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Head of Household Socioeconomic Status Effect on Dietary Intake of Children

Samantha Ann Willcutt

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By

Samantha Ann Willcutt

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Head of household socioeconomic status effect on dietary intake of children

By

Samantha Ann Willcutt

Approved:

Sylvia H. Byrd
(Major Professor)

David R. Buys
(Committee Member)

Brent J. Fountain
(Committee Member)

Marion W. Evans, Jr.
(Graduate Coordinator)

George M. Hopper
Dean
College of Agriculture and Life Sciences

Name: Samantha Ann Willcutt

Date of Degree: August 12, 2016

Institution: Mississippi State University

Major Field: Nutrition

Major Professor: Sylvia H. Byrd

Title of Study: Head of household socioeconomic status effect on dietary intake of children

Pages in Study 57

Candidate for Degree of Master of Science

Obesity is considered an epidemic and a precursor for many diseases. Children from lower income families are more likely to be obese, however previous studies on differences in child dietary intake based on parental income show mixed results. This study used NHANES 2005-2010 data to examine reported food consumption of children ages 6 to 11. Comparisons were made between children (n = 1433) of lower income parents (PIR <= 1.85) and children (n = 1162) of higher income parents (PIR > 1.85). Variables included total fruit and vegetable intake, total energy, food groups, oils, fiber, total sugar, added sugars and solid fats. SUDAAN was used to analyze data and differences were significant at $p < 0.05$. Regression model indicated head of household education but not family income was positively associated with greater total fruit and vegetable intake. Minimal intake differences were found between income groups

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CHAPTER I

INTRODUCTION

Childhood Obesity

Obesity is considered by many to be an epidemic worldwide [1]. National Health and Nutrition Examination Survey (NHANES) data shows that adult obesity prevalence increased from approximately 13% in 1960 to approximately 35% in 2012. The same data reveals that childhood obesity more than doubled from 1960 to 2010. For 2 to 5 year olds obesity prevalence increased from approximately 5% in 1971 to approximately 12% in 2010. Children ages 6 to 17 had larger increases in obesity prevalence, more than tripling during the same time period (5% in 1971, 18% in 2010) [2]. Since 2010, childhood obesity rates have plateaued [2], however closer examination reveals an increasing gap in obesity prevalence between children from lower socioeconomic status (SES) households and children from higher SES households [3]. Socioeconomic status is a measure of an individual's or family's education/s, income/s and occupation/s. Many studies show that children from lower SES households are more likely than children from higher SES households to be overweight or obese [4-5]. Obesity increases risk for a number of chronic diseases [6-8] resulting as well in increased healthcare costs.

The United States leads the world in prevalence of obesity with marked increases starting in 1980 [1-2]. Healthcare spending for obesity related illnesses has been estimated to be anywhere from $147 billion a year [9] to $190 billion per year or 21% of total healthcare costs [10]. Considering childhood and adult obesity rates have increased substantially and obese children are likely to become obese adults [11-13], interventions aimed at children may be most successful in ameliorating obesity prevalence. Supporting this theory are findings that habits formed early in life tend to persist into adulthood [14-16].

Factors to Consider

There are many components to consider when examining causes for the increase in U.S. childhood obesity over the past five decades and the widening obesity gap between income groups over the past few years. When considering child weight, parental influence has the ability to outweigh and/or influence all other outside influences (school, peers, and home/neighborhood/social environments) and internal cues (hunger/cravings and taste/food preferences) [17]. It is well documented that a person's weight is effected by energy output and energy input [18]. Therefore physical activity (PA) habits and food consumption habits deserve the majority of attention when studying obesity trends. Since children with parents of lower SES are more likely to be obese [3-5], a reasonable hypothesis is children from lower SES families either maintain lower levels of PA, consume more energy, or both.

Parental influence

There are many factors that contribute to the dietary intake patterns of school-aged children. Four major categories encompassing these factors have been described as: intrapersonal, interpersonal, physical and societal. Intrapersonal defines biological or psychosocial influences such as genetics and food preferences, while interpersonal explains the social influence of family and peers. Physical and societal influences are often referred to as environmental factors, with physical defining communities (neighborhoods, schools, stores) and societal explaining macro systems (mass media, social norms) [19]. Parental influence both directly and indirectly affects dietary intake of children across all four categories [20].

Many aspects of parenting in reference to dietary intake of children have been examined. Some of the major aspects include: resemblances in parent-child diet, parent feeding practices (especially maternal feeding practices) and the effects of parent behaviors, beliefs and perceptions on their children's weight status and food consumption habits. Education along with social and economic environmental factors shape parent behavior and parents influence child behavior [19-22]. Therefore parents' socioeconomic status can impact their children's habits. In regards to child weight status these habits include physical activity habits and food consumption habits.

Physical activity

Multiple studies show that children of lower income families are more likely than children of higher income families to live in environments less conducive to PA [23-24]. Other studies report more sedentary activities or less PA [25-26] among children in lower income brackets (no studies were found presenting lower SES children in the U.S. post 1960 as less sedentary or more active). In summary, it is accepted that lower SES children are more likely to be less physically active/more sedentary and to have less access to physical activity. Most studies found regarding obesity and SES of children chose body mass index (BMI) to examine as a quantitative measure, fewer studies found centered on PA, and even fewer studies focused on dietary habits. This may be a result of the inaccuracies that accompany self-reported data [27] as both PA and dietary habits are generally self-reported measures.

Dietary quality

It is necessary to study the dietary quality (DQ) of child populations based on household SES in order to better understand the widening obesity gap. Analyzing food consumption is complex. Some studies have investigated DQ based on child SES in the U.S., but findings have not been in agreement. These studies either suggest better DQ among higher SES children [28-30] or no significant difference in DQ between higher and lower SES children [31-33].

Of the three studies suggesting better DQ among higher SES children, two examined NHANES data [28-29] and one investigated 6-19 year olds from the largest school district in Detroit [30]. Kant et al., 2013 related dietary behaviors of children with family income and education and found family education to be inversely associated with energy density. Family income was found to have no independent association with energy density. The authors suggest that need-based supplemental food assistance programs may be helping to decrease differences in dietary intake between children from higher and lower SES families [28]. Dubowitz et al., 2008 examined associations between vegetable and fruit intake and neighborhood SES and found higher neighborhood SES to be positively associated with vegetable and fruit intake [29]. This study did not focus on children. The Detroit study found that black students of lower SES were less likely to consume vegetables and fruits and more likely to consume empty calories [30]. The latter study is regional and should not be considered representative of the United States.

The three studies found to suggest no significant differences in DQ can all be considered representative as two used NHANES data [31-32] and one was a systematic review of literature [33]. Kirkpatrick et al., 2012 examined children and adults and found most children exceeded allowances for discretionary calories and there were no differences in intakes of energy from solid fats and added sugars (discretionary calories) by income [31]. Middaugh et al., 2012 found that adults participating in NHANES from 1999-2006 did not consume differing amounts of vegetables and fruits based on income until the income level reached 400% of the poverty threshold. When education was added to the model, these differences were removed [32]. Finally, Zarnowiecki et al., 2014 performed a systematic review of the literature (28 studies) and suggested socioeconomic position is associated with children's nutrition knowledge, home food availability and accessibility, and parent modeling but not associated with parent feeding practices [33].

Other studies investigate access to nutritious foods or to convenience/fast foods and suggest higher SES children have greater access to nutritious foods while lower SES children have greater access to convenience/fast foods and less access to nutritious foods [34-36]. Future studies need to examine DQ disparities among child SES populations as the few studies conducted produced controversial findings.

Research questions

1. Does parent head of household socioeconomic status affect child dietary intake of vegetables and fruits?
2. Does household/family income affect child dietary intake of total energy, dietary fiber, oils, solid fats, added sugars or total sugar?

3. Does household/family income affect child dietary intake of food groups or food components?

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CHAPTER II

REVIEW OF LITERATURE

Valid Dietary Assessment

It is important to choose the most appropriate method of dietary intake assessment for the population to be examined in this study. Because children aged 6 to 11 years (school age children) have been found to be enthusiastic in regards to reporting dietary intake [1], while other child groups are limited in ability [2] (preschool age children) or uninterested/uncooperative (adolescents) [3], school age children will be examined in this study. The most common dietary assessment methods utilized for the study of large populations include food frequency questionnaires (FFQ), food records, and 24-hour recalls. Proper reporting based on cognitive ability is a limitation for each method in all populations [4]. School age children are still developing cognitive skills [5], and this factor must be strongly considered while reviewing methods. A review of method's design and goals, strengths and weaknesses and previous validation studies that include school age children follows. Validation studies using the gold standard of dietary intake assessment, doubly labelled water [6], for comparison are given more consideration than comparison studies via observation or other methods. Doubly labelled water methods are not feasible for this study because these methods are costly and not appropriate for large scale surveys.

Food-frequency questionnaires

Food frequency questionnaires (FFQ) are designed to investigate overall diet quality by inquiring how frequently certain foods are consumed over a certain period of time. Food frequency questionnaires can be quantitative as well, and because of the quantity goals of this study (total energy, food groups and certain nutrients), these are the types of FFQs that will be reviewed for validity and reliability. Food frequency questionnaires are made quantitative by asking for usual portion sizes of foods consumed. They are easy to administer, and monetary and time requirements are low. However, the time spent by the researcher developing a FFQ that is valid and reliable for the population to be studied can be costly. Food items selected for a FFQ vary by population and are miniscule compared to the total available food items in an area [7]. Children under the age of 10 have been shown to have trouble with concepts like frequency and averaging [5], and it has been argued that children should be 12 years of age or older to efficiently complete a FFQ [8]. Lastly, a meta-analysis of validity and reliability of varying dietary assessment methods for school age children revealed that food records and recalls were generally more agreeable with validation standards than FFQs [9].

Dietary records

Dietary records or food records require respondents to record/estimate all foods and beverages consumed for a certain period of time, usually 3 to 7 days. The goal for this method is total dietary assessment, in other words it is a quantitative method. Many of the validation studies reviewed included weighed dietary records (WDRs) as well, which require all consumed foods and beverages to be weighed. Dietary records have been examined in validation studies more than other dietary assessment methods and by means of comparison to doubly labelled water measurement of energy intake (EI) more than others [10, 11]. Dietary records have been shown to be accurate quantitative dietary measurement tools for an individual over a certain period of time [12]. Weighed dietary record decrease biases stemming from memory or misreporting and have been shown to be accurate for measuring usual intake [13]. However, children over the age of 9 and overweight or obese children are more likely to under report EI when assessed by weighed or estimated food records [14, 15]. Dietary records, especially WDRs, also carry much more respondent burden than FFQs or 24-hour recalls [11].

Dietary recalls

Twenty four-hour recalls ask respondents to report all foods and beverages consumed either the day before or in the last 24 hours. Administrators are trained to probe for forgotten foods and to provide proper food models to aid in estimating portion sizes. They also enquire about brand names and on how foods were prepared. Literacy requirements and respondent burden are low [12] and recalling a short period of time is a benefit when considering child populations [9]. The goal of one 24-hour recall is to get an estimation of actual intake, and because of the detailed interview, total nutrient intake can be calculated for the individual for that time period [9]. One 24-hour recall does not provide an accurate individual total nutritional assessment because a person's diet varies from day to day, but the method has been shown to provide mean nutrient intakes for group populations reasonably well [13]. A respondent may participate in a multiple-pass recall in which the interviewer uses tools and steps (models to estimate size, questions about food products to better determine nutrients, questions to help respondents remember forgotten foods, etc.) designed to improve accuracy while minimizing respondent burden. The multiple-pass recall assessment tool allows an estimation of usual intake for an individual along with a distribution of mean total nutrient intakes inside a group [16]. A systematic review of dietary assessment validity in children, using comparisons to the doubly labeled water method, revealed that a 24-hour multiple pass recall including recalls from a week day and a weekend day and using parents as proxy reporters as the most accurate method to estimate total EI for children aged 4 to 11 years [17].

Food frequency questionnaires with quantitative capabilities, food records and 24-hour recalls have all been shown to be accurate methods for establishing mean total energy intakes of large populations or groups [9, 17]. However, considering the cognitive abilities of school-aged children along with ease of administration, cost and respondent burden, 24-hour multiple-pass recalls that include child and parent responding together have been shown to be the most accurate and reasonable dietary assessment method [9, 17]. The National Health and Nutrition Examination Survey meets all of these stipulations [18] and therefore data collected from this national survey and representing dietary intake of school-aged children should be considered valid.

Children participating in NHANES, ages 6 to 11 years old, are interviewed in person by highly trained dietary interviewers for the first of two 24-hour dietary recalls. This interview is proxy-assisted by a parent or caretaker, and three dimensional models are provided to assist with portion size estimations. The first interview takes place either at the family's home or in a Mobile Examination Center (MEC). In a subsample of participants, a second 24-hour recall is conducted over the phone within 3 to 10 days of the 1st interview by the same highly trained dietary interviewers. Although it does not always work out that one 24-hour recall is from a weekday and the other is from a weekend day, every other aspect of this national survey's dietary assessment method matches the recommendations for dietary assessment from previous validation studies for school-aged children.

Dietary Recommendations

The Dietary Guidelines Advisory Committee (DGAC), selected in conjunction by the United States Department of Agriculture (USDA) and the U.S. Department of Health and Human Services (HHS), released the 2010 Dietary Guidelines for children and adults. The appointed committee of health and nutrition experts has been releasing updated dietary guidelines for Americans every 5 years since 1985 [19]. ChooseMyPlate.gov was created soon after the 2010 release of the dietary guidelines by the Center for Nutrition Policy and Promotion (CNPP), an organization of the USDA, to incorporate guidelines into a user-friendly format. The website encourages Americans to make healthier choices while providing nutrition information and assessment tools. MyPlate is an updated version of MyPyramid portraying an image of how each meal should look while triggering reminders of MyPlate messages. Some of these messages include: "make at least half your grains whole grains," "go lean with protein," and "vary your veggies."

Daily food plans

One of the tools is "My Daily Food Plan" which asks for the user's gender and age, if the age is 8 years or less a message appears informing the user that average height and weight measurements are used for this age group, if the age is 9 years or more height and weight measurements are requested. A physical activity estimate completes the question section before a daily food plan is provided. A sample daily food plan for a 6 year-old female who is physically active at least 60 minutes a day recommends 5 ounces of grains, 2 cups of vegetables, 1.5 cups of fruit, 2.5 cups of dairy and 5 ounces of protein foods (Table 2.1). This daily plan also recommends limiting oils to 5 teaspoons, solid fats and added sugars to 120 calories, and sodium to less than 2300 milligrams. For the female aged 6 years, the total calorie recommendation per day is 1600 kilocalories. In addition to these total food group recommendations there are general recommendations within each food group. An example from each of the five groups follows: "twice a week, make seafood the protein on your plate," "drink fat-free or low-fat milk," "choose whole or cut-up fruits more often than fruit juice," "aim for 1.5 cups of dark green veggies each week" and "make half your grains whole."

A sample daily food plan for an 11 year-old male boy weighing 70 pounds and standing 4 feet 6 inches who is also physically active for at least 60 minutes a day recommends 6 ounces of grains, 2.5 cups of vegetables, 2 cups of fruit, 2.5 cups of dairy and 5.5 ounces of protein foods. This plan recommends limiting oils to 6 teaspoons, solid fats and added sugars to 260 calories, and sodium to less than 2300 milligrams, with a total per day calorie recommendation of 2000 kilocalories. General recommendations are the same for both sample plans with the exception of the vegetable group. The vegetable group is divided into five sub-groups: dark green veggies, red & orange veggies, beans & peas, starchy veggies and other veggies. The 11 year-old male is told to aim for 1.5 cups of dark green veggies per week like the 6 year-old female. All other categories vary slightly for 6 year-old girl versus 11 year-old boy comparisons respectively: red & orange veggies 4 cups and 5.5 cups, beans & peas 1 cup and 1.5 cups, starchy veggies 4 cups and 5 cups, and other veggies 3.5 cups and 4 cups. Both food plans remind the children to be physically active for at least 60 minutes a day [20]. Dietary recommendations vary depending on sex, age, height, weight and time spent being physically active, however the sample daily food plans in Table 2.1 for the 6 year-old female and the 11 year-old male provide an estimated daily recommendation range for food groups and calories for the population to be examined with this research. The 2010

Table 2.1 Daily Food Plans from USDA

Food groups, energy and sodium recommendations	6 year-old female (physically active 60 m/d)	11 year-old male (physically active 60 m/d)
Grains	5 oz.	6 oz.
Vegetables	2 c	2.5 c
- Dark green*	1.5 c	1.5 c
- Red and orange*	4 c	5.5 c
- Beans and peas*	1 c	1.5 c
- Starchy*	4 c	5 c
- Other*	3.5 c	4 c
Fruit	1.5 c	2 c
Dairy	2.5 c	2.5 c
Protein foods	5 oz.	5.5 oz.
Oils	5 t	6 t
Energy from solid fats and added sugars	120 Kcal	260 Kcal
Total energy	1600 Kcal	2000 Kcal
Sodium	< 2300 mg	< 2300 mg

* Per week recommendations

Dietary Reference Intakes

The dietary guidelines are constructed using the most recent nutritionally and medically accredited literature [19]. One such resource is the Dietary Reference Intakes (DRIs) created by the Food and Nutrition Board of the Institute of Medicine (IOM). The

DRIs include Estimated Average Requirements (EAR), Recommended Dietary Allowances (RDA), Adequate Intake (AI), and Tolerable Upper Intake Level (UL) nutrient reference values. Reference values are categorized into groups: infants, children, males, females, pregnancy and lactation. These groups are then subdivided into age groups. For this research population, 6 to 11 year olds, three different categories will be reviewed: children aged 4 to 8 years, males aged 9 to 13 years and females aged 9 to 13 years. Gender does not become a factor until age 9 for these values. For nutrients recommended by the 2010 Dietary Guidelines but not limited, the RDAs or AIs will be reviewed, and for nutrients with recommended limitations the ULs or general recommendation statements will be reviewed. RDAs are values found by taking the average of the recommended daily intake values that are sufficient for 97 to 98% of healthy individuals in a group. When this number cannot be found AIs are determined via observed or experimental approximations of nutrient intake by healthy individuals in a group. Tolerable Upper Intake Levels (ULs) are values for the highest amount of a nutrient that can be ingested daily without posing a threat to the health of almost all healthy individuals in a group. For all three categories mentioned previously, 130 grams per day (g/d) of carbohydrates are recommended while total fat recommendations are not determined (Table 2.2). Total fiber recommendations are 25 g/d for children aged 4 to 8 years, 26 g/d for females aged 9 to 13 years and 31 g/d for males aged 9 to13 years. Respectively, protein recommendations are as follows: 19 g/d, 34 g/d and 34 g/d [21].

According to the 2005 Dietary Guidelines, vitamin E, calcium, potassium and magnesium intake levels for children were lacking and of public concern. Vitamin D was added to the list with the release of the 2010 Dietary Guidelines policy document [19].

These micronutrients will be reviewed using RDA or AI values as well. Vitamin D RDAs are the same for each category, 15 micrograms/day as cholecalciferol, or the natural form of Vitamin D found in foods before it is converted in the skin by sunlight, assuming minimal sunlight. Vitamin E RDAs differ for children aged 4 to 8 years, 7 milligrams/day (mg/d), but are the same for females and males aged 9 to 13 years, 11 mg/d. RDAs for calcium and magnesium are the same for females and males aged 9 to 13 as well while differing for children aged 4 to 8 years: 1300 mg/d and 240 mg/d and 1000 mg/d and 130 mg/d respectively. Adequate Intake values are used for potassium and follow the same trend, 4.5 g/d and 3.8 g/d [21].

As mentioned previously the 2010 Dietary Guidelines place limitations on certain nutrients including solid fats, added sugars, and sodium. The DRIs are specific with reference values for sodium; ULs for each category follow: 1.9 g/d for children aged 4 to 8 years and 2.2 g/d for both females and males aged 9 to 13 years. In reference to added sugars IOM's Food and Nutrition Board sets a limit to no more than 25% of total energy consumed instead of setting a RDA or AI value. For solid fats the Food and Nutrition Board uses the more concise terminology of trans fatty acids and saturated fatty acids with the more general recommendation of consuming amounts as low as possible while maintaining a diet of adequate nutrition. The same recommendation is given for dietary cholesterol intake [21].

Table 2.2 Daily Dietary References Intakes

Nutrient recommendations	Children (aged 4-8 years)	Females (aged 9-13 years)	Males (aged 9-13 years)
Carbohydrates	130 g	130 g	130 g
Total fiber	25 g	26 g	31 g
Protein	19 g	34 g	34 g
Vitamin D	15 µg	15 µg	15 µg
Vitamin E	7 mg	11 mg	11 mg
Calcium	1000 mg	1300 mg	1300 mg
Magnesium	130 mg	240 mg	240 mg
Potassium (AI)	3.8 g	4.5 g	4.5 g
Sodium (UL)	1.9 g	2.2 g	2.2 g
Added sugars	No more than 25% of total energy consumed		

Dietary Intake

Children of all ages are failing to consume enough nutrient rich foods while overconsuming nutrient poor, energy dense foods [19-21]. High energy foods with little nutritional value are referred to as empty calorie or discretionary foods. Study designs have calculated empty calories by combining the total energy from solid fats and added sugars [19]. Previous studies have examined changes in U.S. child dietary and beverage intake patterns over time, some of these include demographic comparisons. Other studies have investigated a specific time period in order to measure diet quality for varying child populations or for all children regardless of sex, race/ethnicity or socioeconomic status. All of these studies express significance as p-value < .05. The Continuing Survey of Food Intakes by Individuals (CSFII), 1989-1991 to 1998 and/or the National Health and Nutrition Examination Survey (NHANES), 1971-1974 to 2009-2010, supply the data for analyses of child dietary intakes over time. Numerous dietary variables: total energy, energy density, food groups, popular foods, energy from beverages, energy from nutritive beverages, energy from low calorie beverages, along with multiple demographic variables have been compared to decipher trends/correlations over time and/or within time periods.

Total energy trends

For children aged 6 to 11 years, Non-Hispanic (NH) white children, children whose head of household education included some college, and children with a poverty income ratio (PIR) of 1.31 to 1.85 (PIR numbers are calculated by dividing household income by the appropriate poverty threshold, poverty thresholds or poverty levels vary by state and by year), total energy has been shown to increase from 1989 to 2004 and then decrease from 2005 to 2010 with total energy in 2009-2010 almost matching total energy in 1989-1990. A similar trend is shown for Mexican American and NH black children, children whose head of household either graduated high school or had some high school, and children with PIRs of less than or equal to 1.30 or greater than 1.85 with the exception of a slight increase in mean kilocalories in 2009-2010 versus 1989-1990. Males were found to consistently consume 300 to 450 more kilocalories per day than females (CSFII plus NHANES) [22]. Total energy has also been shown to decrease from 1971 to 2008 for children aged 6 to 11 years (NHANES only). The same study showed increases in energy density across all age, PIR, and education categories with the exception of children whose head of family completed college. In this group there were no significant differences in energy density over time [23].

Food and beverage trends

Food sources including: major food groups, food categories such as savory snacks or ready to eat cereals, and popular foods such as burgers or pizzas have been investigated over time in comparison studies. Slining et al., 2013 examined food sources of energy for children ages 2 to 18 years old for trends across two decades. Tortilla and corn dishes, pizzas, savory snacks, poultry, sweet snacks/candy, and fruit had significantly higher mean caloric percentages in 2009-2010 (NHANES) than in 1989-1991 (CSFII) , while breads and rolls, meat, processed meat products, ready to eat cereals, starchy vegetables and vegetables had significantly lower mean caloric percentages in 2009-2010 (NHANES) versus 1989-1991(CSFII) [22].

Child beverage consumption patterns have also been examined for trends over time and within specific periods. Three categories of beverages: sugar-sweetened beverages (SSBs), caloric nutritional beverages (CNBs) and low calorie beverages (LCBs) were defined and kilocalories consumed per day per capita (school-aged children) from each category were compared across three time periods: 1989-1991 (CSFII), 2005-2006 (NHANES) and 2007-2008 (NHANES). Caloric intake of SSBs significantly increased from 1989 to 2008 while caloric intake of CNBs significantly decreased. There were no significant differences in LCBs. The same study used data compiled from two non-consecutive 24-hour recalls (NHANES 2007-2008) to examine SSBs more closely. Results showed that Hispanic school-aged children consumed less fruit drinks and soda than NH white and black school-aged children, NH white children consumed the most high fat, high sugar milk, and NH black children consumed the most fruit drinks and soda along with the most 100% fruit juice [25]. For children ages 2 to 18, consumption of whole milk has been shown to significantly decrease from 1989 to 2010 while SSB and fruit juice consumption increased from 1989 to 2004 then decreased from 2005 to 2010, leveling off to the amount consumed in 1989 [22].

Dietary intake variations

Gender, race/ethnicity, and income have been examined to correlate differences in child dietary intakes of food groups, Healthy Eating Index scores, food sources of: energy, solid fats and added sugars, and fruits and vegetables. Because these were not timeline studies, more recent data from NHANES were examined.

Food groups

Dietary intake data from 2001 to 2004 for children aged 2 to 18 years were categorized into food groups and compared across three race/ethnicity groups: Mexican American, Non-Hispanic (NH) black, and Non-Hispanic white, and three income brackets: highest PIR (1.86 or greater), middle PIR (1.31 to 1.85) and lowest PIR (1.30 or lower). This data revealed: Mexican American children consumed more total fruits and total vegetables, NH black children consumed more starchy vegetables, meats and beans, and NH white children consumed more milk and oils, while the lowest and highest PIR groups consumed more total fruits, whole fruits and dark green vegetables, the lowest and middle PIR groups consumed more total vegetables, orange vegetables, dry beans and peas, starchy vegetables, meats and beans, and the middle and highest PIR groups consumed more milk and oils. Mexican Americans and the lowest PIR group consumed significantly more dry beans and peas while the only food group in which dietary recommendations were close to being met by all income groups was the total grains group [20].

Lorson et al., 2009 investigated child fruit and vegetable consumption data from 1999 to 2002 examining effect of gender, race/ethnicity and income. Race/ethnicity groups match previously mentioned studies but income categories differ (highest PIR > or = 3.50, middle PIR = 1.30 to 3.50, lowest PIR = below 1.30). The study suggested that males consume slightly more fruits and vegetables, but are slightly less likely to meet dietary recommendations. No significant differences were found by race/ethnicity for total vegetable or fruit juice consumption, but Mexican American children consumed significantly more total fruits. The lowest and highest PIR groups consumed more total fruits, fruit juices and total vegetables than the middle PIR group, however most children, male or female, from all race/ethnicity groups and income brackets were not meeting fruit and vegetable intake recommendations [29].

Healthy Eating Index

The Healthy Eating Index (HEI) measures conformance with federal dietary guidance. The HEI-2010 is an updated version reflecting the 2010 Dietary Guidelines and has been shown to be a valid measurement of diet quality [26]. There are 12 components of the HEI-2010, 9 covering diet adequacy of total vegetables, whole grains, dairy, etc., and 3 addressing foods to be consumed in moderation: refined grains, sodium, and empty calories. Higher scores represent better diet quality with 100 being the maximum score. Healthy Eating Index scores were calculated using data from NHANES 2003-2004, 2005-2006, 2007-2008 for children ages 2 to 17. No significant difference was found in total HEI scores between lower income children (PIR less than 1.85) and higher income children (PIR greater than or equal to 1.85) [21].

Leading contributors of energy, solid fats and added sugars

Dietary and beverage intake data from 2003 to 2006 for children ages 2 to 17 were categorized into leading contributors of energy, solid fats and added sugars and compared across the same three race/ethnicity groups and income bracket categories mentioned previously. This data revealed: grain desserts as the number one source of energy for NH white children and children in the lowest and highest PIR groups, chicken as the top source of energy for NH black children, and Mexican dishes as the predominate source of energy for Mexican Americans. Pizza was the major source of energy in the middle PIR group and the greatest source of solid fats for NH black and white children and children in the middle and highest PIR groups. Whole milk was the number one source of solid fats for Mexican American children and children in the lowest PIR group, and soda was the main source of added sugars for NH white and Mexican American children and across all three income groups. Fruit drinks were the number one source of added sugars for NH black children [19].

Top nutrient food sources for entire child population

Keast et al., 2013 conducted a similar study using the same NHANES data from the same time period. Food sources for total energy, macronutrients, micronutrients, as well as total sugars, added sugars, dietary fiber, total fats, saturated fatty acids, and cholesterol for all U.S. children (no demographic variables were incorporated) were investigated. Milk was the predominant energy source for total energy, protein, vitamin

D, calcium, and potassium, soft drinks/soda was the number one energy source for carbohydrates, total sugars, and added sugars, and cheese was the greatest energy source for total fat and saturated fatty acids. Fruit topped the dietary fiber list, eggs were the main contributor for cholesterol, and salt more than doubled 2nd place yeast breads and rolls to top the sodium category [27].

Nielson et al., 2014 examined more recent data (NHANES 2009-2010) from one 24-hour recall to estimate the percentage of youth ages 2 to 19 consuming certain fruits and vegetables on a given day. In all age groups and race/ethnicity groups, fruit juice was more likely to be consumed than citrus/melons/berries, and red and orange vegetables (includes tomatoes and tomato products) were more likely to be consumed than starchy or other vegetables. Red and orange vegetables were also about five times more likely to be consumed than dark green vegetables [30].

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CHAPTER III

METHODS

The National Health and Nutrition Examination Survey (NHANES) is conducted by the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics to inspect the health and dietary intake of non-institutionalized United States citizens. NHANES is a nationally representative, cross-sectional survey including socioeconomic, demographic, and 24-hour dietary recall questions. NHANES became continuous in 1999 and averages approximately 5,000 interviewed respondents ages 2 months and older each year. Data is released in two year increments with the most recent data available coming from NHANES 2009-2010. Consistent procedures are followed within 2 year cycles so that data may be combined to examine certain aspects within groups. Combining years allows for larger sample sizes within those groups consequently producing increased confidence level. The sample size is made into a representative sample via complex, stratified, multistage probability calculations. NHANES uses a four stage sampling design with the first stage being Primary Sampling Units (PSUs) and consisting of county clusters or individual counties. The second stage has the purpose of establishing variance estimation and consist of one to three Masked Variance Units (MVUs) per PSU. The third stage selects individual households or Dwelling Units (DUs) and the last stage includes Sample Persons (SPs) within the household. Certain populations are oversampled in order to better estimate health status within these groups.

Some of these populations include lower income individuals, Hispanic Americans and non-Hispanic African Americans. Detailed descriptions of NHANES methodologies can be found by visiting the Centers for Disease Control and Prevention's website: www.cdc.gov.

Survey design and sample

Children ages 6 to 11 participated in face to face interviews with highly trained dietary interviewers for the first of two 24-hour dietary recalls. This interview is proxy-assisted by a parent or caretaker, and three dimensional models are provided to assist with portion size estimations. The first interview takes place either at the family's home or in a Mobile Examination Center (MEC). In a subsample of participants, a second 24-hour recall is conducted over the phone within 3 to 10 days of the 1st interview by the same highly trained dietary interviewers. Although it is not always possible that one 24-hour recall is from a weekday and the other is from a weekend day, every other aspect of this national survey's dietary assessment method matches the recommendations for dietary assessment from previous validation studies for school-aged children. Dietary intake data for children ages 6 to 11 that participated in NHANES 2005-2010 and completed both 24-hour dietary recalls, being deemed reliable by interviewers, were compared to parent income and education. The 2005-2006 and 2007-2008 cycles were included in order to achieve larger population numbers and subsequently, a higher degree of validity. In an effort to keep data as recent as possible, NHANES cycles prior to 2005-2006 were not included.

Measures

Data for 2,595 children were obtained and SUDAAN 11, Software for the Statistical Analysis of Correlated Data (Research Triangle Institute, 2013) was used to create and compare independent and dependent variables. Family income and head of household education were used to measure socioeconomic status effect on child vegetable and fruit consumption. Household income was collapsed into two groups: poverty income ratio (PIR) <= 1.85 and PIR > 1.85 and head of household education was collapsed into two groups: completed high school/General Education Diploma (GED) or less and attended college. Poverty levels for the respective year studied were used to determine PIR. Race was also examined as an independent variable to measure effect on vegetable and fruit consumption by children. Race was analyzed as the following: Hispanic Mexican Americans, Non-Hispanic African Americans, Non-Hispanic Caucasian Americans and other.

Food groups and food components were obtained using the Food Patterns Equivalent Database (FPED). The What We Eat in America (WWEIA) survey data from 24-hour dietary recalls of the 2,595 observations mentioned previously were used to create a FPED for this study. The FPED methodology is explained in detail in the FPED 2011-2012: Methodology and User Guide by Bowman et al. (2014). To summarize, the USDA's Food and Nutrient Database for Dietary Studies (FNDDS) contains around 8,000 foods and beverages and their nutrient content. FNDDS codes link to FPED so that foods reported in WWEIA can be broken down into 37 different food groups and food components. An example of a food eaten and its FPED components follows: ham and cheese sandwich with lettuce, tomato and mayonnaise is further broken down into these

FPED components: whole grains, refined grains, cheese, solid fats, cured meat, other vegetables, tomatoes, oils, eggs, and added sugars. Both the cheese and the cured meat contain solid fat, therefore the solid fat portions of these two ingredients would be combined to achieve the total solid fat amount present in the mixed food item.

Table 3.1 Food Patterns Equivalent Database components

Total Fruit Citrus, Melons, Berries Other Fruits Fruit Juice
Total Vegetables Dark-Green Vegetables Total Red-Orange Vegetables Tomatoes Other Red-Orange Vegetables, Excluding Tomatoes Total Starchy Vegetables White Potatoes Other Starchy Vegetables, Excluding White Potatoes Other Vegetables Beans and Peas*
Total Grains Whole Grains Refined Grains
Total Dairy (Milk, Yogurt, Cheese)** Milk (including calcium-fortified soy milk)** Yogurt** Cheese**
Total Protein Foods*** Total Meat, Poultry, Seafood*** Meat (beef, veal, pork, lamb, game)*** Cured Meat (frankfurters, sausage, corned beef, and luncheon meat made from beef, pork, poultry)*** Organ Meat (from beef, veal, pork, lamb, game, poultry)*** Poultry (chicken, turkey, other fowl)*** Seafood high in n-3 fatty acids (e.g., salmon)*** Seafood low in n-3 fatty acids (e.g., tilapia)*** Eggs*** Soybean Products (excluding calcium-fortified soy milk and immature soybeans)*** Nuts and Seeds*** Beans and Peas* Oils (e.g., olive oil, vegetable oil, and fats naturally found in nuts, fish, olives, and avocado)
Solid Fats (e.g., butter; fats naturally found in dairy and meat; fats used in making cookies, cakes, ice cream)
Added Sugars (e.g., caloric sweeteners in soda, candy, dairy desserts, cakes, cookies)
Alcoholic Drinks

* Beans and peas are included twice in the FPED database because they can be quantified either as a vegetable or a protein food.
** Nonfat portion
*** Lean portion
Table from National Collaborative on Childhood Obesity Research FPED Factsheet

Data analyses

Four statistical analyses were conducted in SUDAAN 11, each being gender adjudicated to control for differences in dietary intake between males and females. Regression analysis was conducted to measure how vegetable and fruit intake varied between groups using PROC REGRESS to associate total vegetable and fruit consumption (FRUITVEG was the dependent variable) with income, education and race.

PROC DESCRIPT was used to calculate sample means and standard errors for absolute intakes of food components and food groups in children ages 6 to 11 by low/high income and sex. For the absolute intakes analysis, all 37 FPED components along with total energy intake, total sugar, and dietary fiber were examined. Total energy, total sugar, and dietary fiber were obtained directly from FNDDS. After finding mean and standard error values, PROC DESCRIPT along with CONTRAST commands were utilized to conduct t-tests and calculate p-values measuring differences within cohorts (males and females) and between cohorts (low and high income). Differences were considered significant at $p < .05$.

FPED components were combined to create seven food groups: fruit, non-starchy vegetables, starchy vegetables, legumes and nuts, grains, meat, and dairy. Sample means and standard errors calculations along with significance tests were conducted in the same manner described for the previous analysis.

The same two statistical processes described in the second paragraph were used to calculate sample means and standard errors and then conduct t-tests and calculate p-values for prevalence of consumers of food components in children ages 6 to 11 by low/high income and sex. Certain FPED components were not included in this test because mean values were zero or very close to zero for all groups in the initial absolute intake analysis. Two examples are alcohol (all mean values were zero number of drinks) and dark green vegetables (mean values were less than or equal to .06 cup eq.). For this test a child was considered a consumer if he or she consumed greater than 0.5 cups or ounce equivalents per day. A value of one was assigned to these children, and a value of zero was assigned to the children consuming less than 0.5 cups or ounce equivalents per day. For each cohort all values were combined to show prevalence of food components intakes of the defined amounts described previously.

CHAPTER IV

RESULTS

Parent socioeconomic effect on child vegetable and fruit consumption

Regression model was used to depend reported total vegetable and fruit consumption by children ages 6 to 11 on their parents' income, education and race. The model was analyzed using Multiple R-Square analysis with variables including: (PIR) <= 1.85 and PIR > 1.85, completed high school/General Education Diploma (GED) or less and attended college, Hispanic Mexican Americans, Non-Hispanic African Americans, Non-Hispanic Caucasian Americans, and other. There were no significant differences due to parent income or race. Head of household education did effect reported total vegetable and fruit intake, with parents attending college being positively associated with reported total vegetable and fruit consumption. In other words children whose parents attended college reported consuming significantly more total vegetables and fruits.

Table 4.1 Multiple R-Square for the dependent variable FRUITVEG

Variable	Beta coefficient	S.E. beta	Lower 95% limit	Upper 95% limit	T – Test B = 0	P - Value
Intercept	1.43	0.06	1.30	1.56	22.32	0.0000
Family income						
PIR <= 1.85	0.00	0.00	0.00	0.00	.	.
PIR > 1.85	0.03	0.07	-0.12	0.18	0.42	0.6760
Head of household education						
High school/GED or less	0.00	0.00	0.00	0.00	.	.
Attended college	0.16	0.07	0.02	0.29	2.36	0.0227*
Race						
Hispanic/Mexican American	0.14	0.09	-0.05	0.33	1.51	0.1369
NH Caucasian American	0.00	0.00	0.00	0.00	.	.
NH African American	-0.04	0.07	-0.17	0.09	-0.60	0.5496
Other	0.26	0.18	-0.09	0.62	1.50	0.1410

* Statistically significant difference

Parent income effect on absolute intake of total energy, dietary fiber, oils, solid fats, added sugars and total sugar

Using reported absolute intake mean differences (low income minus high income), T – test statistical analysis revealed no significant differences in total energy, dietary fiber, solid fats, added sugars, or total sugars. The high income group reported significantly higher absolute total intake of oils. (Table 4.1) Alcohol was not included due to zero mean reported intakes for both income groups.

Table 4.2 Total energy, dietary fiber, oils, solid fats, added sugars, and total sugars

	Low income (< = 1.85 PIR) n= 1433		High income (> 1.85 PIR) n=1162		
Variable	Mean	S.E.	Mean	S.E.	p - value
Total energy (kcal)	1893.88	24.403	1912.93	22.215	0.5982
Dietary fiber					0.3338
Oils (grams)	17.14	0.488	18.79	0.508	0.0184*
Solid fats (grams)	37.53	0.888	37.36	0.619	0.8753
Added sugars (tsp. eq.)	17.92	0.364	18.84	0.425	0.1428
Total sugar (tsp. eq.)	18.41	0.358	19.19	0.428	0.2104

* Statistically significant difference

Parent income effect on absolute intake of food components

Using reported absolute intake mean differences (low income minus high income), T – test statistical analysis revealed that the high income group (PIR > 1.85) reported significantly higher absolute intakes for the following food components: dark green vegetables, red and orange vegetables excluding tomatoes, peanuts, tree nuts, and seeds excluding coconut. The same analysis revealed that the low income group (PIR <= 1.85) reported significantly higher absolute intakes for the following food components: fruit juices, beef, veal, pork, lamb, game meat; excluding organ meats and cured meat, total meat, and legumes computed as protein foods. No significant differences were found for food components is the grains group or the dairy products group. (Tables 4.3 – 4.6)

Table 4.3 Food components: fruits and vegetables

	Low income (< = 1.85 PIR) n= 1433		High income (> 1.85 PIR) n=1162		
Variable (cup eq.)	Mean	S.E.	Mean	S.E.	p - value
Whole fruits of citrus, melons and berries	0.17	0.020	0.22	0.024	0.0554
Whole fruits excluding citrus, melons and berries	0.47	0.023	0.52	0.034	0.2371
Fruit juices	0.49	0.029	0.35	0.019	0.0001*
Total fruit	1.13	0.049	1.09	0.043	0.4524
Dark green vegetables	0.04	0.006	0.06	0.007	0.0284*
Tomatoes and tomato products	0.22	0.010	0.21	0.014	0.5005
Red and orange vegetables excluding tomatoes	0.05	0.005	0.07	0.007	0.0375*
Total red and orange vegetables	0.27	0.011	0.27	0.018	0.8178
White potatoes	0.29	0.012	0.26	0.016	0.1246
Other starchy vegetables excluding white potatoes	0.08	0.007	0.07	0.006	0.3857
Other vegetables not in components listed above	0.22	0.011	0.22	0.018	0.8221
Total vegetables excluding legumes	0.89	0.026	0.88	0.030	0.9301
Legumes computed as vegetables	0.07	0.006	0.04	0.006	0.0029

* Statistically significant difference

Table 4.4 Food components: grains

	Low income (< = 1.85 PIR) n= 1433		High income (> 1.85 PIR) n=1162		
Variable (oz. eq.)	Mean	S.E.	Mean	S.E.	p - value
Whole grains	0.55	0.031	0.61	0.029	0.1040
Refined or non-whole grains	5.88	0.099	5.98	0.112	0.4943
Total grains	6.43	0.099	6.59	0.110	0.8221

Table 4.5 Food components: animal and non-animal high protein foods excluding dairy products

	Low income (< = 1.85 PIR) n= 1433		High income (>1.85 PIR) n= 1162		
Variable (oz. eq.)	Mean	S.E.	Mean	S.E.	p - value
Beef, veal, pork, lamb, game; excluding organ meat and cured meat	1.14	0.058	0.96	0.064	0.0316*
Cured/luncheon meat	0.94	0.055	0.86	0.045	0.2732
Organ meat	0.01	0.003	0.00	0.001	0.1736
Poultry excluding organ meats and cured meat	1.15	0.062	1.02	0.061	0.0514
Seafood high in omega-3 fatty acids	0.03	0.006	0.05	0.015	0.1500
Seafood low in omega-3 fatty acids	0.21	0.026	0.17	0.047	0.5123
Total meat	3.47	0.086	3.06	0.078	0.0003*
Eggs and egg substitutes	0.38	0.022	0.36	0.027	0.5835
Soy products excluding soy milk	0.02	0.003	0.02	0.004	0.6359
Peanuts, tree nuts, and seeds excluding coconut	0.24	0.022	0.48	0.039	0.0000*
Legumes computed as protein foods	0.28	0.023	0.16	0.023	0.0027*
Total high protein foods excluding legumes	4.12	0.094	3.92	0.091	0.0946

* Statistically significant difference

Table 4.6 Food components: dairy products

	Low income (< = 1.85 PIR) n= 1433		High income (> 1.85 PIR) n=1162		
Variable (cup eq.)	Mean	S.E.	Mean	S.E.	p - value
Fluid milk and calcium fortified soy milk	1.48	0.041	1.52	0.053	0.6050
Yogurt	0.04	0.005	0.06	0.008	0.0658
Cheese	0.67	0.042	0.64	0.029	0.5974
Total milk, yogurt, cheese and whey	2.20	0.060	2.23	0.064	0.7421

Parent income effect on absolute intake of food groups

Food components from FPED were combined to create food groups, and again using reported absolute intake mean differences (low income minus high income), T – test statistical analysis revealed that the high income group reported significantly higher absolute intakes of legumes and nuts, while the low income group reported significantly higher absolute intakes of meat, poultry, seafood and eggs. No statistically significant differences were found for the food groups including: fruit, non-starchy vegetables, starchy vegetables, grains and dairy. (Table 4.6)

Table 4.7 Food groups

	Low income (< = 1.85 PIR) n= 1433		High income (> 1.85 PIR) n=1162		
Variable	Mean	S.E.	Mean	S.E.	p - value
Fruit (cup eq.)	0.64	0.035	0.74	0.043	0.0771
Non-starchy vegetables (cup eq.)	0.52	0.019	0.55	0.024	0.3283
Starchy vegetables (cup eq.)	0.36	0.015	0.33	0.017	0.1200
Legumes and nuts (cup eq.)	0.55	0.029	0.66	0.047	0.0421*
Grains (oz. eq.)	6.43	0.099	6.59	0.110	0.2888
Meat, poultry, seafood and eggs (oz. eq.)	3.85	0.090	3.42	0.085	0.0005*
Dairy (cup eq.)	2.20	0.060	2.23	0.064	0.7421

* Statistically significant difference

Parent income effect on consumption prevalence of food components

Prevalence of reported intake of 0.5 cup equivalents or 0.5 ounce equivalents of the respective food component was examined using consumer versus non-consumer analysis. Mean prevalence differences (low income minus high income) used in T-test statistical analysis revealed that a greater proportion of high income children reported consumption of: whole fruits of citrus, melons and berries; whole grains; and peanuts, tree nuts, and seeds (excluding coconut). The same analysis revealed that a greater proportion of low income children reported consumption of: fruit juices; beef, veal, pork, lamb, game meat (excluding organ meats and cured meat); and total meat. (Tables 4.7-4.10)

Table 4.8 Prevalence of food components: fruits and vegetables

	Low income (< = 1.85 PIR) n= 1433		High income (> 1.85 PIR) n=1162		
Variable (cup eq.)	Mean	S.E.	Mean	S.E.	p - value
Whole fruits of citrus, melons and berries	0.10	0.015	0.16	0.020	0.0052*
Whole fruits excluding citrus, melons and berries	0.35	0.021	0.40	0.028	0.2678
Fruit juices	0.38	0.021	0.25	0.021	0.0000*
Total fruit	0.70	0.023	0.70	0.028	0.8999
Total starchy vegetables	0.28	0.022	0.23	0.016	0.0692
Total vegetables excluding legumes	0.71	0.020	0.70	0.019	0.7491

One serving calculated as 0.5 cup equivalents (1 if yes, 0 if no)
*Statistically significant difference

Table 4.9 Prevalence of food components: grains

	Low income (< = 1.85 PIR) n= 1433		High income (> 1.85 PIR) n=1162		
Variable (oz. eq.)	Mean	S.E.	Mean	S.E.	p - value
Whole grains	0.36	0.020	0.44	0.023	0.0008*
Refined or non-whole grains	1.00	0.001	1.00	0.001	0.8886
Total grains	1.00	0.001	1.00	0.000	.1619

One serving calculated as 0.5 ounce equivalents (1 if yes, 0 if no)
*Statistically significant difference

Table 4.10 Prevalence of food components: animal and non-animal high protein foods excluding dairy products

	Low income (< = 1.85 PIR) n= 1433		High income (> 1.85 PIR) n=1162		
Variable (oz. eq.)	Mean	S.E.	Mean	S.E.	p - value
Beef, veal, pork, lamb, game meat; excluding organ meats and cured meat	0.61	0.023	0.53	0.024	0.0311*
Cured/luncheon meat	0.56	0.025	0.53	0.023	0.4027
Poultry excluding organ meats and cured meat	0.58	0.025	0.55	0.025	0.3180
Seafood high in omega-3 fatty acids	0.02	0.005	0.03	0.009	0.6581
Seafood low in omega-3 fatty acids	0.12	0.015	0.11	0.023	0.6680
Total meat	0.97	0.006	0.95	0.010	0.0299*
Eggs and egg substitutes	0.27	0.021	0.24	0.017	0.2423
Peanuts, tree nuts, and seeds excluding coconut	0.14	0.013	0.28	0.022	0.0000*
Legumes computed as protein foods	0.18	0.015	0.10	0.016	0.0044*
Total high protein foods excluding legumes	0.99	0.002	0.99	0.002	0.0629

One serving calculated as 0.5 ounce equivalents (1 if yes, 0 if no)
*Statistically significant difference

Table 4.11 Prevalence of food components: dairy products

	Low income (< = 1.85 PIR) n= 1433		High income (> 1.85 PIR) n=1162		
Variable (cup eq.)	Mean	S.E.	Mean	S.E.	p - value
Fluid milk and calcium fortified soy milk	0.86	0.013	0.84	0.018	0.3804
Yogurt	0.01	0.005	0.03	0.009	0.2267
Cheese	0.49	0.019	0.49	0.024	0.8903
Total milk, yogurt, cheese and whey	0.96	0.008	0.96	0.006	0.7932

One serving calculated as 0.5 cup equivalents (1 if yes, 0 if no)

Summary

Regression model indicated head of household education but not income or race was positively associated with greater reported intake of total vegetables and fruits. No differences were found between income groups in reported intake of total energy, dietary fiber, solid fats, total sugars or added sugars. Children from families earning less than or equal to 1.85 times the poverty line reported greater absolute intake of animal protein foods, legumes and fruit juice. The exact same results were revealed when comparing consumers and non-consumers (consumed 0.5 cup equivalents or ounce equivalents respectively). Children from families earning more than 1.85 times the poverty line reported greater absolute intake of oils, nuts and seeds, red and orange vegetables (other than tomatoes) and dark green vegetables. The consumers versus non-consumers analysis showed these children consuming a greater proportion of nuts, whole grains and whole fruits of citrus, melons and berries.

CHAPTER V

DISCUSSION

Limitations

Data used for this study were obtained from surveys in which participants worked with parents or caretakers to report dietary intake. Although the pressure of being honest in front of a child exists in this situation, there is inaccuracy in self-reporting dietary intake [1] and in parent reporting of child dietary intake [2]. Also, as lower income participants were more likely to be overweight or obese, and overweight and obese individuals have been shown to be more likely to under report intake [3], it is possible that the lower income group under reported dietary intake more than the higher income group.

The population of 6 to 11 year olds participating in NHANES 2005 to 2010 was not large enough to compare more than two income brackets. Examining more income groups with a greater difference between the lowest and highest income groups would have perhaps provided better correlations of the SES obesity gap difference to dietary intake. Although the data used was the most current data available at the start of this study, this data set is currently 11 to 6 years old.

Finally, secondary analysis of cross-sectional data is not the strongest indicator of causation. Associations or correlations found in this study should be used to form hypotheses for future experimental or longitudinal studies.

Inspection of statistically significant differences

Minimal differences in dietary intake were found in this study, especially when examining parent income effect. Some of these differences while statistically significant, are not very significant when considered in a practical sense. Two examples of this include dark green vegetables and red and orange vegetables excluding tomatoes. For dark green vegetables, the low income group reported an absolute daily intake averaging 0.04 cups while the high income group reported an absolute daily intake averaging 0.06 cups which is about a tablespoon equivalent. For red and orange vegetables excluding tomatoes, the low income group reported an absolute daily intake averaging .05 cups compared to the high income group's .07 cups. If three teaspoons make up one tablespoon and there are 16 tablespoons in a cup, then it can be calculated that there are 48 teaspoons in a cup. This means that a difference of .02 is only a teaspoon's difference (1/48 ~ .02). In other words, these two variables differ only by a teaspoon.

Studying prevalence of food components allowed a different way to view differences in dietary intake. Most of the results from this analysis were in line with the absolute intake results. There were two exceptions: whole fruits of citrus, melons, and berries and whole grains. When investigating absolute intake differences, these two variables were not statistically significant. When investigating prevalence of 6 to 11 year old children consuming 0.5 or greater cup/ounce equivalents in a day, the differences were statistically significant. Ten percent of the low income group reported consuming at least 0.5 cups of whole fruits of citrus, melons, and berries in a day, for the high income group that number increased to 16%. Thirty-six percent of the low income group reported consuming at least 0.5 grams of whole grains in a day, for the high income group that number again increased to 44%.

Variables with statistically significant differences that seem to have more practical application include: fruit juice, oils, and protein sources (not including dairy). It is interesting that the low income group reported higher intakes of fruit juice, but there were no significant differences in added sugars or total sugars between income groups. It is also interesting that the low income group reported higher intakes of total meat, but there were no significant difference in solid fats. Another of interest was the protein category where the low income group reported higher intakes of legumes computed as protein foods, while the high income group reported higher intakes of peanuts, tree nuts, and seeds excluding coconut. When considering income nuts and seeds are considerably more expensive than beans. Nuts and seeds contain oils which may account for some of the difference in reported oil intake (low income mean = 17.14 grams, high income mean = 18.79 grams). Foods that contain oils, especially those considered healthy oils (lower in saturated fatty acids and higher in unsaturated fatty acids like omega-3 and omega-6) are generally more costly(in addition to nuts and seeds, seafood, avocados, and coconuts are some examples).

Perhaps the most interesting statistically significant difference found in this study was reported intake of vegetables and fruits being significantly higher for children whose head of household parent had some college. As this study seems to suggest parent education, more than parent income affects dietary intake.

Socioeconomic influences on parents

Parents with higher incomes should be more capable of providing more nutritious foods to their children than parents with lower incomes. However, this study reveals negligible differences in dietary intake of children for the most part, and even with some differences, the dietary intake data for both income groups does not come close to meeting dietary recommendations discussed in chapter II. Also, children in higher income groups with more educated parents are not meeting dietary recommendations for vegetables and fruits. The most reasonable explanation for this phenomenon is that parents today have less time and are more in debt while suffering from the effects of or dependence upon technological advancements.

Working hours

It is believed that most Americans are working longer hours or more irregular hours for less pay while becoming more and more in debt [4]. The increased working hours trend began in the 1980s [5] and correlates with the start of the Information Age and the beginning of marked increases in childhood obesity. There is conflicting data analysis on increases/decreases for working hours and wages over time, but allowing for total household working hours and inflation presents a clearer picture. The number of dual income homes and single parent homes has increased, which means decreased hours available for food preparation [4, 5]. Also, working mothers have been found to average ten more multitasking hours per week than fathers with most of these multitasking hours involving childcare or housework and bringing on negative emotions and stress [6].

According to the U.S. Department of Labor the inflation-adjusted value of minimum wage today is well below that of the late 1960s. In addition, the U.S. Bureau of

Labor Statistics estimates a dramatic increase in consumer debt from an average of less than $2000 per person before 1950 (inflation adjusted) to over $10000 by 2008.

These socioeconomic influences help to explain the possible shift from family focus to job focus. Parents are spending more time away from home with increased total household working hours, and when parents are home (particularly moms) they are crunched for time. It is possible that parents do not have enough time to shop for and prepare nutritious foods or battle child food neophobia. Educating parents on the importance of making time to prepare and provide nutritious foods and fighting the food neophobia battle by continuing to offer these foods could greatly improve obesity prevalence as their children become adults.

Technological advancements

Advancements in technology have influenced society, especially over the past few decades, and a great deal of those influences have had positive effects. Advancements in some technologies however have directly or indirectly led to increased childhood obesity rates. Media advancements have been directly tied to the obesity epidemic in U.S. youth, but social media interactions and smart phone applications may provide successful intervention strategies [7]. A couple of indirect causes include globalization and more specifically convenience foods production which are both made possible by high technology devices. Because of the rise of the global economy, America’s work force framework has been altered. Manual labor jobs along with small businesses continue to decline [8] changing the dynamics of America’s middle and lower classes. These changes have led to the overall decrease in wages hence greater debt and increased household working hours. Parents low on time are more attracted to convenience foods, and mass production of tasty convenience foods is made possible by technological advancements. The increase in childhood obesity prevalence has been caused by circular factors which are multifaceted and seem to be working together.

By 1960 television was becoming more commonplace in American homes and the popularity of television has been growing since. Most families report multiple forms of media in the home including computers, DVD players, and video game systems [7]. Also smart phones having the capability to entertain via internet activity, video streaming and gaming are becoming less expensive and therefore more obtainable by lower income families. The Pew Research Center estimates cell phone ownership among America's youth increased from 48 percent to 84 percent in only five years (2009). For the most part media participation is sedentary and is considered a leading cause for physical activity decreases among child populations [9]. A reasonable thought is that parents pressed for time may rely more heavily on media entertainment to occupy their children's time. No studies were found that directly ask parents to what extent they depend on media for child entertainment. Also few studies examine the effect of computer/internet use on child health as the internet's emergence into homes has been rapid and recent and the research process is lengthy. However numerous studies examine television viewing time and consistently reveal a negative association between hours viewing and pediatric obesity [7, 10]. In regards to SES Hispanic/Latino and African American children (more likely to be from lower SES families and more likely to be obese) watch significantly more television than Caucasian children [10]. Another factor to consider is that children more readily adopt and utilize entertainment technology all the while being the most vulnerable to its influence [11].

The trend of media devices becoming more and more ubiquitous shows no sign of changing. Therefore information/communication/entertainment technological advancements should be incorporated into childhood obesity intervention strategies. Social media interactions could provide children with encouraging health messages. Just one policy implementation stating mandatory health messages for all those joining social media cites under the age of 18 could have a sizeable positive impact. A few applications (apps) exists to aid parents in preparing healthful meals for their families, but apps aimed at children to improve health behaviors are few. There is an open market to influence children in a positive manner through media and also abundant opportunity to reach out to parents [7].

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CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of this study was to examine relationships between parent income/education and child dietary intake in an effort to explain the widening obesity gap between SES groups. Since adult and childhood obesity are more prevalent now than ever and obesity is a major indicator of chronic disease, comparing the dietary intake data from lower and higher SES groups provided information that can lead to future investigation and possible intervention strategies.

This study supports previous studies suggesting better diet quality for higher SES children as well as previous studies suggesting no significant differences in diet quality of higher SES children and lower SES children. Regression model indicated head of household education was positively associated with greater reported total vegetable and fruit intake. Parent income was not shown to affect reported total vegetable and fruit intake. Also, parent income was not shown to affect reported dietary intake of total energy, dietary fiber, solid fats, added sugars or total sugar. Reported intake differences based on parent income included: oils, nuts and seeds, red and orange vegetables other than tomatoes, and dark green vegetables (high income group reported higher intake) and total meat, legumes, and fruit juice (low income group reported higher intake). These differences, though statistically significant, are not practically significant as both groups reported amounts well short of dietary recommendations for vegetables, fruits, dairy products, protein foods, and oils. One exception being the low income group reported sufficient intake amounts of beans and peas. Both groups are exceeding recommendations for grains (mostly refined grains see Table 4.3) and almost doubling recommendations for energy from solid fats and added sugars. (Table 6.1)

Table 6.1 Recommended versus reported intake

Dietary variable	Recommendation range (Table 2.1)		Reported intake (NHANES 2005-2010)	
	6 year-old female	11 year-old male	Low Income	High Income
Grains (ounces)	5	6	6.43	6.59
Vegetables (cups)	2	2.5	0.96	0.92
- Dark green	0.21	0.21	0.04	0.06*
- Red and orange	0.57	0.79	0.27	0.27
- Beans and peas	0.14	0.21	0.25*	0.14
- Starchy	0.57	0.71	0.37	0.33
- Other	0.5	0.57	0.22	0.22
Fruit (cups)	1.5	2	1.13	1.09
Dairy (cups)	2.5	2.5	2.20	2.23
Protein foods (ounces)	5	5.5	4.12*	3.92
Oils (teaspoons)	5	6	3.76	4.14*
Energy from solid fats and added sugars (kilocalories)	120	260	~ 410	~ 412
Total energy (kilocalories)	1600	2000	1893.88	1912.93

Failing to meet recommended amounts
Exceeding recommended amounts
Within recommended amounts
*Significantly higher value

This study suggests education as the factor that can make a difference. This study also suggests that other factors such as physical activity or increased access to health care may be causing the increasing obesity gap between children from lower SES families and children from higher SES families as few differences were found in reported dietary intake. It is important to consider that children from higher SES families that are more likely to be at a normal weight are not necessarily consuming a more nutritious diet. As these children become adults and their physical activity levels and metabolic rates decrease, they will be more at risk for overweight and obesity. For this reason, increasing nutrition knowledge is important for all Americans, regardless of socioeconomic status.

More policies like the Healthy, Hunger-Free Kids Act of 2010 and the Mississippi Healthy Students Act of 2007 should be implemented to better educate children in school about healthy eating habits and nutrition knowledge. Teaching home economics in school is another environmental change that could carry tremendous benefits while helping to combat obesity. Nutrition education could also be increased via media outlets from television/radio commercials to applications for smart phones to social media strategies. Educational advancements need not be limited to children as parents influence child habits. It is important to educate parents on healthy child weight status and healthy child dietary intake in order to change parental beliefs and perceptions which in turn will improve parent feeding practices. This education could flow through media devices as well or be more personal by way of mandatory dietitian consults for all expecting mothers.

Obesity in the United States and worldwide is a major issue as obese individuals are likely to develop chronic diseases including heart disease, diabetes, cancer, kidney disease and more. Obesity increases the risk of comorbidities as well. Health care costs related to obesity continue to rise and providing funds for obesity related health care is taxing on the individual and the government. Policy implementation to better educate

Americans about the importance of a nutritious diet could lead to high benefit cost ratios improving the health and prosperity of our nation and our nation's people.