are complying with the U.S. dietary guidelines and to observe their dietary patterns (10). The YHEI is derived from the Healthy Eating Index (HEI) that focuses on the diet quality of adults. The YHEI consists of 14 components that include: whole grains, vegetables, fruits, dairy, meat ratio, snack foods, soda and drinks, multivitamin use, margarine and butter use, fried foods, visible animal fat, dinner with family, and breakfast eaten. Each of these components is associated with a maximum score 5 or 10 points. The points are derived from a standard for a maximum and minimum score based on the number of servings per day consumed by the individual for each component. The individual scores from each component are summed; possible scores range from 0-100 (11). A higher YHEI score reflects better diet quality.

The YHEI was modified in this study since 3 components could not be properly calculated via the data provided by the YAQs. These components included visible fat, dinner with family and breakfast eaten. The latter two components could not be calculated using the YAQ because they are based off of behavior, which is not provided by the YAQ. Table 1 provides the scoring criteria for both the original and modified YHEI components. Whole grains, vegetables, fruits, dairy, meat, snack foods and soda and drinks are all scored out of 10 points. Multivitamin use, margarine and butter use and fried foods are scored out of 5 points. This results in the modified total YHEI score ranging from 0 to 85 points.

Table 1: Components and Scoring of the original and Modified Youth Healthy Eating Index (11)

		YHEI scoring criteria	
Original YHEI Components	**Modified YHEI Components**	**Requirement for minimum score of 0**	**Requirements for maximum score of 10**
		servings/day[1]	
1. Whole Grains	1. Whole Grains	0	≥3
2. Vegetables	2. Vegetables	0	≥3
3. Fruits	3. Fruits	0	≥3
4. Dairy	4. Dairy	0	≥2
5. Meat Ratio[2]	5. Meat Ratio[2]	0	≥2
6. Snack Foods[3]	6. Snack Foods[3]	≥3	0
7. Soda and Drinks	7. Soda and Drinks	≥3	0
		Requirement for minimum score of 0	**Requirements for maximum score of 5**
		servings/day[1]	
8. Multivitamin use	8. Multivitamin use	Never	Daily
9. Margarine and butter use	9. Margarine and butter use	≥2 pats/day	Never
10. Fried foods outside home	10. Fried foods outside home	Daily	Never
11. Visible animal fat[4]	-	None	All
13. Dinner with family	-	≥5 times/week	Never
14. Eat breakfast	-	Daily	Never
Total YHEI score (0-100)	Total YHEI score (0-85)		

[1] Jump-In and STAR studies used the Youth/Adolescent Questionnaire (YAQ) to assess habitual dietary intake in adolescent girls ages 8-13 years. Serving sizes are based on definitions of the YAQ.

[2] Total servings per day of white meat including chicken, fish, seafood, eggs, soy, tofu, beans, and nuts were divided by servings per day of dark meat including beef, pork, and lamb.

[3] Snack foods include salty snacks (e.g., potato chips, corn chips, popcorn, pretzels, and crackers) and snacks with added sugar (e.g., cake, snack cake, toaster pastry, sweet roll/Danish/pastry, doughnut, brownie, cookies, pie, chocolate, candy bar with chocolate, candy without chocolate, fruit rollup, popsicle, and flavored gelatin).

[4] Visible animal fat includes the visible fat on meat and the skin on chicken and turkey.

Anthropometry

Anthropometric indices of body habitus are measured following standard protocols (51), including body weight, standing height and sitting height. Body mass index is calculated from height and weight. Body mass (nearest 0.1 kg) is measured using a calibrated scale (Seca,Model 881; Hamburg, Germany), and height (nearest mm) and sitting height are measured using a stadiometer (Shorr Height Measuring Board, Olney, MD). Duplicate measures of each variable are obtained and the average is used as the criterion score.

Body Composition

Direct measures of whole-body soft tissue and regional (android percent fat) composition are obtained from dual energy x-ray absorptiometry (DXA) using a GE/Lunar Radiation Corp (Madison, WI) PRODIGY following standard subject positioning and data acquisition protocols. DXA measures of abdominal fat are significantly correlated (r~0.90) with visceral adipose tissue (VAT) (61). Scans and analyses are done by a single certified technician using the extended research mode analysis feature of the most current software available at the time of baseline assessments. Radiation exposure is very low; skin entrance exposures for the PRODIGY are 0.4 μGy (0.4μSv) for a total body scan. Regional and total-body measures are obtained with 0.5% precision in vitro and 1-3% precision in vivo. A rigorous QA program is maintained, including training and certification of operators, employing standard, published protocols for data acquisition and management, daily QA phantom scans, routine monitoring of operators performance including review of randomly selected samples (10%) of scans by the QA officer, and daily backup of participants' scans and calibration phantom biographies.

Statistical Analysis

Descriptive statistics (central tendency, dispersion, measures of normality) were calculated for all variables. Pearson correlation coefficients were used to estimate the magnitude of the relationships among measures of body composition, diet, physical activity and other covariates of interest. Linear regression analysis was used to assess the independent effects of

YHEI and its sub components on direct and indirect measures of body composition, including total percent body fat, android percent fat and BMI, adjusted for relevant covariates. The dependent and independent variables were transformed using a logarithmic transformation as needed to better approximate normality by reducing skewness. Interaction terms between YHEI and other predictors of composition were also tested. Linear regression diagnostics were assessed to insure that the assumptions of the model were met. The percentage of variance explained (R^2) was used as a measure of the "goodness-of-fit" of the model, and partial correlation coefficients for the regression models were examined to assess independent effects of independent variables on body composition.

Results

Table 1 shows the descriptive statistics of the 576 adolescent study participants. The participants had an average age of 10.7±1.1 years and were 1.3 years from reaching peak height velocity. Participants averaged 48.6±52.1 minutes of moderate to vigorous activity (MVPA) and consumed 1868±752 kcals per day. Body composition measures of BMI, total percent body fat and android percent fat averaged 19.1±4 kg/m^2, 28.9±9.1% and 31.5±12.9%. Based on BMI percentiles, 3% of the sample was underweight, 69% normal weight, 15% overweight and 13% obese. The underweight category represents individuals with a BMI less than the 5th percentile. Normal weight individuals have a BMI between the 5th and 85th percentile. Overweight individuals have a BMI between the 85th and 95th percentile. Obesity is classified as a BMI greater than the 95th percentile.

Individual YHEI component scores for the sample are shown in **Table 2**. The first 7 components listed in the table are whole grains, vegetables, fruit, dairy, meat, snack foods and soda and drinks. Possible scores can range from 0 to 10 points, and the sample had averages of

2.9, 5.1, 4.5, 7.2, 9.6, 5.5 and 7.8 points, respectively. A higher score on the components of whole grains, vegetables, fruit, dairy and meat suggests that these foods were eaten in higher quantities. A low score in snack foods and soda and drinks suggests that salty snack foods and sugary soda and drinks were limited in the participants' diet. The last 3 components listed in the table are multivitamin use, margarine and butter use and fried foods. These components have a minimum score of 0 and maximum score of 5 points. The sample's average scores were 1.6, 3.3 and 3.1 points. A maximum score in multivitamin use suggests the individual consumes a multivitamin daily. Lower scores in margarine and butter use and fried foods suggest that the number of servings per day of these foods were low. The maximum and minimum values for each component are given in the table. Summation of all the components provides the total YHEI score that can range from 0-85 points. The average total YHEI score was 50.5 points.

Table 3 shows the Pearson correlation coefficients among the measures of YHEI components and body composition. The measures of body composition were significantly intercorrelated. Total percent body fat was highly correlated with android percent fat (r=0.97) and BMI (r=0.85). The total YHEI score is significantly and inversely related to BMI, total percent body fat and android percent fat (r=-0.16, -0.15, -0.13 respectively). Soda and drinks and margarine and butter use are higher in sugar and fat, but related to total body percent fat significantly and inversely. The meat and multivitamin use components of the YHEI are significantly and inversely related to all body composition measures. Relationships are seen between the components as well. Whole grains is significantly related to vegetables, fruit, dairy and multivitamin use. Snack foods is significantly and inversely related to vegetables, fruit and dairy. Fried foods shows a significant relationship to meat, snack foods, soda and drinks, multivitamin use and margarine and butter use. Total caloric intake is significantly and directly related to the YHEI components of whole grains, vegetables, fruit and dairy (r=0.292, 0.429, 0.404, 0.522 respectively). Total caloric intake is significantly and inversely related to snack foods, soda and drinks, margarine and butter use and fried foods. No significant relationship was observed between total caloric intake and the measures of body composition.

Table 4 gives the partial correlations obtained from multiple linear regressions between YHEI components and body composition measures. These models were controlled for total energy intake, PYPAQ score, maturity offset, whole grains, vegetables, fruit, dairy, meat, snack foods, soda and drinks, multivitamin use, margarine and butter use, fried foods and total YHEI. Fried foods, margarine and butter use, snack foods and dairy are all significantly and directly related to each measure of body composition. Each measure of body composition was significantly and inversely related to total YHEI score. No significant relationship was seen between meat and any of the body composition measures. The R squared value of the linear regression with BMI as the dependent variable was 0.148. The R squared value of the linear regression with total percent body fat as the dependent variable was 0.105. The R squared value of the linear regression with android percent body fat as the dependent variable was 0.119.

Table 5 gives the partial correlations obtained from multiple linear regressions between the covariates and body composition measures. These models were controlled for total energy intake, PYPAQ score, maturity offset, whole grains, vegetables, fruit, dairy, meat, snack foods, soda and drinks, multivitamin use, margarine and butter use, fried foods and total YHEI. Maturity offset, whole grains, vegetables, fruit, soda and drinks and multivitamin use are all significantly and directly related to each measure of body composition. Total energy intake and PYPAQ score did not show a significant relationship with the body composition measures.

Discussion

The descriptive characteristics of the sample used in this study can be found in Table 1. The average total YHEI score was 50.4 points out of the possible 85 points. Other studies have reported average YHEI scores of 48.9, so this study sample is similar to previous work (17). In conjunction with diet, the sample had an average of 48.6 minutes of moderate to vigorous physical activity (MVPA). This is not a low number of minutes per day of physical activity but it is lower than the recommended “minimal” amount because the guideline is set at 60 minutes per day (12). The majority of the sample was of normal weight (69%) while 15% and 13% were overweight and obese, which is slightly lower than the national prevalence of obesity at 17% (1). Total percent body fat of the sample was 28.9%, which is similar to previous studies where the average body fat percentage was 31.9% (14). A healthy body fat percentage for this age of female has a maximum of 30% (18). The average android percent fat in the sample was 31.5%, which is slightly larger than previous studies of 27.5% (14).

The eating habits of the participants in this study resemble those seen in other studies. The mean score for the components of whole grains, vegetables, fruits, margarine and butter use, fried foods and dairy differ only by approximately 1 point. This study sample was on average 3 points higher in the components of meat, snack foods and soda and drinks.

The significant relationships shown in Table 3 between all the measures of body composition make sense since android fat is a sub-category of total body fat. If total body fat increases, then it is very possible and likely that android fat will increase as well. Likewise, addition of body fat would result in an increased BMI. This table showed that soda and drinks and margarine and butter use were both significantly and inversely related to total percent body fat. This result makes sense due to the scoring of the YHEI. Less soda and drinks and margarine and butter used are associated with a higher score for these components. As the score increases, less of these foods are eaten and total percent body fat is reduced. When soda and margarine are reduced, total calorie consumption is reduced as well and can promote fat loss. This result is similar to that of other studies where soda and drinks increases the risk of obesity (15). Meat and multivitamin use were also significantly and inversely related to all the body composition measures. The amino acids of the meat may have been incorporated into the development of lean muscle mass rather than body fat since adolescent girls are growing. A family which has their child use a multivitamin may be more health conscious, which could result in less body fat accumulation. The same health conscious family idea can be seen in the significant relationship between whole grains, fruits, vegetables, dairy and multivitamin use. A family that tries to eat healthy will add more of these components to the diet, while snack foods will be limited as seen by the significant and inverse relationship between snack foods, vegetables and fruits in table 3. Fried foods showed a significant relationship with meat, which may have occurred if the meat were fried. Fried foods, snack foods and soda and drinks will be consumed more in individuals who are less health conscious as given in table 3. Total caloric intake was significantly and inversely related to snack foods, soda and drinks, margarine and butter use and fried foods. As stated previously, this result makes sense due to a higher YHEI score for these components being associated with less consumption of these foods. Less consumption of these foods leads to fewer calories consumed, which can promote weight loss. Total caloric intake was significantly and directly related to whole grains, fruits, vegetables, fruit and dairy. Individuals who strive to achieve a healthier diet will add more of the foods from these groups to everyday consumption. The addition can increase caloric intake.

Through multiple linear regressions, this study suggests that diet quality and body composition are related. The findings of the study are that fried foods, snack foods, margarine and butter use and dairy are all significantly and directly related to the body composition measures of BMI, total percent fat and android percent fat. This result was expected since these foods have higher fat contents, and thus, larger amounts of calories. Table 3 shows the significant inverse relationship between these components and total calories. The inverse relationship is present since higher scores are associated with less consumption of foods from these components, and thus, less calories consumed. If whole milk dairy products were used then the fat and calorie content is increased, and can lead to weight gain. Other studies have shown that drinking 3 or more servings per day of milk leads to an increase in BMI (16). The calcium present in the milk can lead to the building of skeletal structure that can increase BMI. Total YHEI score was found to be significant and inversely related to the measures of body composition. A higher score indicates a better diet that usually consists of more fruits, vegetables and other lower calorie foods that will not promote fat gain. There does not seem to be stronger relationships when direct measures of total body fat percent and android percent fat are used over the indirect measure of BMI. The results for the multiple linear regressions of the covariates given in table 5 show dietary components that can be used to predict body composition in addition to maturation. However, total caloric intake and PYPAQ score were not significantly related to the measures of body composition. This suggests that the dietary components and maturity offset are better indicators of body composition than total energy intake and physical activity. The R squared for each model fell in the 10-14% range, which suggests that the independent variables used in the model do not explain the measures of body composition well, likely reflecting the challenges of measuring diet accurately in youth.

This study had several limitations. The data obtained through the Jump-In and STAR studies is only from adolescent females. Since no males were sampled, the results of this study can only be applied to females over a restricted age range. Additionally, female body composition can consist of more fat. This fat is typically stored in the legs and lower half of the body, which could have an effect on the results of the portion of this study observing the relationship between diet quality and android fat since android fat is located in the trunk and upper body.

The assessment of participants' diet via the YAQ is another limitation of this study. This questionnaire requires individuals to recall from memory the amount of certain foods that were eaten over the past year, which can lead to a less accurate depiction of diet. Under reporting of consumed foods can occur if individuals are uncomfortable with documenting the true quantity. The YAQ is limited to asking about very specific foods and may leave out common foods that are consumed on a daily basis that can lead to not achieving a well-rounded depiction of diet. The YAQ did not provide the data to calculate 3 of the YHEI components. The original YHEI had to be modified in this study so the YHEI score obtained by participants does not depict diet quality expressed by the original YHEI.

This study was important to undertake since obesity is becoming a health issue in younger individuals (1). Lifestyle factors, such as diet quality, play a large role in weight gain. It is important to understand dietary patterns and quality in adolescent individuals since this behavior typically becomes habitual and tracked into later years of life. If these eating habits continue and obesity persists, then other chronic diseases can develop. The YHEI in this study allowed for an individual's diet to be broken down into components that could allow patterns to be observed. Margarine and butter, fried foods and snack foods are composed of energy dense fats and sugar and resulted in a significant relationship with all of the body composition measures. Whole grain consumption was significantly related to vegetable, fruit and dairy consumption. This suggests that individuals who try to implement more vegetables in their diet also add more fruits and whole grains, that is, strive to achieve an overall healthier diet. The dietary pattern expressed here is important to understand since current and future health strongly relies on it.

The findings of this study that consumption of fried foods, margarine and butter use and snack foods are significantly associated with an increased total body fat percent, android percent fat and BMI can be applied to using diet quality to adjust body composition. The findings can be used as an application to limit these 3 components in order to obtain a more optimal body composition reflected in the measures used in this study. In order for this application to be spread to males of the same age as the participant's used herein, a future study should examine the relationship between diet quality and body composition in adolescent males. To increase the accuracy of the diet data, future studies should utilize daily food logs. This study can be used in conjunction with the proposed future studies to provide the most accurate depiction of the relationship between diet quality and body composition, and provide the information needed to design dietary recommendations for achieving a healthy body composition in adolescence.

The aims of the study were to assess the relationship between YHEI score and total body percent fat, android percent fat and BMI in adolescent girls. YHEI was used as a measure of diet quality where higher scores reflect a better diet. In conclusion, diet quality was associated with lower total body percent fat, android percent fat and BMI. Thus, diet quality is a useful tool for predicting body composition.

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Table 1: Descriptive Characteristics of 576 Adolescent Girls

Characteristics	Mean (Standard Deviation)
Age (years)	10.7 (1.1)
Maturity Offset (years)	-1.3 (1.1)
Caloric Intake (kcals)	1868 (752)
Total YHEI Score	50.4 (9.2)
MVPA (min/day)	48.6 (52.1)
Height (cm)	79.1 (39.4)
Weight (kg)	40.8 (12.2)
BMI (kg/m^2)	19.1 (4)
BMI Category Underweight (%)	3
BMI Category Normal Weight (%)	69
BMI Category Overweight (%)	15
BMI Category Obese (%)	13
Total Percent Body Fat (%)	28.9 (9.1)
Android Percent Fat (%)	31.5 (12.9)

Table 2: YHEI Scores of 576 Adolescent Girls

YHEI Component	Minimum	Maximum	Mean	YHEI Potential Range
Whole Grains	0	10	2.9	0-10
Vegetables	.21	10	5.1	0-10
Fruit	.4	10	4.5	0-10
Dairy	1	10	7.2	0-10
Meat	.6	10	9.6	0-10
Snack Foods	0	9.9	5.5	0-10
Soda and Drinks	0	10	7.8	0-10
Multivitamin Use	0	5	1.6	0-5
Margarine and Butter Use	0	5	3.3	0-5
Fried Foods	0	5	3.1	0-5
Total YHEI Score	24.9	74.7	50.5	0-85

Table 3: Pearson Correlation Coefficients Showing Linear Bivariate Relationships Among the Measures of YHEI Components and Body Composition

	Whole Grains	Vegetables	Fruit	Dairy	Meat	Snack Foods	Soda and Drinks	Multivitamin Use	Margarine and Butter Use	Fried Foods	Total YHEI Score	Total Percent Body Fat	Android Percent Fat	BMI
Whole Grains														
Vegetables	.280**													
Fruit	.196**	.389**												
Dairy	.209**	.196**	.215**											
Meat	.057	.133**	.190**	.147**										
Snack Foods	-.041	-.211**	-.211**	-.250**	-.004									
Soda and Drinks	.053	.018	-.097*	-.088*	.016	.173**								
Multivitamin Use	.132**	.066	.135**	.062	.110**	.010	.083*							
Margarine and Butter Use	.030	-.003	.024	-.145**	.006	.208**	.082*	.027						
Fried Foods	.107*	.106*	.054	-.007	.125**	.243**	.221**	.119**	.128**					
Total Caloric Intake	.292**	.429**	.404**	.522**	0.00	-.634**	-.318**	0.006	-.195**					
Total YHEI Score	.544**	.545**	.513**	.386**	.363**	.205**	.334**	.401**	.268**	.435**				
Total Percent Body Fat	.007	.000	-.036	-.076	-.160**	-.047	-.091*	-.138**	-.093*	-.026	-.161**			
Android Percent Fat	.014	.006	-.030	-.101*	-.172**	-.026	-.079	-.154**	-.073	-.026	-.157**	.970**		
BMI	.015	.012	-.035	-.093*	-.187**	.002	-.078	-.131**	-.032	-.006	-.133**	.851**	.834**	
Total Caloric Intake	.292**	.429**	.404**	.522**	0.00	-.634**	-.318**	0.006	-.195**	-.243**	.135**	0.065	0.062	0.032

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 4: Partial Correlations From Multiple Linear Regressions Between YHEI component and Body Composition Measures of 576 Adolescent Girls

YHEI Component	BMI (kg/m^2)	Total Percent Body Fat (%)	Android Percent Fat (%)
Fried Foods	0.19**	0.15**	0.16**
Margarine and Butter Use	0.16**	0.09*	0.11**
Snack Foods	0.2**	0.15**	0.17**
Dairy	0.14**	0.1*	0.1*
Meat	0.05	0.04	0.05
Total YHEI Score	-0.21**	-0.16**	-0.17**

All models controlled for total energy intake, PYPAQ score, MVPA, maturity offset, whole grains vegetables, fruit, dairy, meat, snack foods, soda and drinks, multivitamin use, margarine and butter use, fried foods and total YHEI.

** significant at the 0.01 level

* significant at the 0.05 level

Table 5: Partial Correlations From Multiple Linear Regressions Between Covariates and Body Composition Measures of 576 Adolescent Girls

YHEI Component	BMI (kg/m^2)	Total Percent Body Fat (%)	Android Percent Fat (%)
Total Energy Intake	0.06	0.06	0.08
PYPAQ Score	0.001	-0.06	-0.06
Maturity Offset	0.25**	0.13**	0.12**
Whole Grains	0.21**	0.16**	0.17**
Vegetables	0.19**	0.15**	0.16**
Fruit	0.18**	0.14**	0.15**
Soda and Drinks	0.17**	0.12**	0.14**
Multivitamin Use	0.14**	0.09*	0.09*

All models controlled for total energy intake, PYPAQ score, maturity offset, whole grains vegetables, fruit, dairy, meat, snack foods, soda and drinks, multivitamin use, margarine and butter use, fried foods and total YHEI.

** significant at the 0.01 level

* significant at the 0.05 level