THE RELATIONSHIP BETWEEN DIET QUALITY, AS ASSESSED BY THE HEALTHY EATING INDEX 2005, AND DISEASE RISK FACTORS IN OVERWEIGHT CHILDREN

By

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LIST OF ABBREVIATIONS

AHEI	Alternate Healthy Eating Index
Block Kids FFQ	Block Kids Food Frequency Questionnaire 2004
BP	Blood Pressure
BMI	Body Mass Index
BMI-z score	Body Mass Index z-score
CVD	Cardiovascular Disease
CSFII	Continuing Survey of Food Intakes by Individuals
DGA-2005	2005 Dietary Guidelines for Americans
DGOV	Dark Green and Orange Vegetables
E-FLIP for Kids	Extension Family Lifestyle Intervention Program for Kids
FGP	Food Guide Pyramid
FGS	Food Guide System
HEI-2005	2005 Healthy Eating Index
HRQOL	Healthy-Related Quality of Life
HDL-cholesterol	High Density Lipoprotein-Cholesterol
HbA1c	Glycosylated Hemoglobin
HTN	Hypertension
LDL-cholesterol	Low Density Lipoprotein-Cholesterol
Original-HEI	Original Healthy Eating Index
NHANES	National Health and Nutrition Examination Survey
SoFAAS	Solid Fat, Alcohol and Added Sugar
TC	Total Cholesterol
TG	Triglycerides
T2D	Type-2 Diabetes

USDA CNPP	United States Department of Agriculture Center for Nutrition Policy Promotion
YHEI	Youth Healthy Eating Index

Abstract of Thesis Presented to the Graduate School
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By

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Objective: To evaluate the relationship between diet quality (2005 Healthy Eating Index (HEI-2005)) and disease risk factors in overweight children living in rural areas of north central Florida. Background: Estimates show that approximately 32% of children and adolescents, ages 6-11, are overweight, 17% are obese and 11% are extremely obese. Reducing childhood obesity is important because it predicts chronic diseases which are seen as early as childhood, as well as in adulthood. Even though there is existing literature assessing the diet quality of overweight children, limitations exist (i.e. there is little to no research on disease risk factors and its associations with diet quality, in overweight children). Methods: This cross-sectional study presents baseline data from the Extension Family Lifestyle Intervention Program. One hundred seventy eight overweight 7-12 year olds completed the Block Kids Food Frequency Questionnaire 2004 (FFQ) and underwent various physical measurements of height, weight, waist circumference, blood pressure (BP), and finger prick blood collection to determine hemoglobin A1c (HbA1c), triglycerides (TG), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C) and total cholesterol (TC) levels. Data from

the FFQs were used to calculate the HEI-2005 score for each participant. Results: The majority of participants were female (56%), Caucasian (65%), and >97th percentile weight for height (82%). The mean total HEI-2005 score was 61.2±10.6. Only 2% of the participants met the government recommendations (80/100) for total HEI-2005 score. Participants scored poorly for Whole Grains, Sodium and calories from Solid Fat and Added Sugar component scores in addition to several that needed improvement. Results revealed several associations for children in the 85th to 95th percentile weight for height group: Total Cholesterol (TC) ($p<0.01, r=-0.76$) and LDL-Cholesterol ($p<0.01, r=-0.74$) were inversely associated with Total HEI-2005 score; TC was inversely associated with Total Fruit ($p=0.05, r=-0.57$), Total Vegetables ($p=0.05, r=-0.57$), Saturated Fat ($p<0.01, r=-0.74$) and Sodium ($p<0.01, r=-0.77$) component scores. Conclusions: Results of this study suggest that future weight management interventions should be designed to focus on improving dietary quality components in addition to decreasing caloric intake, as this also reduces chronic disease risks in overweight children.

CHAPTER 1
INTRODUCTION

An emergent concern about the increase in type-2 diabetes (T2D) and cardiovascular disease (CVD) in the young American population, over the past few decades, has occurred. Risk factors for T2D and CVD include behavioral factors (diet and physical activity), genetic factors (family history), and environmental factors. These same risk factors can also contribute to obesity. In addition to obesity and an imbalance of energy consumption with energy expenditure, overall diet quality, and the excess or limited intake of some nutrients and food groups may also contribute to the development of chronic diseases such as T2D and CVD. While literature does exist evaluating the association between diet quality and disease risk factors in adults [1], little research has investigated this association in overweight children. This project is a sub-study of the ongoing behavioral weight management intervention project, the Extension Family Lifestyle Intervention Program for Kids (E-FLIP for Kids) and was conducted prior to the start of the intervention.

The purpose of this project was 3-fold: 1) to evaluate the overall diet quality, in terms of adherence to the 2005 Dietary Guidelines for Americans (DGA-2005), among overweight children, ages 7-12 years, using the HEI-2005. I hypothesized that the children would not meet the recommended dietary guidelines; 2) to investigate the relationship between diet quality and disease risk factors in the same overweight study population. I hypothesized that children with poorer diet quality (lower HEI-2005 scores) would have a larger waist circumference, higher BP, higher glycosylated hemoglobin (HbA1c), higher serum TG, higher serum total cholesterol (TC), higher serum low density lipoprotein - cholesterol (LDL-Cholesterol), and 3) to explore the association of

specific dietary components of the HEI-2005 with disease risk factors in overweight children. I hypothesized that higher Total Fruit Score, Whole Fruit Score, Total Vegetables Score, Dark Green and Orange Vegetables (DGOV) Score, Total Grain Score and Whole Grain Score will be associated with lower serum TC and LDL-cholesterol levels; higher Dairy Score and higher Sodium Score will be associated with lower systolic blood pressure (SBP) and diastolic blood pressure (DBP); higher Saturated Fat Score will be associated with lower serum TC and LDL cholesterol levels; and higher Solid Fat, Alcohol and Added Sugar (SoFAAS) Score will be associated with lower serum TG and serum HbA1c levels.

CHAPTER 2
LITERATURE REVIEW

Childhood Obesity

Childhood obesity is a major health problem in America. There are many negative health outcomes associated with childhood obesity that were previously thought to only affect adults. These outcomes include cardiovascular disease, type-2 diabetes, dyslipidemia, hypertension (HTN), asthma, pulmonary disease, musculoskeletal disease that prevents exercise, as well as social and psychosocial consequences and even mortality [2-7]. Since the early 1960s, the National Center for Health Statistics has used their findings, from ongoing surveillance studies, to determine the prevalence of major diseases and risk factors for these diseases [8]. The name has evolved over the years from the National Health Examination Survey to the National Health and Nutrition Examination Survey (NHANES). NHANES – conducted by National Center for Health Statistics – is a survey research program that assesses the health and nutritional status of adults and children in the United States (US) [8]. Since the early 1970s, overweight has become a major public health concern for children and adolescents in the United States [9]. Figure 2-1 illustrates the prevalence of overweight children from 1963-70 until 1999 [10]. As shown, the prevalence of overweight did increase over that 30 year span. In America, the terms for childhood obesity have evolved over the years. The report from the US Health and Human Services (HHS) used the term overweight to define gender and age specific BMI greater than or equal to the 95th percentile [9]. Currently, the term overweight is more popularly defined as having a body mass index (BMI) greater than or equal to the 85th percentile, specific for age and gender. And, the term obesity is defined as having a BMI greater than or equal to the 95th percentile

specific for age and gender. In 2012, Ogden et al. conducted a study with 2-19 year olds, using data from 1999-2010 NHANES (Figure 2-2) [11]. The encouraging news demonstrated by Ogden et al [11] is the prevalence of boys and girls having a high BMI, gender and age specific BMI ≥ 85th percentile, has remained consistent. Conversely, this consistent prevalence confirms that the childhood obesity epidemic has failed to improve. The investigators also reported that 32% of children and adolescents ages 6-11 years old were overweight, 16% were obese and 11% were extremely obese (gender and age specific BMI ≥ 85th , 95th and 97th percentile, respectively) [11]. For the remainder of this thesis, overweight and obesity will be defined as Ogden et al. has defined it.

The literature indicates that overweight children may become overweight adults [12, 13]. In 1995, McPherson and colleagues (1995) [14] reported that the prevalence of overweight in children was more common than the prevalence of underweight and growth retarded children, including among low–income children in America. This prevalence of obesity appears to carry over into adulthood. Whitaker et al. (1997) published a retrospective study where the purpose was to determine the probability of obesity in young adulthood in relation to the presence/absence of obesity at various times throughout childhood and presence/absence of obesity in the child's' parents [12]. They found that parental obesity significantly alters the risk of obesity in adulthood for both obese and non-obese children, especially those under the age of 10 years old. Freedman et al. (2001) [13] published a prospective study where the purpose was to determine the relationship of childhood obesity to coronary heart disease risk factors in adulthood. The participants were initially examined between the ages of 2 to 17 and

then re-examined between the ages of 18 to 37. Along with the other findings, Freedman et al. found that 25% of obese adults were overweight as children and 22% had childhood BMIs between 85th and 94th percentile.

This information leads one to believe that childhood obesity is a vicious cycle, and that children are now seeing the negative health and psychological effects that tend to carry over into adulthood. Childhood obesity causes a wide range of serious complications, and increases the risk of premature illness and death later in life, raising public health concerns. Some of the chronic diseases that obesity is a risk factor for include CVD such as coronary artery disease and hypertension, T2D, metabolic syndrome, arthritis, liver and kidney disease, cancer, asthma, sleep apnea and even, mortality. Research continues to show that body weight status is extremely important to health status.

Body Weight Status

The body weight status of children is categorized as underweight, healthy weight, overweight, obese, and morbidly obese (Table 2-1) [15]. Awareness of body weight status is important because studies have found that increased body weight is associated with poorer physical health and various studies have shown that with greater degrees of obesity, health tends to deteriorate [16-18]. Children and adolescents' growth and BMI-z score is plotted using growth charts for gender and age [15]. BMI z-score expresses body weight status as the standard deviations a person's BMI is above or below the mean [19]. BMI is calculated as weight, in kilograms, divided by the square of the height, in meters, [15].

Contributing Factors of Obesity

When more calories are consumed than expended, the result is increased body weight. Over time, this increase in body weight can result in overweight and obesity. The childhood obesity epidemic is multi-factorial. Genetics, environment and behavioral factors are all thought to contribute to the imbalance between calories consumed and expended in overweight and obese children.

Genetic Factors

Genetics is the study of heredity. Heredity is the passing of characteristics from one generation to the other [20]. An individual's tendency to gain weight may be partially due to certain genetic characteristics [21, 22]. For example, a clinical feature of Prader-Willi syndrome – a rare genetic disorder – is obesity [23]. A characteristic of Prader-Willi syndrome is early childhood-onset hyperphagia and obesity from age 2-8 years [24]. Other genetic disorders that are characterized by obesity include Bardet-Biedl, Cohen, and Alstrom syndromes [25].

The risk factors for various diseases are higher for certain races. For example, African Americans, Hispanic, Native Americans, Asian Americans and Pacific Islanders are at a higher risk for developing T2D than their Caucasian counterparts [26]. Weight is 30-70% dependent on genetics [27, 28]. Genetic characteristics don't change drastically within a few decades, but interestingly enough the prevalence of obesity has tripled among school aged children during that time. Ultimately, the rapid increase in prevalence of pediatric obesity cannot be solely attributed to genetics.

Environmental Factors

In addition to genetics, environmental factors influence weight gain, overweight and obesity in children. Two types of environment exist: 1) Food environment and 2)

Physical environment. A great amount of evidence has recognized the influence that the food environment has on body weight and dietary behavior in children [29]. The food environment is the source of food and beverages and the circumstances around which they are acquired and consumed [30]. For children, the food environment includes home, food stores, restaurants and schools [31]. Research shows that lower BMI is associated with supermarkets present in local neighborhoods, especially for low-income Americans [29]. When the geographic density of fast food restaurants and convenience stores are increased, it's related to a higher BMI [29].

The relationship between inadequate physical activity and weight gain is strong and consistent [32, 33]. In spite of national recommendations for greater physical activity, American children engage in low levels of physical activity [32]. There is increasing evidence that certain features of physical and social environment influence levels of physical activity [34, 35]. A sense of safety in the neighborhood appears to be one important environmental determinant [34]. Adults who perceive their neighborhoods to be unsafe are substantially more likely to be physically inactive, along with their kids, than are adults who perceived their neighborhoods as safe [36]. Outdoor safety is especially important for children, because time spent outdoors is strongly associated with physical activity [32]. Outdoors, children have the opportunity to engage in various games that incorporate physical activity [37]. Parents rank safety as the most important factor in deciding whether to let their young children play in a given location [32]. Lovasi et al. [38] found that there was a strong support for the importance of food stores, exercise facilities and safety, as it related to obesity-related effects of built environment characteristics. Lovasi et al. [38] also concluded that there could be a reduction in

obesity related health disparities if there was an increase in the access to supermarkets, more places to exercise, and safety.

Behavioral Factors

Finally, behavior is another factor that contributes to the obesity epidemic. Even though there is not one explicit behavior that triggers overweight and obesity, there are particular behaviors that contribute to poorly regulated energy balance and thus to increased adiposity and obesity. It is ideal that for normal growth and development, metabolism, immunity and cognitive function, children and adolescents consume a diet that includes the proper amounts of nutrient rich foods and beverages from all the major food groups [29]. In order for children and adolescents to maintain a healthy weight and healthy weight gain, a proper balance of total caloric (energy) intake and energy expenditure is essential [29]. While there is very little support on particular foods that play a part in unjustifiable energy intake in children, hypotheses include: an increase in energy density of the diet [39],an increase in consumption of fruit juices [40], an increase in portion sizes of food and beverages [41], an increase in the frequency of meals consumed away from the home, especially fast food consumption, [42, 43], a decrease in the frequency of breakfast consumption [29, 44], a low intake of fruits, vegetables and fiber [45], and an increase in the consumption of beverages with added sugar [46]. Guthrie et al. [47] mentioned that the amount of foods purchased away from the home has increased from 14% in 1977-78 to 32% in 1994-96. Consuming meals away from the home is associated with larger portion sizes, compared to the same foods prepared at home, thus foods prepared outside of the home usually contain more calories [42].

Research has proven that engaging in regular physical activity reduces certain disease risk factors as well as achieving and maintaining a healthy body weight [48]. The DGA-2005 recommends a minimum of 60 minutes of physical activity, in addition to usual activity in the home or at school most days of the week, for children [48]. Physical inactivity is another behavior that leads to overweight and obesity in children and adolescents. Caspersen and colleagues [49] define physical activity as “any bodily movement produced by skeletal muscles that result in calorie expenditure”. Physical activity is very important because it helps build healthy bones [50] and muscles [51], helps control weight [52], reduces anxiety [53] and stress [54], increases self-esteem [55], and may improve BP [56] and cholesterol levels [57]. Alternatively, the opposite behaviors are associated with decreased adiposity in children. Another behavior that is associated with increased adiposity is an excess of hours of “screen time”, which includes television, computer, video games, etc [58]. Adding physical activity in the day of a child should not solely be the responsibility of the parent or child because children spend a good amount of time at school, where the opportunity of being physically active is increased. Frightfully, Eaton et al. [59] found that daily participation in school physical education among adolescents has dropped from 42% in 1991 to 28% in 2003 for various reasons. Also, children spend a considerable amount of time engaged in sedentary behavior[58]. Roberts and colleagues [60] found that children aged 8-18 years spend a little more than 3 hours per day watching TV, videos, DVDs, and movies.

Consequences of Obesity

Physical Health Consequences

Childhood Obesity causes a wide range of serious complications, and increases the risk of premature illness and death later in life, raising public-health concerns.

Pediatric obesity is not only associated with adverse short term health effects but many studies suggest that overweight children and adolescents become overweight and obese adults and thus increase their risk for developing a wide range of chronic diseases [12, 13, 61-63]. Some of the chronic diseases that obesity is the risk factor for include T2D [64], CVD [65], metabolic syndrome [63, 66], arthritis [67, 68], liver disease [69, 70], sleep apnea [71, 72], asthma [4, 73] and certain cancers [74, 75]. For the purposes of this research, T2D, CVD and cancers, and the risk factors associated, will be discussed from this point forward. Goran et al. [76] advise that there are several risk factors that contribute to the development of CVD and T2D. The risk factors of T2D and CVD include increased body and abdominal fat, insulin resistance, ethnicity and onset of puberty [76]. African American, Hispanic, and Native American children are at the highest risk for developing both CVD and T2D [76]. Strauss and Pollack [77] explain that the prevalence of African American and Hispanic children that are above the 85 percentile, in 1988, was 35% compared to Caucasian children who were at just above 20%. According to Freedman et al. [13], 25% of children ages 5 to 10 years have relatively high cholesterol, high BP, or other early warning sign for heart disease.

Type-2 Diabetes. Type 2 Diabetes occurs when the body develops a resistance to insulin and can't properly use insulin [78]. The metabolic defects that contribute to the development of T2D may vary from individual to individual. Possible causes include the pancreas's gradually inability to produce sufficient amounts of insulin to regulate the blood glucose [78] and/or a defect in the receptors that allow insulin to bind to the surface of cells [79]. T2D is diagnosed when an individual's resistance to or relative deficiency of insulin results in a chronic elevation of serum glucose (fasting glucose

≥126 mg/dl) [80]. Children whose BMI is above the 85th percentile for age, are at an increased risk for developing T2D [78]. A potential reason that T2D is associated with obesity is because adipose tissue is extremely resistant to insulin in comparison to other bodily tissues [81]. Diabetes is one of the more common chronic conditions in school aged children in the United States [78]. T2D becomes increasingly more common in children after age 10, with higher rates in minority groups in comparison to non-Hispanic whites, those who are obese, have family history of diabetes, and those who experience insulin resistance [78]. The highest rates of T2D are seen in American Indian children and adolescents [78]. Mahler and Adler have shown that the more children and adolescents weigh, the more risk of T2D there is through insulin resistance, which is the same effect seen in adults [82].

The Bogalusa Heart Study, 1972-2005, has been described as the longest, most detailed study of biracial children in the world [13]. This study looked at the history of cardiovascular (CV) risk factors, coronary heart disease (CHD), T2D and hypertension [13]. The investigators observed that an increased BMI in childhood is associated with insulin resistance, thus supporting that children's weight status is a risk factor for T2D [13]. Both weight status and weight gains are risk factors for T2D [83]. Bhargava et al. [84] followed 1,492 adolescents and found that children with low weight at age 2, but then with an exponential increase in BMI between ages 2-12 were at an increased risk for developing impaired glucose tolerance and diabetes.

Cardiovascular Disease. Cardiovascular disease (CVD) is the class of diseases that involve the heart, blood vessels and arteries[85]. An important determinant of CVD is obesity [85]. As stated by Freedman and colleagues (2001), overweight children are

more likely to become obese adults [13]. Only few studies, to date, have followed children the appropriate amount of time needed to determine the relationship between weight status and adult chronic diseases [7]. The Harvard Growth Study included 508 men and women who were between the ages of 13 and 18 years old between 1922 and 1935 [68]. These adolescents were both lean and overweight [68]. The term “lean” was classified as having a BMI between the 25th and 50th percentile and the term “overweight” meant having a BMI above the 75th percentile compared to their counterparts of the same age and gender [68]. The results of this study are that overweight adolescents were at higher risk for experiencing coronary events in adulthood than their peers [68]. One of the most profound effects that obesity has on CVD is hypertension even though overweight and obesity are the most important modifiable risk factors [86]. Moreover, the Bogalusa Heart Study, mentioned above, found that the major etiologies of adult heart disease, atherosclerosis, coronary heart disease and essential hypertension began in childhood [13].

Hypertension. Blood Pressure is the force of blood that pushes against the arteries as the heart pumps [79]. A balance between cardiac input and vascular resistance is what determines BP [87]. If one of these variables increases without the other decreasing equally, average BP tends to rise [87]. Gruskin [87] determined different factors that affect BP. The factors that affect cardiac output include baroreceptors, extracellular volume, effective circulating volume, and the sympathetic nervous system [87]. The factors that affect vascular resistance have two categories: 1) Pressors and 2) Depressors. Electrolyte homeostasis is very crucial to the balance between cardiac output and vascular resistance [87]. Changes sodium, potassium,

calcium and magnesium, especially, affect cardiac output and vascular resistance [87]. For example, when homeostasis is normal, sodium consumed is nearly equal to sodium excreted in the urine thereby resulting in the constancy of extracellular sodium volume (≈142mmol/L). When sodium is retained, the extracellular volume increases, increasing BP. But a host of physical and hormonal mechanisms take place and triggers change in glomerular filtration rate and tubular reabsorption of sodium, resulting in excretion of excess sodium, thereby restoring normal sodium levels. Also, when potassium consumption increases, the production and release of rennin is suppressed [87]. Increased potassium ingestion also induces natriuresis [88]. Natriuresis is the removal of sodium in the urine by action of the kidneys [88]. This excretion of sodium from the blood causes BP to decrease since blood volume decreases as a result of osmotic forces that removes water from the blood as it follows sodium out of blood circulation and into the urine [88].

If BP is consistently elevated, damage to various parts of the body can follow [89]. High BP or HTN can lead to coronary artery disease, heart failure, stroke and renal disease, amongst other conditions [89]. Pediatric hypertension (PH) is more common today than ever and the long-term effects of PH are very substantial [90]. Throughout the day, BP rises and falls. For example, when asleep, BP falls and when awake, BP rises [89]. BP also rises when excited, nervous and during activities[89]. Only when BP remains high throughout the day, is one at risk for health problems.

According to the Task Force on Blood Pressure Control in Children, commissioned by the National Heart, Lung, and Blood Institute (NHLBI), there are five categories of BP levels in children (Table 2-2) [91]. Average BP is considered normal when both systolic

and diastolic values are at the 90th percentile and below for the child's age, gender and height. Average BP is diagnosed as pre-hypertensive when either systolic or diastolic values are above the 90th percentile, but below the 95th percentile. Average BP is diagnosed as Stage I hypertension when either systolic or diastolic values are from the 95th percentile to the 99th percentile plus 5 mmHg. Finally, a child's average BP is diagnosed as Stage II hypertension when either systolic or diastolic values are greater than the 99th percentile plus 5 mmHg.

In developed countries, hypertension (HTN) is the leading cause of death [92]. Leupker et al. completed a study with 10-14 year olds and found that between 1986 and 1996 there was a concordant increase in BMI and systolic BP [93]. Similarly, Sorof et al. found that as BMI percentile increased from the 5th to the 95th percentile, the greater the prevalence of systolic hypertension [94]. This investigator found BMI to be the strongest association with hypertension [94].

The Dietary Approaches to Stop Hypertension (DASH) trial has proven that certain dietary patterns have shown to be effective in the prevention of hypertension[95]. The participants in this intervention trial, ≥ 22 years old, were randomized to one of three diet groups: 1) control diet (four servings of fruits and vegetables daily and a macronutrient profile that was representative of American consumption); 2) Fruit and Vegetables diet (ten servings of fruit and vegetables daily that was rich in potassium, magnesium and fiber); and 3) Combination diet (emphasis on fruits, vegetables, low-fat dairy, whole grains, poultry, fish, nuts, reduced red meat, fat, sweets, and sweetened beverages) [95]. The combination diet also was rich in potassium, magnesium, calcium, fiber, reduced in saturated fat, total cholesterol, and

total fat [95]. The sodium content was maintained at 3g per 2100 kcal, which is slightly below the average American daily intake [95]. The dietary patterns include increased consumption of fruits, vegetables, and low-fat dairy foods and a reduction of total and saturated fat consumption [95].

Various studies have proven that salt intake is directly related to BP levels in adults and the reduction of salt is related to a reduction in BP [96-99]. The DASH Sodium Trial is a follow up -study to the DASH Trial. Instead of examining the range and consistency of group average BP, this trial examined the average systolic BP for individuals. Researchers have introduced the concept of salt sensitivity, which shows that the BP of some individuals rise with increased salt intake and falls with the reduction of salt intake, while yet the BP of others do not [87, 100, 101]. This trial used a study sample of 412 men and women ≥ 22 years old [101]. A total of 204 were assigned to the control diet, similar to what Americans consume [101]. The remaining 188 participants were assigned to the three feeding periods, which were 30-day feeding periods of salt intake at three clinically relevant levels (High, Medium, and Low) [101]. The researchers found that categorizing individuals as salt responders is very difficult [101]. Thus, the results support the current recommendations for lower salt intake for the whole population instead of those individuals who are “susceptible” individuals [101].

A study, in 2005, by Alonso et al. investigated whether whole-fat, low-fat or total dairy consumption was associated prospectively with hypertension risk [101, 102]. This study was conducted in 5880 students in Spain >20 years old who were not hypertensive or had any cardiovascular disease at the start of the study. The investigators used validated semi-quantitative food frequency questionnaires to assess

dairy consumption. The finding was that in this cohort low-fat dairy consumption, but not whole-fat dairy consumption was associated with lower risk of incident hypertension.

Cancer. Micozzi [103] mentioned that cancer experienced in adulthood is associated with childhood and adolescent overweight and obesity. Must et al. [68] conducted a long-term follow up study and found that men who were overweight adolescents had a higher prevalence of colorectal cancers. Various studies have been consistent in showing that there are associations between obesity and increased risk of endometrium, kidney, gallbladder cancer in women, and breast cancer in postmenopausal women [104]. Though most of these studies have found associations of adult obesity with cancers, it is well known that childhood obesity may persist into adulthood [12, 13].

Social and Psychological Consequences

Not only do children experience physical health consequences of obesity, they are also subject to more social and psychosocial consequences. Although physical health consequences become apparent in adulthood, many of the social and psychosocial consequences have an immediate effect [25, 105, 106]. Some of these consequences may include eating disorders and disordered eating [105], teasing and bullying [107], decreased self-esteem [108], negative body image [109], increased depression [110] and overall decrease in quality of life [3]. Fairburn and Brownell [111] suggest that eating disorders include not only anorexia nervosa and bulimia nervosa, but food avoidance emotional disorder, selective eating and pervasive refusal syndrome. Tanofsky-Kraff et al. [112] observed that higher eating-disordered cognitions and behaviors were experienced among 82 non-treatment-seeking overweight children compared to 80 normal weight children aged 6-13 years old. A school based study by

Neumark-Sztainer et al. [113] found that, among 7th-12th graders, overweight participants self-reported binge eating more often than their normal weight peers.

Among 106 children and adolescents aged 5-18 years, Schwimmer et al. [3] observed that obese children and adolescents, compared with healthy children and adolescents, reported significantly lower health-related quality of life (HRQOL). In fact, the obese children and adolescents were more likely to have impaired HRQOL, similar to children and adolescence diagnosed with cancer [3]. Further evidence of the bias against overweight individuals by children comes from Hayden-Wade et al. [107] who studied 70 overweight and 86 non overweight children aged 10-14 years old from southern California and suburban New York City. The children were asked to complete questionnaires that assessed various components of HRQOL, which included: loneliness, self-esteem, weight concerns, and preferences for active vs. sedentary and social vs. isolative activities, teasing and an eating disorder psychopathology and body image disturbance questionnaire [107]. When many factors - frequency, intensity, emotional impact and stigmatized content - were examined, findings indicated that teasing proved to more severe for overweight children when compared to all other components [107].

Healthy Eating Index

Background

Every five years since 1980, the Department of Health and Human Services (HHS) and the United States Department of Agriculture (USDA) have jointly provided nutrition recommendations to the American public (children and adults) and since this time, the guidelines have become more comprehensive [48]. This joint effort has ensured that the Federal government speaks with one voice about nutritional issues [48]. These

recommendations are called the Dietary Guidelines for Americans (DGA), which provides scientific-based guidance in defining healthful diets and how consuming a healthful diet can reduce major disease risks [114]. These guidelines are recommended for individuals 2 years and older [114]. The Healthy Eating Index (HEI) was originally developed in 1995 by the USDA in an attempt to assess how well Americans conformed to Federal Dietary Guidance (FDG) and the original Food Guide Pyramid (FGP) and is termed the original-HEI [114]. All in all, the HEI is a composite tool that assesses overall diet quality in the American population. Because it is an index, the HEI measures the degree to which individuals are following the 2005 Dietary Guidelines for Americans (DGA-2005) and FGP. The original-HEI was issued in October 1995 by the USDA Center for Nutrition and Policy Promotion (CNPP) and has been used to measure the adherence to the FDG for the 1989-1990, 1994-96, and 1998 Continuing Survey of Food Intakes by Individuals (CSFII) as well as the 1999-2000 NHANES data [29].

Original-HEI Scoring

The original-HEI was composed of 10 dietary components, equally weighted, which provided one single score out of a possible 100 points (Table 2-3) [100]. A diet score above 80 is considered “good”, one with a score between 51 and 80 is considered “needs improvement,” and one with a score of 50 or less is considered “poor” [115]. When the recommended servings are reached, a maximum score of 10 is given. Likewise, when no portion of the component is consumed, a score of zero is given [115]. Intakes between the minimum and maximum levels are scored proportionately [115] Components 1-5 of the original-HEI measures the degree to which individuals conformed to FGP’s recommended number of servings of Fruit, Vegetables, Grains, Milk (dairy) and Meat (and beans), based on gender and age [115]. Component six

through nine assessed aspects of the diet that should be limited or consumed in moderation Component six is a score that evaluates total daily sodium intake [116]. Component seven represents saturated fat consumption as a percentage of total food intakes. Component score eight represents total fat consumption as a percentage for total of energy intake. Component nine reflects daily TC intake and the last component estimates the extent of variety in a person's diet.

Modifications to the original-HEI. Investigators have modified the original-HEI in an attempt further define what constitutes the most healthful diet for Americans. These modified versions of the original-HEI include the Youth Healthy Eating Index (YHEI), Alternate Healthy Eating Index (AHEI) and the 2005 Healthy Eating Index (HEI-2005). Feskanich and colleagues, in 2004, modified the original-HEI to create the YHEI, in an attempt to better address dietary issues that are specific to older children and adolescents [117]. Feskanich and colleagues [117] developed the YHEI and used it to score food consumption and address dietary behaviors, such as eating breakfast, attending dinner with family, and avoiding snack foods and soft drinks that are pivotal to healthy childhood and adolescent growth and development. These behaviors were given scores and added to components of the original-HEI totaling 100 points [117]. The study by Hurley et al. is a cross-sectional study that compared HEI and YHEI scores for two samples of low-income African American urban middle school adolescents [118]. This group of investigators also compared the associations between the pair of indexes and health indicators to assess the relative strength of each measure to predict the dietary risks for chronic disease [118]. The investigators found that lower HEI scores, not YHEI, was associated with higher percent body/abdominal fat [118]. Even though

both indices are useful for assessing diet quality, only HEI was inversely associated with body composition, chronic disease predictors, and accounted for gender differences in the DGA.

In 2006, McCullough and colleagues created a modified version of the original-HEI. The AHEI – a 9-component design sought to associate reduced disease risks to target food choices and macronutrient sources [114]. This study examined 2 healthy cohorts from different studies, 67,271 women from the Nurse's Health Study and 38,615 men from the Health Professional's Follow-up Study [114]. During the 8-12 year follow-up, these investigators found that the AHEI predicted chronic disease risk better than the original-HEI, possibly because a strong inverse association with CVD [114].

Another revision of the original HEI is to the HEI-2005, created in November 2007 by Guenther and colleagues [115]. This revision of the original HEI occurred because of the new DGA-2005 which placed more emphasis on specific components of a quality diet [115]. Good diet quality includes but is not limited to: increased consumption of whole grains, different types of fruits and vegetables, appropriate amounts of specific types of fats and the new concept of "discretionary calories" [116]. Discretionary calories are termed "SoFAAS" representing calories from Solid Fat (including fat in milk products), Alcohol and Added Sugar. The DGA-2005 suggests that Americans should reduce their SoFAAS intake which provides most of the non-essential calories that Americans consume [48]. Americans consume 35% of their total calories from SoFAAS, which is currently too high [48]. It is recommended that Americans consume 20 to 30 percent of their total calories from SoFAAS [48]. An increased consumption of SoFAAS

increases the amount of Saturated fat and cholesterol intake which decreases the amount of dietary fiber and other nutrients consumed [48].

HEI-2005 Scoring

The HEI-2005 complies with the DGA-2005 and the new food intake patterns developed for the MyPyramid Food Guidance System (FGS). The original-HEI was modified for two reasons [116]. Firstly, the HEI-2005 takes into account the fact that energy needs vary among individuals by age, gender, and activity levels [116]. Secondly, the HEI-2005 is based on an energy density approach [116]. This approach is to distinguish dietary quality from dietary quantity [116]. The food group standards are expressed per 1,000 kcal (Table 2-4.) [66]. The food group standards are Total Grains, Whole Grains, Vegetables, Dark Green and Orange Vegetables and Legumes (cooked dry beans and peas), Total Fruits (including 100% juice), Whole Fruits (forms other than juice), Milk (all milk products and soy beverages), Meat and Beans (meat, poultry, fish, eggs, soybean products other than beverages, nuts, and seeds); and Oils (non-hydrogenated vegetable oils and oils in fish, nuts, and seeds) [116]. Standard nutrients and discretionary energy are based on percent total energy [116]. The remaining three components, for which moderation is recommended, are Saturated Fat; Sodium; and extra calories from SoFAAS [116]. Higher intakes of these components reveal poorer intakes and thus are scored lower [116]. Like the original-HEI, when the recommended servings are reached, a maximum score is given with the HEI-2005 [116]. Likewise, when no portion of the individual component is consumed, a score of zero is given and intakes between the minimum and maximum levels are scored proportionately [116].

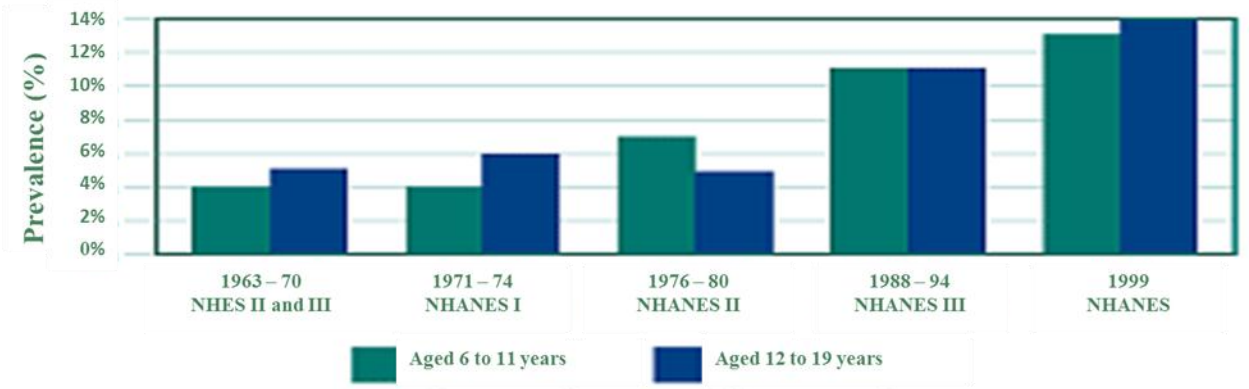
Current Use and Implications of the HEI-2005

The estimated amounts of calories needed to maintain energy balance differ for gender and age groups at different levels of physical activity (Table 2-5) [29]. The USDA CNPP has also suggested amounts of various foods from basic food groups, sub-groups and oils to meet recommended nutrient intakes at 12 different calorie levels (Table 2-6) [29]. One study that has estimated the HEI-2005 scores (Table 2-7) [29] in different populations was conducted by Guenther et al [119]. These scores are representative of Americans, looking at two surveys in particular, the CSFII 1994-96 and the NHANES 2001-02 [119]. Reviewing the data from these two sets of years show that the HEI-2005 score didn't change, but the distribution of the components did [119]. For example, whole fruits, total vegetables, and whole grains statistically decreased in 2001-02 compared to 1994-96 [119]. The components milk, oil, and sodium all statistically increased from 1994-96 to 2001-02 [119]. One can argue that the quality of the diet has not improved much for Americans [119]. Not only does the diet quality of Americans need improvement, but children's diet quality needs improvement.

Table 2-8 demonstrates the diet quality of children ages 2-5, 6-11, and 12-17 [120]. This study assessed the quality of children's diets, using HEI-2005, in 2003-04 [120]. Even though all of the scores are under 60, children ages 2-5 years old had a tendency to have a diet that was of more quality than any of the other age groups [120]. The results expressed "needs improvement" quality of diets in children and adolescents ages 2-17 years, even though the scores were higher in 2-5 year olds compared to 6-11 and 12-17 year olds [120]. No recent data has been documented, using the HEI-2005, estimating how well children and adolescents adhere to the DGA-2005 [120].

Studies have used the HEI-2005 to determine how children and adolescents adhere to the DGA [121-125]. In school aged children and adolescents, 5-18 years, some concerns were raised from the 1999-2004 NHANES data [126]. Some of the key concerns were that the children and adolescents scored low on many of the HEI-2005 components (Figure 2-3) [120]. For instance, the children and adolescents scored low with their intake of vegetables and fruits, especially whole fruits; children had a very low percentage of intake of dark green and orange vegetables and legumes; children had a very low intake of whole grains; there was a high intake of discretionary calories from SoFAAS, sodium and saturated fat among these school age children and adolescents, represented by the lower percentage scores [126].

To our knowledge, the relation of diet quality and disease risk factors has not been studied in children. In this study, it is significant that the HEI-2005 is used, as opposed to using other methods of assessing diet quality, since the HEI-2005 is comprised of the different components of the diet rather than just one [116]. Evaluating single nutrients may prove to be insufficient information, since there are complicated interactions that occur among nutrients. For example, iron absorption is enhanced in the presence of Vitamin C. The goal of this research was to evaluate diet quality in terms of adherence to the 2005 DGA and FGP among overweight children, 8-12 years old, living in rural counties via the HEI-2005. The index scores were compared with markers of disease risks, such as high BP, increased waist circumference, high serum TG, high serum HbA1c, low serum HDL-cholesterol, high serum TC and serum LDL-cholesterol levels. For the purpose of this study, overweight was defined as being at or above the 85th percentile for BMI for gender and age.



*Gender- and age-specific BMI ≥ the 95th percentile
Adopted from: Centers for Disease Control and Prevention (CDC), National Center for Health Statistics (NCHS), National Health Examination Survey (NHES), National Health and Nutrition Examination Survey (NHANES)

Figure 2-1. Prevalence of overweight* among US children and adolescents

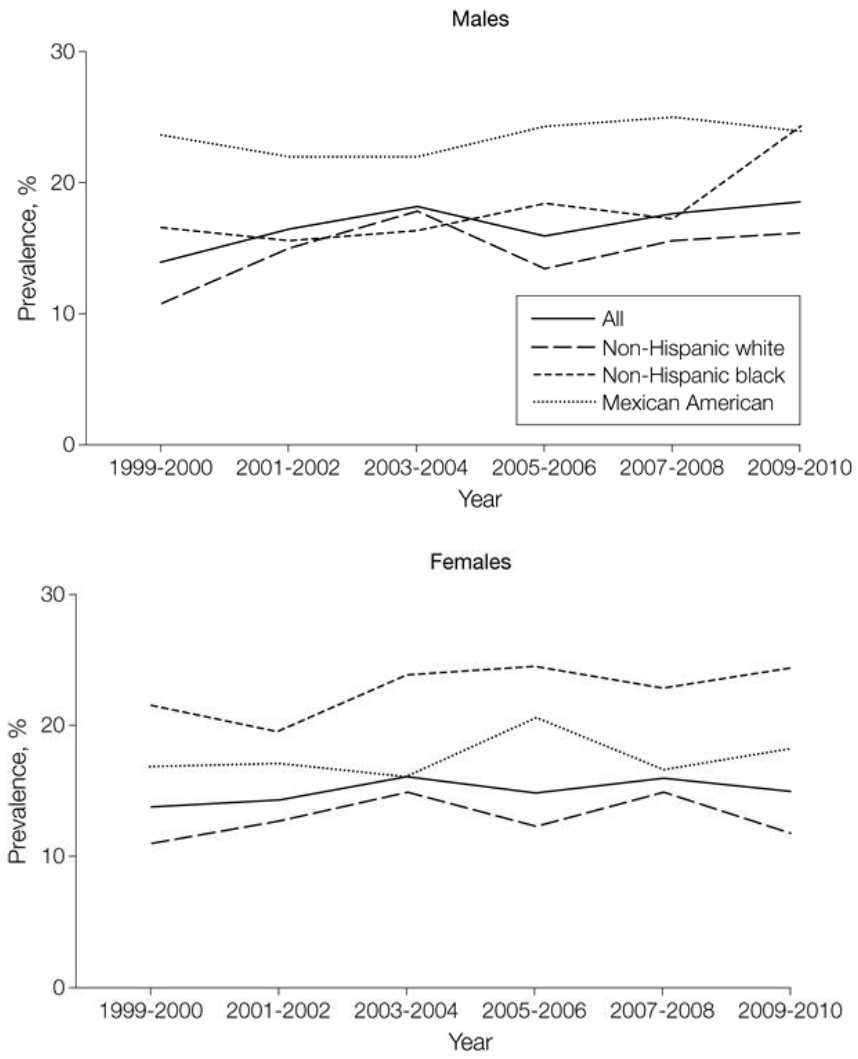


Figure 2-2. Prevalence of Obesity in US Males and Females Aged 2 through 19 Years

Table 2-1. Body weight status for children and adolescents

Category	BMI for Age Percentile Range
Underweight	Less than the 5th percentile
Healthy weight	5th percentile to less than the 85th percentile
Overweight	85th percentile to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile

Table 2-2. Task Force on Blood Pressure Control in Children Guidelines of Hypertension classification of Blood Pressure (BP)

Category	Systolic BP (mmHg)		Diastolic BP (mmHg)
Normal	≤ 90th percentile	And	≤ 90th percentile
Pre-hypertensive	90th to 95th percentile	Or	90th to 95th percentile
Hypertension, Stage 1	95th to 99th percentile	Or	95th to 99th percentile
Hypertension, Stage 2	≥ 99th percentile	Or	≥ 99th percentile

Table 2-3. Original-Healthy Eating Index (original-HEI) components and standards for scoring

Component	Maximum Value	Standard for maximum score	Standard for minimum score of zero
Total Fruit	10	2-4 servings (approx, 1-2 cups[1])	0 servings
Total Vegetables	10	3-5 servings (approx. 1.5-2.5 cups[1])	0 servings
Total Grains	10	6-11 servings (approx. 6-11 oz eq[1])	0 servings
Milk	10	2-3 servings (2-3 cups[2])	0 servings
Meat (and beans)	10	2-3 servings (approx. 5.5-7.0 oz eq.[1])	0 servings
Sodium	10	≤ 2.4 g	≥4.8 g
Saturated Fat	10	≤10% energy	≥15% energy
Total Fat	10	≤30% energy	≥45% energy
Cholesterol	10	≤300 mg	≥450 mg
Variety	10	≥ 16 different foods in 3 days[3]	≤6 different foods in 3 days
Total	100		

[1] According to gender and age
[2] According to age
[3] In 1994-96 and 1999-2000, 8 or more different foods in 1 day

Table 2-4. 2005 Healthy Eating Index components and standards for scoring

Component	Maximum points[1]	Standard for maximum score	Standard for minimum score of zero
Total Fruit (includes 100% juice)	5	≥0.8 cup equiv. per 1,000 kcal	No Fruit
Whole Fruit (not juice)	5	≥0.4 cup equiv. per 1,000 kcal	No Whole Fruit
Total Vegetables	5	≥1.1 cup equiv. per 1,000 kcal	No Vegetables
Dark Green and Orange Vegetables and Legumes[2]	5	≥0.4 cup equiv. per 1,000 kcal	No Dark Green or Orange Vegetables or Legumes
Total Grains	5	≥3.0 oz equiv. per 1,000 kcal	No Grains
Whole Grains	5	≥1.5 oz equiv. per 1,000 kcal	No Whole Grains
Milk[3]	10	≥1.3 cup equiv. per 1,000 kcal	No Milk
Meat and Beans	10	≥2.5 oz equiv. per 1,000 kcal	No Meat or Beans
Oils[4]	10	≥12 grams per 1,000 kcal	No Oil
Saturated Fat	10	≤7% of energy[5]	≥15% of energy
Sodium	10	≤0.7 gram per[5] 1,000kcal	≥2.0 grams per 1,000 kcal
Calories from Solid Fat, Alcohol and Added Sugar (SoFAAS)	20	≤20% of energy	≥50% of energy
Total	100		

[1] The maximum total HEI-2005 score is 100
[2] Legumes counted as vegetables only after Meat and Beans standard is met.
[3] Includes all milk products, such as fluid milk, yogurt, and cheese, and soy beverages.
[4] Includes non-hydrogenated vegetable oils and oils in fish, nuts, and seeds.
[5] Saturated Fat and Sodium get a score of 8 for the intake levels that reflect the 2005 Dietary Guidelines, <10% of calories from saturated fat and 1.1 grams of sodium/1,000 kcal, respectively.

Table 2-5. Estimated Daily Calorie Needs for Children ages 4-13 years old

Variable	Calorie Range		
Females			
4 – 8 years	1,200	→	1,800
9 – 13	1,600	→	2,200
Males			
4 – 8 years	1,400	→	2,000
9 – 13	1,800	→	2,600

Table 2-6. Recommended Daily Amounts of Food from Each Group for children

Calorie level	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
Fruits	1 cup	1 cup	1.5 cups	1.5 cups	1.5 cups	2 cups	2 cups	2 cups	2 cups	2 cups	2.5 cups	2.5 cups
Vegetables	1 cup	1.5 cups	1.5 cups	2 cups	2.5 cups	2.5 cups	3 cups	3 cups	3.5 cups	3.5 cups	4 cups	4 cups
Grains	3 oz-eq	4 oz-eq	5 oz-eq	5 oz-eq	6 oz-eq	6 oz-eq	7 oz-eq	8 oz-eq	9 oz-eq	10 oz-eq	10 oz-eq	10 oz-eq
Meat and Beans	2 oz-eq	3 oz-eq	4 oz-eq	5 oz-eq	5 oz-eq	5.5 oz-eq	6 oz-eq	6.5 oz-eq	6.5 oz-eq	7 oz-eq	7 oz-eq	7 oz-eq
Milk	2 cups	2 cups	2 cups	3 cups	3 cups	3 cups	3 cups	3 cups	3 cups	3 cups	3 cups	3 cups
Oils	3 tsp	4 tsp	4 tsp	5 tsp	5 tsp	6 tsp	6 tsp	7 tsp	8 tsp	8 tsp	10 tsp	11 tsp
Discretionary calorie allowance	165	171	171	132	195	267	290	362	410	426	512	648

Table 2-7. Estimated 2005 Healthy Eating Index Component and Total Scores, United States, 1994-96 and 2001-02

Component (Maximum Score)[1]	1994-96 Score [2]	2001-02 Score [2]
Total Fruit (5)	3.1	3.1
Whole Fruit (5)	4.5	3.4*
Total Vegetables (5)	3.6	3.2*
Dark Green and Orange Vegetables and Legumes (5)	1.4	1.4
Total Grains (5)	5.0	5.0
Whole Grains (5)	1.2	1.0*
Milk (10)	5.9	6.3*
Meat and Beans (10)	10.0	10.0
Oil (10)	6.0	6.8*
Saturated Fat (10)	6.5	6.4
Sodium (10)	3.2	4.1*
Calories from Solid Fats, Alcoholic beverages, and Added Sugars (20)	7.8	7.5
Total HEI-2005 score (100)	58.2	58.2

[1] The maximum total HEI-2005 score is 100

[2] Sources of data: Continuing Survey of Food Intakes by Individuals, 1994-96, and National Health and Nutrition Examination Survey, 2001-02

* Significantly different ($p<0.05$).

Table 2-8. Estimated mean 2005 Healthy Eating Index total and component scores for children and adolescents ages 2 to 17, United States, 2003-04

Component (maximum score)[1]	Age 2-5 years[2] (n=763)	Age 6-11 years[2] (n=900)	Age 12-17 years[2] (n=1,632)
Total Fruit (5)	5.0	2.9*	2.5†
Whole Fruit (5)	4.3	2.7*	2.2†
Total Vegetables (5)	2.2	2.3	2.4
Dark Green and Orange	0.6	0.5	0.6
Total Grains (5)	5.0	5.0	5.0
Whole Grains (5)	0.8	0.9	0.6†
Milk (10)	10.0	8.7*	7.7†
Meat and Beans (10)	7.3	7.8	8.8†
Oil (10)	5.5	6.6	7.5†
Saturated Fat (10)	4.7	5.2	5.4
Sodium (10)	4.8	4.5	4.2†
Calories from Solid Fats, Alcoholic	9.4	7.7*	7.9†
Total HEI-2005 score (100)	59.6	54.7	54.8

[1] The maximum total HEI-2005 score is 100

[2] Number of servings depends on recommended Food Guide Pyramid servings

*Age 2-5 versus 6-11 (significantly different, $p<0.05$).

†Age 2-5 versus 12-17 (significantly different, $p<0.05$).

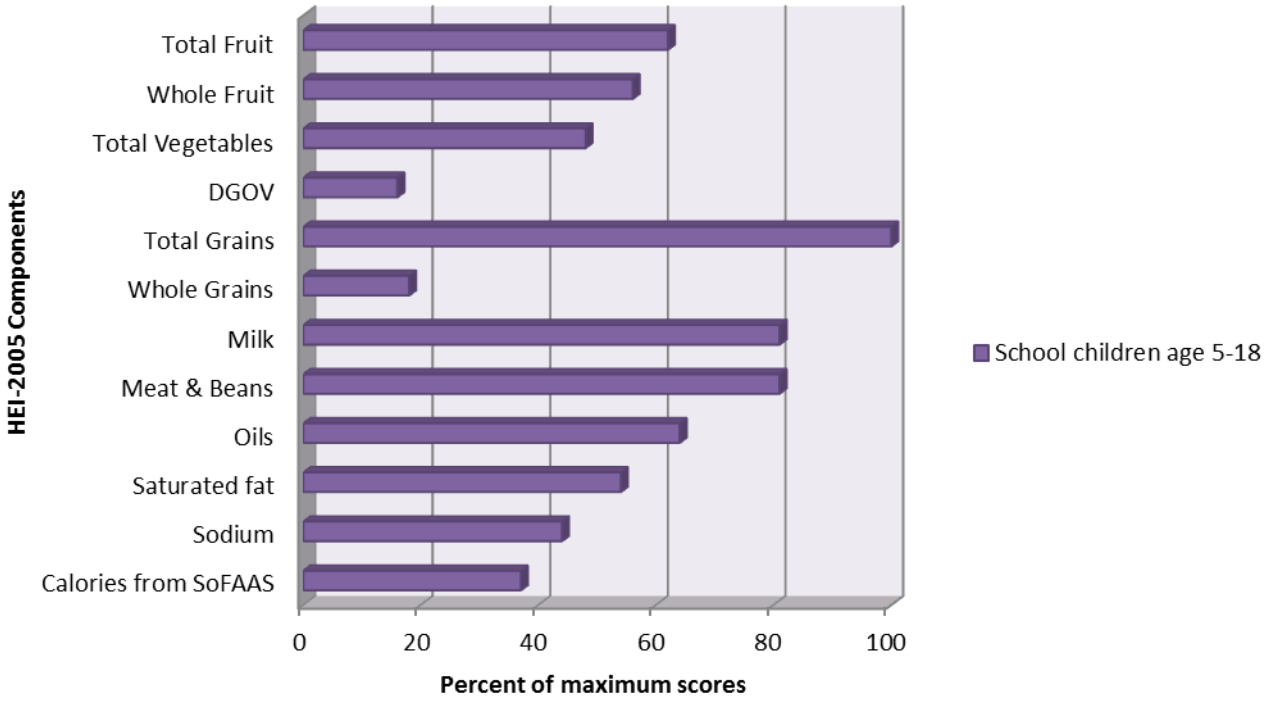


Figure 2-3. 2005 Healthy Eating Index Component Scores for children and adolescents from 1999-2004 NHANES data.

CHAPTER 3
METHODOLOGY

This study is a cross-sectional evaluation of diet quality and the association between diet quality and disease risk factors in an overweight pediatric population. The data from this study was gathered from the first two waves of the Extension Family Lifestyle Intervention Project (E-FLIP for Kids) Study.

Participants

Subjects for this sub-analysis included children recruited in the first four waves of the E-FLIP for Kids Study. The E-FLIP for Kids Study is prospective, randomized controlled study that evaluates the influence of two behavioral lifestyle interventions, Parent Only (PO) and Family-Based (FB) compared to a Health Education Control (HEC) group. Participants were recruited from rural counties in North Central Florida through direct solicitation methods. These methods included distributing information to households, health-care providers, churches, social organizations, and community events using brochures, presentations, and Cooperative Extension Service faculty. All potential candidates were screened over the telephone. The E-FLIP for Kids Study was approved by the Institutional Review Board of University of Florida. To participate in E-FLIP for Kids Study, children met the requirements of being between the ages of 8-12 and met weight requirements (BMI of ≥ 85th percentile for their age and gender) prior to study initiation. Participants were excluded from the E-FLIP for Kids Study if they had: any medical restrictions that contraindicated participation in the program which included a reduced energy intake and increased physical activity ; resting BP exceeding 140/90 mm Hg; medication regimes including, but not limited to, monoamine oxidase inhibitors, antibiotics for HIV or TB, or the use of prescription weight-loss drugs taken within the

past six months; and or conditions that affect the E-FLIP for Kids Study including inability to consent, inability to read English, major psychiatric disorder, or a child with a developmental delay, pattern of aggressive or oppositional behavior.

Demographic data for this sub-analysis included age, gender and Race. Race was classified as African American, Caucasian, Bi-Racial or Unknown/No Response. Anthropometric data included height, weight, and waist circumference. Height and weight were used to calculate BMI, BMI-z score and BMI percentile category. For this study, BMI category was grouped ≥85th to <95th percentile, ≥95th to <97th percentile, and ≥97th percentile because this study only included participants who were above the 85th percentile and three groups was the best way to categorize the participants. Clinical characteristic data included finger pricks which was used to measure serum HbA1c, serum TC, serum HDL-Cholesterol, serum LDL-Cholesterol, and serum TG.

Procedures

Parents who provided consent and children who assented to participate in the E-FLIP for Kids Study completed assessment measures across two assessment visits. At the first visit, led by the Mobile Clinical Assessment Team, the child's height, weight, heart rate BP and blood analysis was collected to determine eligibility. If eligible the child and primary care giver returned for a baseline data collection visit within three weeks of the study initiation. At the second visit, height, weight and waist circumference was measured. The SenseWear® armband accelerometer was given to the child, at the second visit, to be worn for 7-days. Data for this analysis was taken from the baseline data collection visit. Anthropometric measures were collected by a trained nurse or nurse technician. Questionnaire data was collected with the assistance of a trained research assistant or parent of the child. Participants with missing data for

disease risk indicators, including systolic and diastolic blood pressure, serum total cholesterol, LDL-Cholesterol, HDL-Cholesterol, HbA1c and TG, as well as anthropometric measures were excluded.

Height and Weight

Height was measured to the nearest 0.1 centimeter using a Harpendon stadiometer, without shoes. Weight was measured to the nearest 0.1 kilogram using a certified digital scale, with one layer of clothes, without shoes and emptied pockets. Both height and weight were used to calculate BMI, BMI percentile category, and BMI z-score, specific for age and gender. BMI was calculated as weight in kilograms divided by height in meters squared. Age and gender-specific BMI z scores were calculated according to Centers for Disease Control and Prevention growth charts [127]

Waist Circumference

To determine the waist circumference, the upper hip bone was located and a measuring tape was placed around the abdomen, ensuring that the tape measure was horizontal. The tape measure was snug but did not cause compressions on the skin and the measurement was taken.

Blood Pressure and Heart Rate

The resting systolic and diastolic BP and resting heart rate was measured using manual blood pressure cuff. Before the measurements were taken, there was a 5 minute resting period where the participant was devoid of distractions, seated and feet lying flat on the floor. The measurements were taken a total of three times with two minutes between each reading. The first reading was discarded while the last two were averaged together. Participants were excluded from the study if their resting BP was above the 95th percentile for height, weight, and gender.

Blood Analysis

Glycosylated hemoglobin (HbA1c), TG, serum TC, LDL-cholesterol and HDL-cholesterol were measured under aseptic conditions, using approximately 2-3 drops of blood. The Cholestech LDX System and Cholestech GDX System A1c (Invernes Medical, 2010) were the devices used to analyze the cholesterol blood samples and HbA1c, respectively.

Physical Activity

The participants were asked to wear a SenseWear® armband accelerometer, which was worn for 24 hours a day for 7 consecutive days, with the exception of when bathing or swimming. Only participants who wore the SenseWear® armband accelerometer for a minimum of 16 hours were included in the analysis. A total of 4 days of data were used for this analysis. The first 3 weekdays and first 1 weekend day, that the participants wore the SenseWear® armband accelerometer the accepted amount of time, was used in this analysis. The data gathered from the accelerometer examined, objectively, total energy expenditure, total physical activity energy expenditure and MET equivalents of physical activity for the 7 day period. MET equivalents, measured by the SenseWear® armband accelerometer, examine the intensity of physical activity. Percent active energy expenditure (%AEE) was calculated as measured active energy expenditure divided by total energy expenditure multiplied by 100. Multiple studies have defined sedentary individuals as expending < 10% of their daily energy expenditure in activities [128, 129], but that definition was not used in this study because of the paucity of data to support their validity in children. Percent AEE was coded into three tertiles, following the direction of Manini et al. [130]. For our

analysis, the three tertiles of %AEE are defined as low: < 15%; medium: 15-24%; high: >24%.

Dietary Intake and HEI-2005

The Block Kids FFQ was completed to assess overall diet, was designed by Dr. Gladys Block and contains 77 food/beverage items for children and adolescents aged 8-17 years (Appendix A). The food list originated from the NHANES 1999-2002 dietary recall data. The Block Kids FFQ asks about the frequency of foods consumed within the previous week. The participants received help with completing the Block Kids FFQ, from either a parent of a research staff member, if they needed the assistance.

There were six response categories, which ranged from none to every day. The quantities of the foods and beverages consumed were estimated with either three or four categories related to the type of food. For example, foods like fruits or vegetables were assessed in cups (i.e., ¼ c, ½ c, 1 c, and 2 c). For items like tacos, responses "were how many?" (e.g., ½, 1, 2, and 3). Visual images of serving sizes, on plates and bowls, were presented in a hand out to assist in portion size determination.

We calculated the HEI-2005 score for each participant by using their responses to the Block Kids FFQ. NutritionQuest, first, analyzed the Block Kids FFQ responses. NutritionQuest used the food items from the Block Kids FFQ to assign to the appropriate food groups. Recipes and foods, from the NutritionQuest nutrient database, were separated into their component parts and individual foods were assigned to the appropriate food groups. NutritionQuest totaled the daily quantity of servings of foods from each food group. NutritionQuest's analysis reports indicated the number of servings consumed for the following food groups: fruit, vegetables, grains, dairy, meat, and discretionary oils and fat; estimated intake of calories and nutrients, sugar intake,

and the percent of calories from solid fat and sweets. We used the information from NutritionQuest to then, calculate the HEI-2005 component scores and total score. Only food and recipe constituents that contributed toward the 8 food groups were counted when calculating average daily number of servings. Participants were excluded if they reported extreme energy intakes of <500 or >5,000 kcal/day (n=7) [117].

Statistical Tests

Data were analyzed using JMP8 statistical software (SAS Institute, Inc, Cary, NC). To test the association between overall HEI-2005 score and the disease risk factor variables, simple pair-wise correlation analyses were performed. We also tested the association between physical activity and the disease risk factor variables as activity is known to influence disease risk factors as well. If indicated, physical activity was used in a multiple linear regression analysis to further elucidate the independent relationship of diet quality (HEI-2005) with these disease risk factors. For the analyses, we controlled for gender, race, and weight status. Similar analyses were then performed with the individual component scores identified in the hypotheses and the disease risk factors to determine any potential relationship. A significance level of $p < 0.05$ was set for each statistical test.

CHAPTER 4
RESULTS

Demographic Description of Participants

Table 4-1 lists the participant demographic data. One hundred seventy eight children participated in the study including 78 males and 100 females. The mean age of the total sample of the participants was 9.94 (±1.4) years. The mean age for boys and girls was 10.2 (±1.4) years and 9.8 (±1.4) years respectively. The racial distribution of participating children included 29 (16%) African American, 115 (65%) Caucasian, 23 (13%) Bi-racial, 10 (5.5%) Unknown/No response and 1 (0.05%) Asian American. From this point forward, whenever comparisons are made between ethnic groups, the one Asian American and 12 Unknown/No Response children were excluded from the analysis.

Anthropometric Description

Of the 178 participants, the distribution of BMI of study participants was 12 (7%) above the 85th percentile, 21 (12 %) above the 95th percentile, and 145 (81%) greater than the 97th percentile. Fifty-three percent of the Caucasian participants, 14% of African American participants and 11% of the Biracial participants were in the >97th percentile group (Table 4-2)

The average height and weight for the study population was 148.4 (±10.4) cm and 64.5 (±19.1) kg, respectively (Table 4-3). The mean weight for height was 28.8 (±5.8), mean BMI-z score was 2.2 (±0.4), mean waist circumference was 94.1 (±14.9) cm, mean systolic blood pressure was 96.7 (±11.2) mmHg, and mean diastolic blood pressure was 64.9 (±8.4) mmHg.

Clinical and Dietary Characteristics, by Gender

Table 4-4 illustrates the clinical and dietary characteristics of the study participants, by gender. At baseline, the mean clinical characteristics were all within normal ranges for all characteristics except for serum TG. For both boys and girls, the mean serum TG levels were in the borderline range, 163.3 (±72.1) and 171.8 (±79.7) mg/dl, respectively (p=0.46). The normal serum TG level, for both boys and girls in this age group, is less than 150 mg/dL. The mean energy intake for this study population was 1329.1 (±602.2) kcal. The minimum reported energy intake was 503.69 kcal and the maximum reported energy intake was 4566.64 kcal. At baseline, the participants' macronutrient levels fell between normal levels. Girls had significantly lower % kcal from protein compared to boys (p=0.05). The participants in this study consumed 33.3 (±6.0) % of calories from fat. The participants in this study consumed an average of 54.3 (±7.6) %from carbohydrates. The mean fiber consumption was 10.5 (±5.9) g, daily.

Clinical and Dietary Characteristics, by Race

The mean clinical and dietary characteristics, by Race, are found in Table 4-5. African Americans had a significantly higher BMI (p=0.002), BMI z-score (p=0.04) and HbA1c (p=0.002) compared to Caucasians. African Americans also had significantly lower triglycerides compared to both Caucasian and Bi-Racial participants (0.003). There were no other significances observed between the races.

Clinical and Dietary Characteristics, by BMI Percentile Distribution

The mean values for physical and blood parameters by BMI percentile distribution are found in Table 4-6. The >97th percentile group had significantly higher body fat (p<0.0001), BMI (p<0.0001), BMI z-score (p<0.0001), waist circumference (p<0.0001), systolic BP (p<0.0001), diastolic BP (p=0.002) and triglycerides (p=0.03). The 85th to

95th percentile group reported consuming significantly higher ($p<0.01$) energy compared to the other percentile groups.

Descriptive Statistics for HEI-2005 Score

HEI-2005 Scores by Gender

Table 4-7 presents the energy consumption and mean total and individual component HEI-2005 scores for all participants and by gender. On average, the energy consumption was 1339.7 (±596.6) kcal. The mean total HEI-2005 score was 61.2± out of a possible 100. Total HEI-2005 scores were similar for boys (62.7 ± 11.2) and for girls (60.1 ± 10.0), ($p=0.10$). The mean daily energy intakes, as assessed by the FFQ, for 7-12 year old boys and girls in the E-FLIP for Kids Study were 1334.9 (±574.8) and 1340.16 (±615.9) kcal ($p=0.93$), respectively. Boys scored significantly higher on the SoFAAS component compared to girls ($p=0.001$). Neither boys nor girls met the government recommendation for the following HEI-2005 components: Total Vegetables, DGOV, Whole grains, Dairy, Oil, Sodium, Saturated fat, SoFAAS and total HEI-2005 score.

HEI-2005 Scores by Race

Table 4-8 presents the comparison of energy consumption and total/component HEI-2005 scores by Race. No significant differences were seen between racial groups and HEI-2005 component scores.

HEI-2005 Scores by BMI Percentile Distribution

Table 4-9 presents the comparison of total/component HEI-2005 scores by BMI percentile distribution. According to the food frequency questionnaire analysis, the 85th to 95th percentile group scored a significantly lower score compared to the 95th to 97th percentile distribution group for the Meat & Beans component ($p=0.02$). The 95th to 97th

percentile group scored significantly higher than the other groups for the Whole Grains component (p=0.05). The 85th to 95th percentile group scored significantly higher for the Sodium component compared to the other BMI percentile groups (p=0.05).

Adherence to Federal Physical Activity Guidance

Only 94 of the 178 study participants had physical activity data that met these criteria (Table 4-10). This study population spent an average of 120 minutes per day being physically active, 114 minutes in moderate intensity (3-6 METS) physical activity and 6 minutes in vigorous intensity (>6 METS) physical activity. According to the federal physical activity guidance, this study population was meeting the recommended goals for physical activity. When the participants were categorized into the three tertiles for %AEE, 32 participants were in the low tertile, 32 participants were in the medium tertile, and 30 participants were in the high tertile. After adjustment for physical activity, no significant associations were observed.

Does the Diet Quality, via the HEI-2005, of this Overweight Study Population Adhere to the DGA-2005?

This study population failed to meet the government recommendations for the total HEI-2005 score (61.2 /100.00). For this study population, the mean HEI-2005 component scores were below the maximum possible score for every component (Table 4-7). The federal government recommends that the total and component HEI-2005 scores are greater than or equal to 80% of the score, indicating that the quality of the diet is “good”. The average study participant met the recommendation (≥80% of the maximum score) for the following HEI-2005 components: Total Fruit, Whole Fruit, Total Grains and Meat & Legumes. The following components that “need improvement”, include: Total Vegetables, DGOV, Dairy, Oil, and Saturated Fat. The HEI-2005

component scores were particularly poor (less than or close to 50% of the maximum score) for Whole Grains, Sodium, and SoFAAS. Only 2% (n=3) of the study participants met the overall recommendation for a “good” diet, in which all were from the Caucasian group (Table 4-11).

Association between Total HEI-2005 Score and Disease Risk Factors

After adjusting for physical activity and weight, there were no associations detected. Table 4-12 presents the data for the association between the HEI-2005 Score and disease risk factors. Neither serum TC (p=0.12, r=0.00), serum LDL-cholesterol (p=0.12, r=0.01), serum HbA1c (p=0.65, r=-0.00) Systolic BP (p=0.45, r=0.00), Diastolic BP (p=0.02, r=-0.02) nor was waist circumference (p=0.72, r=-0.03) significantly associated with mean total HEI-2005 score.

Association between HEI-2005 Component Score and Disease Risk Factors

The hypothesis evaluating the association of specific dietary components of the HEI with disease risk factors was tested using pair-wise correlations. After adjustment for physical activity, there were significant differences in the HEI-2005 components scores and disease risk factors. Total Fruit score was inversely associated with TC (p=0.02, r=-0.16) (Table 4-13).

Exploratory Analysis: Association between Total/Component HEI-2005 Score and Disease Risk Factors

When adjusting for weight, various expected associations were observed. When analyzing the association between total HEI-2005 score and disease risk factors, there was a strong association observed in the 85th to 95th percentile group. TC (*p*=0.004, r=-0.76) and LDL-C (*p*=0.005, r=-0.74) was significantly associated with total HEI-2005 score. When analyzing the association between HEI-2005 component scores and

disease risk factors, associations were observed. In the 85th to 95th percentile group, Total Fruit (*p*=0.05, r=-0.57), Total Vegetable (*p*=0.05, r=-0.57), Saturated Fat (*p*=0.006, r=-0.74) and Sodium (*p*=0.003, r=0.77) were significantly associated with TC. In the same group, Saturated Fat (*p*=0.007, r=-0.73) was associated with LDL-C. In the 95th to 97th percentile group, Sodium (p=0.03, r=0.47) was significantly associated with TC. No expected associations were seen in the ≥97th percentile group. There were no specific associations observed when the component scores were analyzed by Race (Table 4-14).

When adjusting for weight, various expected associations were observed. When analyzing the association between total HEI-2005 score and disease risk factors, there was a strong association observed in the 85th to 95th percentile group. TC and LDL-C was significantly associated with total HEI-2005 score. In the 85th to 95th percentile group, the association between Total Fruit score and TC disappeared. An unexpected association was observed between the SoFAAS score and TG with a positive correlation. No expected associations were seen in the ≥97th percentile group. There were no specific associations observed when the component scores were analyzed by Race (Table 4-15).

Table 4-1. Participant demographic results, by gender, n=178

Variable	All participants	Boys	Girls
Mean Age ± Standard Deviation (yr)	9.94 (±1.4)	10.2 (±1.4)	9.8 (±1.4)
Number of participants	178	78	100
Race			
African American	29 (16%)	12	17
Caucasian	115 (65%)	52	63
Bi-Racial	23 (13%)	8	15
Asian American	1 (0.05%)	1	0
Unknown/No Response	10 (5.5%)	5	5

Table 4-2. Characteristics of the sample, n=178

	Asian American	African American	Caucasian	Bi-Racial	No Response	Total
Boys						
85th to 95th Percentile	1 (0.05%)	0 (0.00%)	3 (1.7%)	1 (0.05%)	0 (0.00%)	5
95th to 97th Percentile	0 (0.00%)	1 (0.05%)	6 (3.4%)	0 (0.00%)	0 (0.00%)	7
>97th Percentile	0 (0.00%)	11 (6.2%)	43 (24.2%)	7 (3.9%)	5 (2.8%)	66
Total	1	12	52	8	5	78
Girls						
85th to 95th Percentile	0 (0.00%)	1 (0.05%)	3 (1.7%)	1 (0.05%)	2 (1.1%)	7
95th to 97th Percentile	0 (0.00%)	3 (1.7%)	9 (5.1%)	1 (0.05%)	1 (0.05%)	14
>97th Percentile	0 (0.00%)	14 (7.9%)	51 (28.7%)	13 (7.3%)	2 (1.1%)	79
Total	0	18	63	15	5	100

Table 4-3. Participant anthropometric results, by gender, n=178

Anthropometric Measurements	All Participants (n=178)	Boys (n=78)	Girls (n=100)
Mean Height, cm	148.4 (±10.4)	149.0 (±9.5)	147.8 (±11.0)
Mean Weight, kg	64.5 (±19.1)	65.1 (±18.4)	63.9 (±19.7)
BMI	28.8 (±5.8)	28.9 (±5.9)	28.7 (±5.8)
BMI z-score	2.2 (±0.4)	2.17 (±0.4)	2.1 (±0.4)
Waist Circumference (cm)	94.1 (±14.9)	94.4 (±14.2)	93.9 (±15.6)
Systolic BP (mmHg)	96.7 (±11.2)	97.6 (±12.7)	96.1 (±9.8)
Diastolic BP (mmHg)	64.9 (±8.4)	65.9 (±9.4)	64.3 (±7.5)

Table 4-4. Mean values for physical and blood parameters, by gender, n=178

Characteristic	All Participants (n=178)	Boys (n=78)	Girls (n=100)	*P* value
		Mean (±SD)		
Biochemical Data				
Hemoglobin A1c (%)	5.5 (±0.3)	5.6 (±0.4) [a]	5.5 (±0.3) [a]	0.27
Cholesterol level (mg/dl)				
TC	160.5 (±27.5)	160.3 (±26.7) [a]	160.7 (±28.2) [a]	0.91
HDL-Cholesterol (mg/dl)	39.1 (±10.0)	39.5 (±10.6) [a]	38.8 (±9.6) [a]	0.63
LDL-Cholesterol (mg/dl)	87.6 (±23.7)	87.8 (±24.0) [a]	87.4 (±23.5) [a]	0.91
TG (mg/dl)	168.1 (±76.4)	163.3 (±72.1) [a]	171.8 (±79.7) [a]	0.46
Dietary Nutrient Intake				
Energy (kcal)	1329.1 (±602.2)	1334.9 (±574.8) [a]	1324. 5 (±625.3) [a]	0.91
% kcal from Fat	33.3 (6.0)	33.2 (±6.0) [a]	33.5 (±6.0) [a]	0.79
% kcal from Carbohydrates	54.3 (7.6)	53.9 (±7.2) [a]	54.5 (±8.1) [a]	0.62
% kcal from Protein	14.1 (2.7)	14.5 (±2.4) [a]	13.7 (±2.8) [b]	0.05
Total Fiber (g)	10.6 (5.9)	10.9 (±5.9) [a]	10.2 (±6.0) [a]	0.44

[ab]Means not sharing the same superscript letter (a,b) are significantly different ($P \leq 0.05$)

Table 4-5. Clinical and Dietary Characteristics, by Race, n=178

Characteristic	African American (n=29)	Caucasian (n=115)	Bi-Racial (n=23)	*P* value
		Mean (±SD)		
Age (years)	10.2 (±1.3) [a]	9.9 (±1.5) [a]	10.2 (±1.4) [a]	0.45
Anthropometric Measurements				
BMI	32.1 (±7.7) [a]	28.0 (±4.9) [b]	29.3 (±6.3) [ab]	0.002
BMI z-score	2.3 (±0.4) [a]	2.1 (±0.4) [b]	2.2 (±0.4) [ab]	0.04
Waist Circumference (cm)	98.5 (±17.3) [a]	93.6 (±14.8) [a]	92.5 (±12.8) [a]	0.25
Physical Assessment				
Systolic BP (mmHg)	98.0 (±13.0) [a]	97.1 (±11.2) [a]	94.3 (±8.6) [a]	0.45
Diastolic BP (mmHg)	63.64 (±8.28) [a]	65.25 (±8.58) [a]	66.59 (±7.12) [a]	0.32
Clinical Characteristics				
HbA1c (%)	5.7 (±0.5) [a]	5.5 (±0.3) [b]	5.6 (±0.3) [a]	0.002
Cholesterol level (mg/dl)				
TC	153.1 (±26.1) [a]	163.6 (±28.5) [a]	159.1 (±24.6) [a]	0.18
HDL-C	41.2 (±11.1) [a]	38.9 (±9.9) [a]	38.3 (±9.2) [a]	0.49
LDL-C	86.8 (±23.5) [a]	88.7 (±25.5) [a]	84.3 (±16.7) [a]	0.69
Triglycerides (mg/dl)	125.1 (±50.6) [a]	177.3 (±79.0) [b]	188.4 (±106.5) [b]	0.003
Dietary Nutrient Intake				
Energy (kcal)	1365.3 (±686.7) [a]	1330.8 (±579.4) [a]	1334.9 (±580.1) [a]	0.96
% kcal from Fat	33.6 (±4.3) [a]	33.9 (±6.5) [a]	31.9 (±5.2) [a]	0.36
% kcal from Carbohydrates	54.1 (±5.2) [a]	53.5 (±8.3) [a]	56.5 (±7.3) [a]	0.23
% kcal from Protein	13.8 (±2.0) [a]	14.3 (±2.8) [a]	13.2 (±3.0) [a]	0.16
Total Fiber (g)	11.3 (±7.4) [a]	10.6 (±5.7) [a]	10.4 (±5.3) [a]	0.83

[ab]Means not sharing the same superscript letter (a,b) are significantly different ($P<0.05$)

Table 4-6. Mean values for physical and blood parameters, by BMI Percentile Distribution, n=178

Variable (Max Score)	85th to 95th percentile (n=12)	95th to 97th percentile (n=21)	>97th percentile (n=145)	*P* value
		Mean (±SD)		
Age (years)	10.5 (±1.5)[a]	9.9 (±1.4)[a]	9.9 (±1.4)[a]	0.42
Anthropometric Measurements				
BMI	22.2 (±1.8)[a]	23.3 (±1.5)[a]	30.1 (±5.6)[b]	< 0.0001
BMI z-score	1.4 (±0.08)[a]	1.7 (±0.06)[b]	2.3 (±0.02)[c]	< 0.0001
Waist Circumference cm)	79.4 (±8.4)[a]	81.6 (±7.6)[a]	97.0 (14.6)[b]	< 0.0001
Systolic BP (mmHg)	87.8 (±6.1)[a]	87.7 (±6.3)[a]	98.7 (±11.1)[a]	<0.0001
Diastolic BP (mmHg)	58.3 (±4.5)[a]	62.2 (±4.0)[ab]	65.9 (±8.8)[b]	0.002
Clinical Characteristics				
HbA1c (%)	5.4 (±0.3)[a]	5.5 (±0.3)[a]	5.5 (±0.3)[a]	0.33
Cholesterol level (mg/dl)				
TC	150.6 (±7.9)[a]	160.5 (±6.2)[a]	161.3 (±2.3)[a]	0.43
HDL-C	39.2 (±7.9)[a]	41.7 (±15.2)[a]	38.7 (±9.3)[a]	0.48
LDL-C	85.6 (±23.2)[a]	90.6 (±22.5) [a]	87.3 (±24.0)[a]	0.81
Triglycerides level (mg/dl)	129.3 (±43.4)[a]	140.9 (±67.1)[a]	175.0 (±78.2)[b]	0.03
Dietary Nutrient Intake				
Energy (kcal)	1725.9 (±906.3)[a]	1401.9 (±541.7) [a]	1286.8 (571.5) [a]	0.04
% kcal from Fat	31.0 (±3.9)[a]	31.7 (±5.5)[a]	33.7 (±6.1)[a]	0.13
% kcal from Carbohydrates	57.7 (±4.9)[a]	56.5 (±7.0)[a]	53.7 (±7.8)[a]	0.07
% kcal from Protein	13.0 (±1.6)[a]	13.7 (±2.4)[a]	14.2 (±2.7)[a]	0.29
Total Fiber (g)	12.5 (±6.4)[a]	12.3 (±5.7)[a]	10.2 (±5.8)[a]	0.17

[ab]Means not sharing the same superscript letter (a,b) are significantly different (*P*<0.05)

Table 4-7. Comparison of Energy Consumption and Total and Component HEI-2005 Scores by Gender, n=178

Variable (Max Score)	All Participants (n=178)	Boys (n=78)	Girls (n=100)	*P* value
		Mean(±SD)		
Energy consumption (Kcal)	1339.7 (±596.6)	1334.9 (±574.8) [a]	1343.4 (±615.9) [a]	0.93
Total HEI-2005 (100)	61.2 (±10.6)	62.7 (±11.2) [a]	60.1 (±10.0) [a]	0.10
Total Fruit (5)	4.4 (±1.3)	4.67 (±0.76) [a]	4.57 (±0.90) [a]	0.45
Whole Fruit (5)	4.0 (±1.6)	3.9 (±1.6) [a]	4.1 (±1.5) [a]	0.33
Total Vegetables & Legumes (5)	3.1 (±1.4)	3.2 (±1.5) [a]	3.0 (±1.4) [a]	0.53
DGOV & Legumes (5)	2.9 (±2.0)	3.2 (±2.0) [a]	2.7 (±2.0) [a]	0.14
Total Grains (5)	4.4 (±0.8)	4.51 (±0.8) [a]	4.3 (±0.8) [a]	0.11
Whole Grains (5)	1.1 (±0.8)	1.1 (±0.9) [a]	1.1 (±0.8) [a]	0.59
Dairy (10)	6.6 (±2.5)	6.8 (±2.5) [a]	6.4 (±2.6) [a]	0.24
Meat & Legumes (10)	8.4 (±2.5)	8.1 (±2.9) [a]	8.6 (±2.1) [a]	0.24
Oil (10)	6.7 (±2.7)	6.7 (±2.8) [a]	6.7 (±2.6) [a]	0.98
Sodium (10)	3.7 (±2.3)	3.5 (±2.2) [a]	4.0 (±2.3) [a]	0.18
Saturated Fat (10)	5.8 (±2.6)	6.1 (±2.3) [a]	5.6 (2.7) [a]	0.22
SoFAAS (20)	10.1 (±5.0)	11.4 (±5.2) [a]	8.9 (±4.5) [b]	0.001

[ab]Means not sharing the same superscript letter (a,b) are significantly different ($P<0.05$)

Table 4-8. Comparison of Age, Energy Consumption and Total/Component HEI-2005 Scores by Race, n=178

Variable (Max Score)	African American (n=29)	Caucasian (n=116)	Bi-Racial (n=23)	*P value*
		Mean (±SD)		
Energy consumption (Kcal)	1365.3 (±686.7) [a]	1319.9 (±586.8) [a]	1307 (±587.0) [a]	0.93
Total HEI-2005 (100)	68.0 (±14.5) [a]	69.3 (±18.4) [a]	61.53 (±12.3) [a]	0.85
Total Fruit (5)	4.2 (±1.6) [a]	4.3 (±1.4) [a]	4.7 (±0.6) [a]	0.24
Whole Fruit (5)	4.1 (±1.7) [a]	3.9 (±1.6) [a]	4.2 (±1.2) [a]	0.68
Total Vegetables & Legumes (5)	3.2 (±1.2) [a]	3.2 (±1.5) [a]	3.0 (±1.3) [a]	0.84
DGOV & Legumes (5)	3.0 (±1.8) [a]	3.0 (±2.0) [a]	2.9 (±2.0) [a]	0.98
Total Grains (5)	4.6 (±0.8) [a]	4.4 (±0.8) [a]	4.2 (±0.7) [a]	0.34
Whole Grains (5)	1.3 (±0.9) [a]	1.0 (±0.9) [a]	1.0 (±0.7) [a]	0.44
Dairy (10)	6.7 (±2.3) [a]	6.7 (±2.5) [a]	5.7 (±2.9) [a]	0.23
Meat & Legumes (10)	8.7 (1.8) [a]	8.5 (±2.5) [a]	8.3 (±2.4) [a]	0.89
Oil (10)	6.8 (±2.4) [a]	6.8 (±2.7) [a]	6.7 (±2.9) [a]	0.97
Sodium (10)	3.0 (±2.1) [a]	3.8 (±2.4) [a]	4.3 (±2.1) [a]	0.15
Saturated Fat (10)	5.7 (±2.6) [a]	5.5 (±2.6) [a]	6.5 (±2.4) [a]	0.32
SoFAAS (20)	10.0 (±4.1) [a]	10.3 (±5.3) [a]	8.3 (±3.9) [a]	0.18

Table 4-9. Comparison of Total/Component HEI-2005 Scores by BMI Percentile Distribution, n=178

Variable (Max Score)	85th to 95th percentile (n=12)	95th to 97th percentile (n=21)	>97th percentile (n=145)	*P* value
		Mean (SD)		
Total HEI-2005 (100)	57.2 (±11.1)[a]	65.3 (±11.9) [a]	60.9 (±10.3) [a]	0.08
Total Fruit (5)	4.5 (±1.0) [a]	4.3 (±1.4) [a]	4.4 (±1.3) [a]	0.89
Whole Fruit (5)	4.0 (±1.5) [a]	4.2 (±1.6) [a]	4.0 (±1.6) [a]	0.88
Total Vegetables & Legumes (5)	2.5 (±1.4) [a]	3.1 (±1.4) [a]	3.2 (±1.4) [a]	0.27
DGOV & Legumes (5)	1.7 (±1.9) [a]	3.0 (±2.0) [a]	3.0 (±2.0) [a]	0.07
Total Grains (5)	4.2 (±0.9) [a]	4.6 (±0.7) [a]	4.4 (±0.8) [a]	0.43
Whole Grains (5)	0.9 (±0.6) [a]	1.5 (±1.1) [b]	1.1 (±0.8) [a]	0.05
Dairy (10)	7.7 (±2.1) [a]	6.9 (±1.9) [a]	6.4 (±2.6) [a]	0.26
Meat & Legumes (10)	7.0 (±2.9) [a]	8.6 (±1.9) [b]	8.5 (±2.5) [b]	0.02
Oil (10)	5.5 (±2.4) [a]	7.0 (±2.7) [a]	6.8 (±2.7) [a]	0.26
Sodium (10)	5.3 (±1.5) [a]	3.5 (±2.3) [b]	3.7 (±2.3) [b]	0.05
Saturated Fat (10)	5.9 (±2.4) [a]	5.2 (±2.1) [a]	5.7 (±2.6) [a]	0.39
SoFAAS (20)	8.2 (±1.4)[a]	11.7 (±5.2) [a]	9.9 (±4.9) [a]	0.13

[ab]Means not sharing the same superscript letter (a,b) are significantly different ($P \leq 0.05$)

Table 4-10. Physical Activity of Participants, n=94

Variable	All Participants
Average minutes of PA (>3METS)	119.9
Minutes in Vigorous activity (>6 METS)	5.9
Minutes in Moderate activity (3-6 METS)	114.4
Minutes in Sedentary activity (<3METS)	1225
% AEE	
Low	32
Medium	32
High	30

Table 4-11. Percent of participants meeting DGA-2005 goals, n=178

Variable	n	%
Total Fruit Score		
Yes	141	79
No	37	21
Whole Fruit Score		
Yes	119	67
No	59	33
Total Vegetables & Legumes Score		
Yes	61	34
No	117	66
DGOV & Legumes Score.		
Yes	78	44
No	100	56
Total Grains Score		
Yes	127	71
No	51	29
Whole Grains Score		
Yes	1	0.56
No	177	99.4
Dairy Score		
Yes	60	34
No	118	66
Meat & Legumes Score		
Yes	128	72
No	50	28
Oil Score		
Yes	67	38
No	111	62
Sodium Score		
Yes	7	4
No	171	96
Saturated Fat Score		
Yes	49	27
No	129	73
SoFAAS Score		
Yes	29	16
No	149	84
Total HEI-2005 Score		
Yes	3	2
No	175	98

Table 4-12. Association between Total HEI-2005 Scores and Disease Risk Factors, n=178

Variable	TC[1]	LDL-C[2]	HbA1c[3]	SBP[4]	DBP[5]	WC[6]
HEI-2005 Score	*p* = 0.33 r=0.07	*p* = 0.38 r=0.07	*p* = 0.65 r=-0.04	*p* = 0.69 r=0.03	*p* = 0.07 r=0.13	*p* =0.75 r=0.02

[1]TC – Serum Total Cholesterol
[2]LDL-C – Serum LDL-cholesterol
[3]HbA1c – Serum Hemoglobin A1c
[4]SBP – Systolic Blood Pressure
[5]DBP – Diastolic Blood Pressure
[6]WC – Waist Circumference

Table 4-13. Association of HEI-2005 Components and Disease Risk Factors, n=178

Variable	Total Cholesterol	LDL – Cholesterol
Total Fruit Score	p=0.20 r=0.10	p=0.35 r=0.07
Whole Fruit Score	p=0.82 r=-0.02	p=0.77 r=0.02
Total Vegetables Score	p=0.72 r=-0.03	p=0.32 r=0.07
DGOV Score	p=0.54 r=-0.05	p=0.67 r=0.03
Total Grains Score	p=0.67 r=-0.03	p=0.45 r=-0.06
Whole Grains Score	p=0.41 r=0.06	p=0.45 r=0.06
Saturated Fat Score	p =0.33 r=0.07	p=0.72 r=0.03
Variable	**Systolic Blood Pressure**	**Diastolic Blood Pressure**
Dairy Score	p=0.25 r=0.09	p =0.34 r=0.07
Sodium Score	p=0.70 r=0.03	p =0.75 r=0.02
Variable	**Triglycerides**	**Hemoglobin A1c**
SoFAAS Score	p =0.80 r=0.01	p = 0.66 r=-0.03

Table 4-14. Exploratory: Association of Total HEI-2005 and Disease Risk Factors, by BMI percentile groups, n=178

Variable	TC[1]	LDL-C[2]	HbA1c[3]	SBP[4]	DBP[5]	WC[6]
85th to 95th percentile						
HEI-2005 Score	*p* =0.004 r=-0.76	*p* =0.005 r=-0.74	*p* =0.44 r=-0.25	*p* =0.32 r=0.26	*p* = 0.85 r=0.06	*p* =0.22 r=0.39
95th to 97th percentile						
HEI-2005 Score	*p* = 0.11 r=0.36	*p* = 0.15 r=0.33	*p* = 0.83 r=-0.05	*p* = 0.85 r=0.05	*p* = 0.51 r=0.15	*p* =0.47 r=0.17
>97th percentile						
HEI-2005 Score	*p* = 0.36 r=0.08	*p* = 0.31 r=0.08	*p* = 0.78 r=-0.02	*p* = 0.36 r=0.08	*p* = 0.07 r=0.15	*p* =0.81 r=0.02

[1]TC – Serum Total Cholesterol
[2]LDL-C – Serum LDL-cholesterol
[3]HbA1c – Serum Hemoglobin A1c
[4]SBP – Systolic Blood Pressure
[5]DBP – Diastolic Blood Pressure
[6]WC – Waist Circumference

Table 4-15. Exploratory: Association of HEI-2005 Components and Disease Risk Factors, by BMI percentile groups, n=178

	Total Cholesterol			LDL - Cholesterol		
Variable	85th to 95th percentile	95th to 97th percentile	> 97th percentile	85th to 95th percentile	95th to 97th percentile	> 97th percentile
Total Fruit Score	p=0.05 r=-0.57	p=0.25 r=0.26	p=0.83 r=0.02	p=0.19 r=-0.40	p=0.34 r=0.22	p=0.77 r=0.02
Whole Fruit Score	p=0.07 r=-0.53	p=0.22 r=0.27	p=0.21 r=0.11	p=0.17 r=-0.42	p=0.14 r=0.33	p=0.44 r=0.06
Total Vegetables Score	p=0.05 r=-0.57	p=0.22 r=0.27	p=0.88 r=0.01	p=0.08 r=-0.52	p=0.33 r=0.22	p=0.26 r=0.09
DGOV Score	p=0.06 r=-0.54	p=0.40 r=-0.19	p=0.38 r=-0.07	p=0.13 r=-0.46	p=0.36 r=0.21	p=0.65 r=0.04
Total Grains Score	p=0.33 r=-0.31	p=0.13 r=-0.34	p=0.80 r=0.02	p=0.28 r=-0.34	p=0.75 r=-0.07	p=0.68 r=-0.04
Whole Grains Score	p=0.42 r=-0.26	p=0.25 r=0.26	p=0.66 r=0.04	p=0.35 r=-0.30	p=0.45 r=0.17	p=0.54 r=0.05
Saturated Fat Score	p=0.006 r=-0.74	p=0.52 r=0.15	p=0.15 r=0.12	p=0.007 r=-0.73	p=0.66 r=0.10	p=0.42 r=0.07

	Systolic Blood Pressure			Diastolic Blood Pressure		
Variable	85th to 95th percentile	95th to 97th percentile	> 97th percentile	85th to 95th percentile	95th to 97th percentile	> 97th percentile
Dairy Score	p=0.24 r=0.36	p=0.83 r=0.05	p=0.08 r=0.15	p=0.88 r=-0.05	p=0.47 r=0.17	p=0.17 r=0.12
Sodium Score	p=0.003 r=0.77	p=0.03 r=0.47	p=0.92 r=0.00	p=0.14 r=0.45	p=0.75 r=0.07	p=0.56 r=0.05

	Triglycerides			Hemoglobin A1c		
Variable	85th to 95th percentile	95th to 97th percentile	> 97th percentile	85th to 95th percentile	95th to 97th percentile	> 97th percentile
SoFAAS Score	p=0.41 r=0.26	p=0.30 r=-0.33	p=0.75 r=-0.03	p=0.30 r=-0.33	p=0.86 r=0.04	p=0.76 r=0.03

CHAPTER 5
DISCUSSION

The HEI-2005 is a tool, created by the USDA, used to assess how adherent the American population, ages 2 years and older, is to the DGA-2005 [115]. The DGA-2005 is meant to help maintain good health and diminish the risk of chronic diseases, although it is unclear in how these are defined in children and therefore difficult to know whether the HEI-2005 is successfully accessing health in children ages 7-12 years old [115].

Mean energy intake was low in this sample. Underreporting of energy intake has been seen consistently in overweight individuals, including children [131-133]. Heitmann and Lissner (1995) found that dietary reporting is influenced, both qualitatively and quantitatively, depending on the degree of obesity [134]. The current study is consistent with Heitmann and Lissner (1995) and other research studies [135-137]. The 85th to 95th percentile group reported consuming significantly more than the other groups. This likely underestimate of energy intake may also be a reflection of the method used to assess intake, a food frequency questionnaire [134]. There were no significant gender differences in overall energy intake, although gender differences were observed for one nutrient (% kcal from protein).

The DGA-2005 recommends a minimum fiber intake of the age of 14g of fiber per 1,000 kcal [48]. The participants in this study are expected to consume 18.76g of fiber given their mean energy consumption of 1339.7 kcal. The DGA-2005 recommends that children 4-18 years old should keep fat consumption between 25 to 35% of calories, their carbohydrate consumption between 45 and 65% of calories and protein consumption 10 to 30% of calories. The participants, in this study, consumed an

average of 33.11% of calories from fat, 54.6% of their calories from carbohydrates, and 14.13% of calories from protein. At baseline, all of the participants' macronutrient levels fell between normal levels.

Does the Diet Quality, via the HEI-2005, of this Overweight Study Population Adhere to the DGA-2005?

The mean HEI-2005 score of the study participants was 61.2, indicating that the overall diet quality of overweight children in rural counties in Florida "needs improvement" as reflected by total HEI-2005 scores [91]. Particularly, these children need to increase their consumption of total vegetables and legumes, dark green and orange vegetables and legumes, whole grains, dairy and oils. On the other hand, this study population needs to decrease their consumption of sodium, saturated fat, and calories from solid fat and added sugar. For this study population, the overall mean HEI-2005 score was seven points higher than the national averages of 54.7 (6-11 years old) and 54.8 (12-17 year olds) [75]. Our findings are consistent with reports comparing the diet quality of children [75, 119, 138, 139]. While still not reaching the level of a "good" overall quality diet (80/100), this observed higher score among our study participants may be explained in part by their willingness to volunteer for a long term study aimed at improving lifestyle behaviors such as nutrition intake. These children and families are "treatment seeking" and thus may have already adopted some aspects of a more healthful diet that are not seen in the general population, at the time of data collection.

Association between Total HEI-2005 Score and Disease Risk Factors

The expected associations between total HEI-2005 score and disease risk factors were not observed with this study population. The reason may be explained by most of

the children in this study not exhibiting elevations in serum lipids, TG, HbA1c or blood pressure. This may be simply due to the young age of the participants and that elevations in these measures may not occur until later in life. A study completed in obese adults defined individuals who were obese but had favorable metabolic profiles as Metabolically Healthy but Obese (MHO) [140]. This study proved that the prevalence of MHO individuals decreased with aging. Another potential explanation why no associations were observed may be related to the fact that many of the study participants were taking specific medications that treated certain diseases like hypertension, type 2-diabetes, and hypercholesterolemia. Additionally, we may not have observed a correlation because the maximum score for the HEI-2005 makes full evaluation difficult. The components have maximum scores that became the ceiling. So, children that surpassed the recommended amounts of dietary component were grouped with children who barely met the recommendations. All in all, the HEI-2005 should be further tested to evaluate its usefulness in predicting disease risk factors in longitudinal studies with a larger study population.

Association between HEI-2005 Component Scores and Disease Risk Factors

When all of the participants were analyzed together, controlling for physical activity, no associations were observed.

The association seen with the SoFAAS score and HbA1c as well as the association seen with the Total Grains score and LDL-cholesterol were expected. The associations seen with the Total Vegetable component and TC and LDL-cholesterol were much unexpected. The results are interpreted as the higher the Total Vegetable or DGOV Score, the higher the serum TC or LDL-cholesterol. A possible reason why we observed this relationship was because when NutritionQuest analyzed the Block Kids

FFQ, they included fried vegetables in the total vegetables. The DGOV and LDL-cholesterol association observed was also unexpected because of the positive correlation, but since preparation of the food items were not collected and the number of food items were limited for the Block Kids FFQ, knowing what all was served on the vegetables is not known.

Exploratory Analysis: Association between Total/Component HEI-2005 Score and Disease Risk Factors

The strong relationship of the HEI-2005 component scores with disease risk factors, when controlling for weight, suggests that higher scores on this index may translate to reduced risk for chronic diseases in overweight and from rural counties in Florida. These results prove that the greater degree of overweight and obesity can contribute to disease risk factors. Also, obesity may override any benefits of quality diets.

Limitations

In addition to the many strengths of this study, there were several limitations. A limitation of this study is that both the original HEI and HEI-2005 were designed to be measured using a single 24-hour recall [1, 120, 141], but this study measured diet quality using a FFQ. Many studies have used FFQs to successfully calculate diet quality [142-144]. The relative reliability and validity of the Block Kids FFQ among youth aged 10 to 17 years has been tested [145]. The results from the study imply that the Block Kids FFQ is valid for some nutrients but not for many of the food groups that were assessed and appears to be a more useful tool for children ≥12 years old. A significant difference was noted between the 24-hour recall and the Block Kids FFQ which included Energy Intake, %Energy from Carbohydrates, %Energy from Protein,

Cholesterol, Fiber, Calcium, Sodium, Vegetables, Grains, and Milk, yogurt, and cheese. In a large epidemiological study, FFQs are financially appealing compared to 24-hour recalls or food records. The Women's Health Initiative mulled over the idea of alternative dietary assessments tools and settled with the food frequency questionnaire because using a food frequency questionnaire would cost $1.2 million compared to $25 million for three 24-hour recalls and $23.2 million for 3-day food records. Another drawback is the underreporting on the Block Kids FFQ, commonly observed among overweight and obese individuals [131-133]. This might have resulted in a concomitant underreporting of energy intake and HEI-2005 components.

In addition to mentioned limitations of the HEI-2005, Guenther et al. (2008) lists further limitations, such as not having component scores that assess the intakes of food groups, total fat, trans fats, cholesterol, or oils [116]. The HEI-2005 does, however, have one component for saturated fats and one for oils. The only oils accounted for in the Oil component are from fish, nuts and non-hydrogenated vegetable oils [116]. Stated previously, the HEI-2005 has truncated scores. Although steps were taken the address the undesirable floor and ceiling effects, these were observed in this study [116]. The floor effect is when the scores bunch at the low end of the scale (score of 0) and the ceiling effect is when the scores bunch at the high end of the scale (scores of 5, 10, or 20 depending on the component) [116]. Completing a study evaluating associations between the HEI-2005 total score and component scores is very difficult because no linear relationship can be observed with a ceiling or floor in the scoring.

Implications for Future Research

The present study found a number of areas where the diets of overweight children, ages 7-12 years, in rural counties in Florida need improvement, which could put them at

increased risk for chronic diseases. Conventionally, weight management interventions have focused on decreasing caloric intake by focusing on increasing fruits and vegetables while decreasing calories from fat, in an effort to achieve weight loss. Traditionally, little attention has been given to the overall diet quality in weight management interventions and specifically to the intake of the recommended amounts of sodium, dairy and saturated fats. I propose that since there is a direct correlation between certain dietary components and disease risk, future weight management interventions should be designed to focus on improving diet quality, in addition to decreasing caloric intake. Based on our results, specific focus should be given to the recommended intakes of vegetables, whole grains, dairy, oils, saturated fat, sodium and calories from solid fat and added sugars. Consequently, utility of the HEI-2005 to predict disease risk should be confirmed in a longitudinal study with a larger population. Short term, future research is needed to: 1) evaluated change in diet quality due to intervention assignment within E-FLIP and 2) examine the relationship between nutrient/food group intake and disease risk factors. Long-term, future research is needed to incorporate a focus on diet quality into existing intervention materials and evaluate its impact.

APPENDIX
BLOCK KIDS FOOD FREQUENCY QUESTIONNAIRE 2004

What are kids eating now?

RESPONDENT ID NUMBER

Your name: _____

Today's date: _____

This survey asks about **all of the foods you ate last week**. Remember what you ate at home, at school, from snack machines, or from fast food or restaurants.

INSTRUCTIONS:

For each food on the survey, please tell us if you ate it in the last week.
Use a pencil to fill it out.

We ask two questions for each food on the survey.

1. ***How many days last week did you eat it?***
Mark the bubble that shows the number of days you ate the food last week. In the EXAMPLE, this person had EGGS two days last week, and MACARONI AND CHEESE on one day last week.

2. ***When you ate it, how much did you have?***
Mark the bubble that shows *how much* of the food you ate in one day. In this EXAMPLE, this person had one EGG each time, and a B-size bowl of MACARONI AND CHEESE (*use the pictures* for A-B-C-D).

	HOW MANY DAYS LAST WEEK?							HOW MUCH IN ONE DAY?			
	MARK ONE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY					
Eggs or breakfast sandwiches like Egg McMuffins	○	○	○	○	○	○	How many eggs do you usually eat in 1 day?	Just a bite	1 egg	2 eggs	3 eggs
Macaroni and cheese	○	●	○	○	○	○	See pictures. How much?	A	B	C	D

The next pages are about all the foods you ate in the past week. Please read the instructions above, and then turn the page over when you are ready to start.

PLEASE DO NOT WRITE IN THIS AREA

SERIAL #

Think about every time you ate anything in the past week. You can tell us you didn't eat a food at all in the past week, or that you ate it one day last week, two days last week, 3-4 days, 5-6 days, or every day.

Remember what you ate at **home**, at **school**, from **fast food**, or from a **restaurant**.

	HOW MANY DAYS LAST WEEK?							HOW MUCH IN ONE DAY?			
	NONE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY					
Pancakes, waffles, Pop Tarts	○	○	○	○	○	○	How many?	○ 1/2	○ 1	○ 2	○ 3
Granola bars, breakfast bars	○	○	○	○	○	○	How many?	○ 1/2	○ 1	○ 2	○ 3
Eggs or breakfast sandwiches like Egg McMuffins	○	○	○	○	○	○	How many eggs do you usually eat in 1 day?	○ Just a bite	○ 1 egg	○ 2 eggs	○ 3 eggs
Bacon or sausage	○	○	○	○	○	○					
Cooked cereal like oatmeal or grits	○	○	○	○	○	○	**See pictures.** Which bowl?		○ B	○ C	○ D
Cold cereal, like Corn Flakes, Frosted Flakes or any other kind	○	○	○	○	○	○	**See pictures.** Which bowl?		○ B	○ C	○ D
When you ate cereal, which kind did you eat? (MARK THE ONE YOU ATE THE MOST OF)	○ Sweet cereals like Frosted Flakes, Froot Loops ○ Plain cereals like Corn Flakes, Cheerios, Rice Krispies ○ Fiber cereals like Raisin Bran, Shredded Wheat ○ Fortified cereals like Total or Product 19										
How often do you have milk on cereal?	○	○	○	○	○	○					
Bananas				○	○	○	How many do you usually have in 1 day?	○ 1/2	○ 1	○ 2	○ 3
Apples or pears			○	○	○	○	How many do you usually have in 1 day?	○ 1/2	○ 1	○ 2	○ 3
Oranges or Tangerines (Don't count juices)		○	○	○	○	○	How many, in one day?	○ 1/2	○ 1	○ 2	○ 3
Strawberries or other berries	○	○	○	○	○	○	**See pictures.** How much?	○ A	○ B	○ C	○ D

Remember what you ate at **home**, at **school**, from **fast food**, or from a **restaurant**.

	HOW MANY DAYS LAST WEEK? NEVER	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY		HOW MUCH IN ONE DAY?			
Applesauce, fruit cocktail or pineapple slices	○	○	○	○	○	○	**See pictures.** Which bowl?		○ B	○ C	○ D
Any other fruit, like grapes, peaches, watermelon, cantaloupe, fruit roll-ups	○	○	○	○	○	○	**See pictures.** How much do you usually eat?	○ A	○ B	○ C	○ D
Hamburgers or cheeseburgers, at home or from a fast food restaurant	○	○	○	○	○	○	How much?	○ ½ small burger	○ 1 small burger	○ 1 large burger	○ 2 large burgers
Which kind do you usually eat?	○ hamburgers			○ cheeseburgers							
Tacos, burritos or enchiladas	○	○	○	○	○	○	How many?	○ ½	○ 1	○ 2	○ 3
Which kind of tacos, burritos, enchiladas do you usually eat?	○ with meat or chicken			○ without meat or chicken							
Hot Pockets, meat ball subs or Sloppy Joes	○	○	○	○	○	○					
Roast beef, or steak	○	○	○	○	○	○	How much?	○ A	○ B	○ C	○ D
Hamburger Helper, beef and noodles, beef stew, or any other beef dishes	○	○	○	○	○	○	How much?	○ A	○ B	○ C	○ D
Pork chops, ribs, or cooked ham	○	○	○	○	○	○	How much?	○ A	○ B	○ C	○ D
Fried chicken including chicken nuggets, from home or from a restaurant like KFC	○	○	○	○	○	○	How many pieces?	○ 1	○ 2 (or 6 nuggets)	○ 3	○ 4
Any other kind of chicken, like roasted chicken, chicken stew, Chicken Helper	○	○	○	○	○	○	How much?	○ A	○ B	○ C	○ D

what you ate at home, at school, ood, or from a restaurant.	HOW MANY DAYS LAST WEEK? NONE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY		HOW MUCH IN ONE DAY?			
of fish, like fish sandwich, fish rimp or tuna	○	○	○	○	○	○	How much?	○ A	○ B	○ C	○ D
, ravioli or lasagna with uce?	○	○	○	○	○	○	How much?	○ A	○ B	○ C	○ D
and cheese	○	○	○	○	○	○	How much?	○ A	○ B	○ C	○ D
izza pockets	○	○	○	○	○	○	How many slices?	○ ½	○ 1	○ 2	○ 3
or corn dogs	○	○	○	○	○	○	How many?	○ ½	○ 1	○ 2	○ 3
at like bologna, chicken, sliced nember sandwiches and es	○	○	○	○	○	○	How many slices of lunch meat?	○ ½	○ 1	○ 2	○ 3
eans	○	○	○	○	○	○	How much?	○ A	○ B	○ C	○ D
e soup, vegetable beef soup, soup	○	○	○	○	○	○	See pictures. Which bowl?		○ B	○ C	○ D
r soup like chicken noodle, up, ramen noodles, or menudo,	○	○	○	○	○	○	See pictures. Which bowl?		○ B	○ C	○ D
or muffins	○	○	○	○	○	○	How many?	○ ½	○ 1	○ 2	○ 3
heat bread or whole wheat rolls	○	○	○	○	○	○	How many slices in one day?	○ 1	○ 2	○ 3-4	○ 5 or more
ead, toast or rolls, including nes or bagels	○	○	○	○	○	○	How many slices in one day?	○ 1	○ 2	○ 3-4	○ 5 or more

SERIAL # ○○○○○○○○○○○○○○○○○○○○

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...at you ate at home, at school, ...d, or from a restaurant.	HOW MANY DAYS LAST WEEK? NOTE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY		HOW MUCH IN ONE DAY?			
	○	○	○	○	○	○	How many ?	○ 1	○ 2	○ 3-4	○ 5 or more
...r butter, like on bread or on ...on potatoes	○	○	○	○	○	○	How many times each day ?	○ 1	○ 2	○ 3	○ 4
...member cheese in sandwiches	○	○	○	○	○	○	How many slices of cheese each day?	○ ½	○ 1	○ 2	○ 3
...or sandwich spread	○	○	○	○	○	○					
...or sandwich	○	○	○	○	○		How many in those cans?	○ ½	○ 1	○ 2	○ 3
	○	○	○	○							
...eeds, peanuts or other nuts	○	○	○		○	○	How much in one day?	○ A	○ B	○ C	○ D
...lettuce, green salad	○	○			○	○	See pictures. Which bowl?		○ B	○ C	○ D
...ing	○		○	○	○	○					
...s, string beans		○	○	○	○	○	See pictures. How much?	○ A	○ B	○ C	○ D
...s, black beans, chili with beans, ...ritos	○	○	○	○	○	○	See pictures. How much?	○ A	○ B	○ C	○ D

SERIAL #

PLEASE DO NOT WRITE IN THIS AREA

what you ate at **home**, at **school**, ood, or from a **restaurant**.	HOW MANY DAYS LAST WEEK? NONE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY		HOW MUCH IN ONE DAY?			
orn on the cob	○	○	○	○	○	○	See pictures. How much?	○ A	○ B	○ C	○ D
including on salad	○	○	○	○	○	○	How much?	○ A little tomato	○ ½	○ 1	○ 2
e collards, mustard greens or spinach	○	○	○	○	○	○	See pictures. How much?	○ A	○ B	○ C	○ D
	○	○	○	○	○	○	See pictures. How much?	○ A	○ B	○ C	○ D
arrot sticks or cooked carrots	○	○	○	○	○	○	See pictures. How much?	○ A	○ B	○ C	○ D
tatoes, or sweet potato pie	○	○	○	○	○	○	See pictures. How much?	○ A	○ B	○ C	○ D
es, Tater Tots, hash browns or s	○	○	○	○	○	○	See pictures. How much?	○ A	○ B (Med Small)	○ C (Med Large)	○ D (Med Super)
kind of potatoes, like baked or boiled	○	○	○	○	○	○	See pictures. How much?	○ A	○ B	○ C	○ D
vegetables, like squash, cauliflower or red peppers	○	○	○	○	○	○	See pictures. How much?	○ A	○ B	○ C	○ D
uding fried rice, Spanish rice, rice s	○	○	○	○	○	○	See pictures. How much?	○ A	○ B	○ C	○ D
salsa, or barbecue sauce	○	○	○	○	○	○					

hat you ate at home, at school, machines, at the movies, or from	HOW MANY DAYS LAST WEEK? Never	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY		HOW MUCH IN ONE DAY?			
like potato chips, tortilla chips, icorn, Bugles	○	○	○	○	○	○	How much in the whole day?	○ A	○ B	○ C	○ D
cluding snack crackers like Cheez-its, oldfish	○	○	○	○	○	○	How much in the whole day?	○ A	○ B	○ C	○ D
cheese	○	○	○	○	○	○	How much?	○ A	○ B	○ C	○ D
ice cream bars or frozen	○	○	○	○	○	○	See pictures. Which bowl?		○ B	○ C	○ D
	○	○	○	○	○	○	How many cookies?	○ 1	○ 2-3	○ 4-5	○ 6+
	○	○	○	○	○	○	How many donuts?	○ ½	○ 1	○ 2	○ 3
akes, Tasty Cake, Ho-Ho's, Twinkies	○	○	○	○	○	○	How many pieces?	○ ½	○ 1	○ 2	○ 3
, fruit crisp, cobbler	○	○	○	○	○	○	How many pieces?	○ ½	○ 1	○ 2	○ 3
andy, like candy bars, M&Ms, Reese's,	○	○	○	○	○	○	How many bars?	○ small	○ 1 medium	○ 1 large	○ 2 large
andy (not chocolate), like Skittles, ifesavers, gum	○	○	○	○	○	○	How many packages?	○ ¼	○ ½	○ 1	○ 2
nilk, hot chocolate or cocoa	○	○	○	○	○	○	How many glasses or cartons each day?	○ ½	○ 1	○ 2	○ 3
ocolate). (Don't count milk on cereal)	○	○	○	○	○	○	How many glasses or cartons each day?	○ ½	○ 1	○ 2	○ 3

f milk do you usually drink?
○ Whole milk ○ Reduced-fat (2%) milk ○ Low-fat (1%) milk
○ Non-fat milk ○ Lactaid milk ○ Don't know
○ Soy milk ○ Rice milk

	HOW MANY DAYS LAST WEEK?						HOW MUCH IN ONE DAY?			
	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY					
...er what you ate at home, at school, ...da machines, at the movies, or from ...d.										
...ike Coke, Dr. Pepper, 7-Up, Sprite, ..., Orange Crush. (Don't count diet	○	○	○	○	○	○	How many bottles or cans in 1 day?	○ 1	○ 2	○ 3-4	○ 5+
...ize soda do you usually drink?	○ 12 ounce can ○ 20 ounce bottle			○ more than 20 ounces						
...es, snow cones, ...les (not Ice cream)	○	○	○	○	○	○				
...an Punch, Kool-Aid, Sunny Delight, ...de, ice tea, Snapple	○	○	○	○	○	○	How many glasses or juice boxes?	○ 1	○ 2	○ 3	○ 4
...ng, Tampico, Mr. Juicy, Ssips punch	○	○	○	○	○	○	How many glasses or juice boxes?	○ 1	○ 2	○ 3	○ 4
...ange juice (Don't count Sunkist or ...range sodas)	○	○	○	○	○	○	How many glasses or juice boxes?	○ 1	○ 2	○ 3	○ 4
...er real fruit juices like apple juice ...e juice. (Remember juice boxes)	○	○	○	○	○	○	How many glasses or juice boxes?	○ 1	○ 2	○ 3	○ 4

...ast week, did you take any **vitamin** ...e One-a-Day or Flintstones? ○ No ○ Yes **If yes**, how many days last week? ○ 1-2 ○ 3-4 ○ 5-6 ○ 7

...a ○ Male ○ Female

...d are you? _____

...ll are you? ___ Feet ___ Inches

...uch do you weigh? ___ Pounds

...u (Mark all that apply)

○ African American ○ Asian
○ White ○ American Indian/Alaska native
○ Hispanic/Latino ○ Other

OFFICE USE ONLY

TODAY'S DATE MO.	DAY	YR.	AGE	WEIGHT pounds	HEIGHT ft.	in.

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BIOGRAPHICAL SKETCH

Alexis Letes'e Woods was born in Winter Garden, Florida. She attended Tildenville Elementary, Lakeview Middle and Maynard Evans High School. In May 2009, she graduated with her bachelor's degree from the University of Florida. Her major was nutritional sciences with a minor in chemistry. Upon graduation, Alexis became a master's student in the Food Science and Human Nutrition graduate program at the University of Florida. She received her Master of Science degree in Nutritional Sciences in the spring of 2012. Alexis was admitted into the Health Education and Behavior department to complete her doctorate.