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Beverage Selections and Presence Affect Health Eating Index Scores in Lunches of Elementary Age Children, Whether from Home or School

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BEVERAGE SELECTIONS AND PRESENCE AFFECT HEALTHY EATING INDEX SCORES IN LUNCHES OF ELEMENTARY AGE CHILDREN, WHETHER FROM HOME OR SCHOOL

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by

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Graduate Studies

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ABSTRACT

BEVERAGE SELECTIONS AND PRESENCE AFFECT HEALTHY EATING INDEX SCORES IN LUNCHES OF ELEMENTARY AGE CHILDREN, WHETHER FROM HOME OR SCHOOL

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Objectives: Examined differences in school lunch meals (served and consumed) brought from home (LBFH) versus National School Lunch Program (NSLP) using Healthy Eating Index 2010 scores for assessment of Meal Quality by component food groups. Influence of beverage selections on HEI-2010 scores were examined for each meal origin.

Methods: Digital plate waste estimations were analyzed for 509 NSLP meals and 524 LBFH from 2nd-5th-grade students in four elementary schools during the 2011-2012 academic year. Nutrient Data Software for Research (NDSR) determined food groups and nutrients for calculations. Independent t-tests compared NSLP and LBFH meal components. Two one-way ANOVA tests compared HEI-2010 dietary components of the following beverage selections: 1% plain milk, non-fat flavored milk, 100% fruit juice, sugar-sweetened beverage (SSB), or water/no beverage.

Results: NSLP (90% non-fat flavored or low-fat plain milk) and LBFH (75% water/none or SSB) vary widely in beverages selected. LBFH provided significantly ($p <$

0.05) more Whole Grains (NSLP 2.8/5pts vs LBFH 4.7pts) and Seafood & Plant Proteins (NSLP 0.5/5pts vs LBFH 1.7pts) than NSLP. NLSP provided more Dairy (NSLP 9.3/10pts vs LBFH 4.7pts). NSLP scored higher in Total Protein, and Reduced Empty Calories. Both meal origins show need for improvement in Greens/Bean Vegetables and Seafood/Plant Proteins. Selection of 1% plain milk resulted in a significantly higher HEI-2010 scores (NSLP served 55.7/100pts, consumed 53.9pts and LBFH, served 62.1, consumed 60.2).

Applications: Child Nutrition Professionals consistently provide nutritious beverages like 1% plain milk, non-fat flavored milk, and 100% juice in NSLP meals. LBFH would benefit from elimination of SSB. A “milk only” line for children with LBFH may encourage milk consumption and improve HEI scores of LBFH. Increased nutrition education to teachers, staff, parents, and children on the effects of various beverages on dietary quality would be appropriate to further improve beverage selection and meal quality.

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Personally, I am thankful for my early childhood in Skamokawa, WA, which molded my appreciation for nature, community, food, and nourishment; and where I received my first kudos, the thrill of seeing one of my own recipes in typescript within a real book. Providential years spent at Annie Wright School, the daily meals, formal dinners and frequent cocktail parties further developing my awe of food and the powerful experience of shared meals. I am lastly, though certainly not least, grateful to my family, each and every one of you, words cannot express how much I truly appreciate your sacrifices; it is my fortunate honor to get to love you and cook for you. I dearly hope I have also made you proud.

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CHAPTER I

LITERATURE REVIEW

Global Obesity, Effects on Health and Lifespan

Factors contributing to increasing global overweight and obesity are multifaceted. Increasing global childhood overweight and obesity rates are concerning to health professionals (Ng et al., 2014). Obesity correlates with adverse health conditions in populations worldwide. The effect on health issues escalates with the degree of overweight or obesity (Kushner & Foster, 2000). Overweight or obese adults face many health challenges. In addition, overweight and obese children are highly susceptible to multiple health issues, such as diabetes mellitus, insulin resistance, osteoarthritis, cardiovascular disease, gallbladder disease, gout, dyslipidemia, hypertension, polycystic ovary syndrome, other fertility complications, sleep apnea, breathlessness, psychological problems, and some types of cancer (Cunningham, Kramer, & Venkat Narayan, 2014; Ng et al., 2014; WHO, 2000). With these encumbering and persistent health complications, children face reduced quality of life, which may lead to underachievement in school and potentially lifespan shortened by about 4% (Fontaine, Redden, Wang, Westfall & Allison, 2003; Ng et al., 2014).

The International Obesity Task Force (IOTF) sets the internationally recognized categories for weight, based on Body Mass Index (BMI). BMI is calculated using height in meters (m) and weight kilograms (kg), with the equation, (kg/m^2) at age 18 years. *Thinness* (*grade 3, 2* or *1*), *Overweight*, *Obesity* and *Morbid Obesity* are weight to stature designations based on BMI cutoff points for adults (18+), viewable below in Table 1

(Cole & Lobstein, 2012). There is not a single accepted standard for overweight and obesity in children, but the IOTF cutoffs are generally accepted by many international organizations like The World Health Organization (WHO). There are counterpoint cut-offs for children by age and sex (boy or girl) of the child. See Appendixes A and B.

Table 1: Thinness, Overweight, and Obesity by Body Mass

Extended International (IOTF) Body Mass Index (BMI) Cut-Offs for Thinness, Overweight and Obesity*

International child cut-offs are available corresponding to body mass index (BMI = kg/m²) cut-offs 18 years (i.e. adulthood):

- 16 thinness grade 3
- 17 thinness grade 2
- 18.5 thinness grade 1
- 25 overweight
- 30 obesity
- 35 morbid obesity

*IOTF cut-offs for sex (boys and girls) specific ages by month

Source: Cole & Lobstein, 2012

The global overweight and obesity rate has risen over the last 33 years with over 1/3 of the total world population categorized as obese (Ng et al., 2014). Some countries, such as Samoa, Tonga, Kuwait, Qatar, and Libya have over 50% obesity rates (Ng et al., 2014). The rate of childhood overweight and obesity has increased over the last 30 years, to nearly 25% in developed countries and to 13% and 15% in developing countries (Ng et al., 2014). Figure 1A and 1B below show the patterns of prevalence in adults over the last 33 years for overweight and obesity, and obesity alone. Though the rate of growth for overweight and obesity is slowing for the populations of developed countries, it is still rising. Figure 2A and 2B below show the patterns of prevalence in children over the last 33 years for Overweight and Obesity, and Obesity alone.

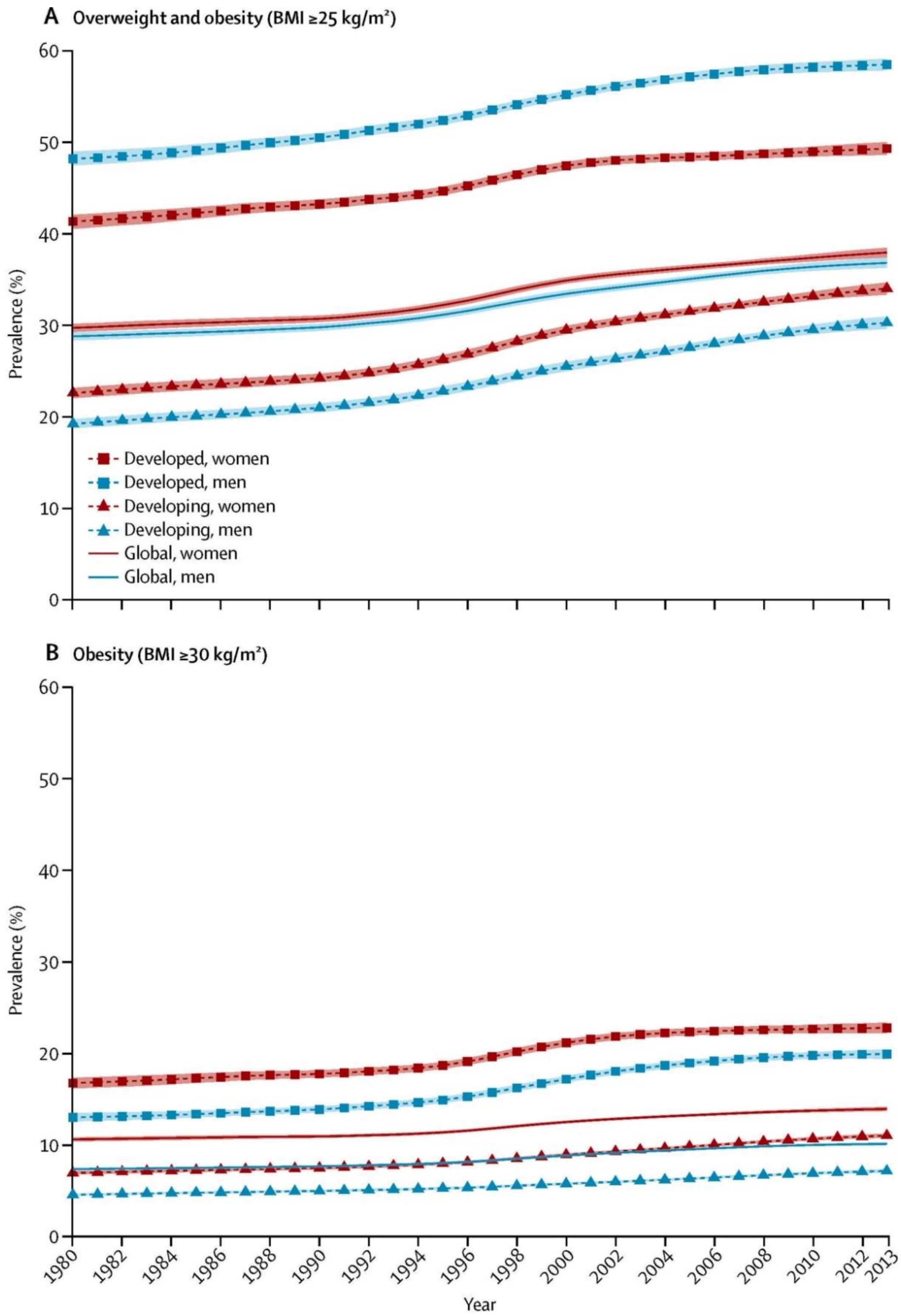

Figure 1. Global Prevalence of Adult Overweight and Obesity. (Ng et al., 2014)

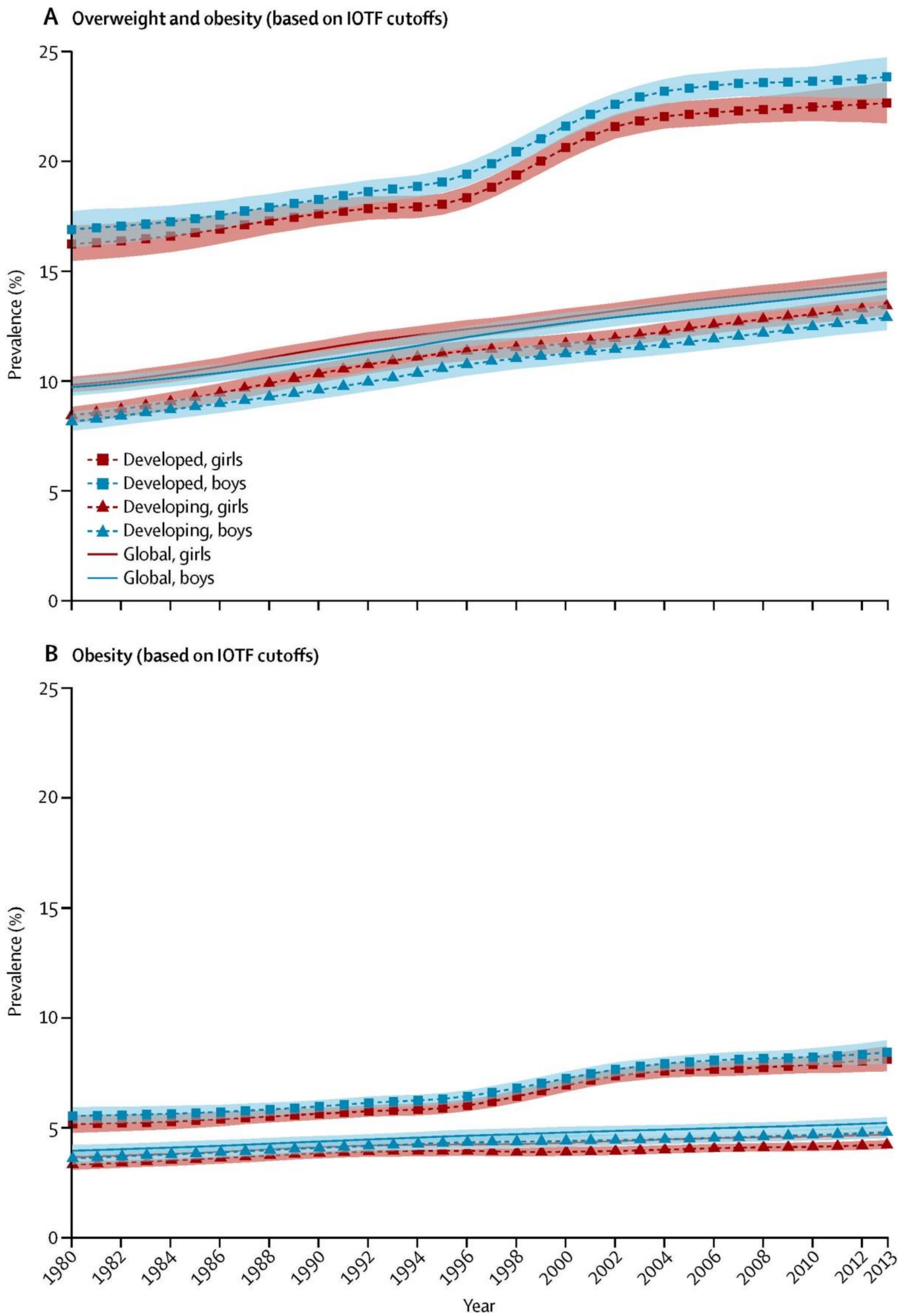

Figure 2. Global Prevalence of Adult Overweight and Obesity. (Ng et al., 2014)

For several decades, overweight and obesity has been on the rise in the United States (US), which seemed to be keeping pace with other developed countries (Ng et al., 2014; Ogden, Carroll, Kit, & Flegal, 2014). The rate of increase has moderated, however, in the US over the last five years, though the proportion of the population remains high with no indication of decline (Ng et al., 2014). International rates of childhood overweight and obesity continue to increase, promoting concern in the medical care community (Ogden et al., 2006; Ogden, Carroll, Curtin, Lamb & Flegal, 2010).

Table 2. U.S. Prevalence of Childhood Overweight and Obesity, NHANES 2011-2012

	Overweight or Obesity BMI-for-age ≥ 85th percentile	Obesity BMI-for-age ≥ 95th percentile
All	31.8%	16.9%
2-5 year olds	22.8%	8.4%
6-11 year olds	34.2%	17.7%
12-19 year olds	34.5%	20.5%
All Females 2-19 years old	31.6%	17.2%
White (non-Hispanic)	29.2%	15.6%
Black (non-Hispanic)	36.1%	20.5%
Hispanic	37.0%	20.6%
All Males 2-19 years old	32.0%	16.7%
White (non-Hispanic)	27.8%	12.6%
Black (non-Hispanic)	34.4%	19.9%
Hispanic	40.7%	24.1%

Source: Ogden, Carroll, Kit, & Flegal, 2014

Childhood Obesity and Health Issues

WHO considers obesity a chronic disease (WHO, 2000). Obesity and its comorbidities lead to approximately four years of disability affected life experienced (Ng et al., 2014). Obesity leads to more than 3.4 million deaths each year (Ng et al., 2014). Years of life lost due to obesity are estimated to be in the range of six to seven years for those with an obese diagnosis by BMI, while those with an overweight status categorization lose about four years from their lifespan (Fontaine et al., 2003). A greater degree of reduced life expectancy occurs when onset of overweight or obesity occurs at a younger age (Finkelstein et al., 2010; Fontaine, Redden, Wang, Westfall, & Allison, 2003).

Individuals who become obese or overweight as children are likely to remain at that status throughout adulthood (Cunningham, Kramer, & Venkat Narayan, 2014). Impacts burden the individual, but also broader society, both culturally and economically. Direct costs (medical) and indirect costs (absenteeism and lower productivity) caused by childhood obesity in the US reach about 15 billion dollars annually (Cawley, 2010). Economic impact amplifies as obese children become adults.

Obesity and Sugar Sweetened Beverages

Research suggests overweight and obesity are associated with intake of soft drinks and sugar-sweetened beverages (SSB). This relationship is shown both in adults and children (Malik, Schulze & Hu, 2006; Vartanian, Schwartz & Brownell, 2007). Consistent SSB intake may lead to increased desire for sweet foods, and energy consumption (Cassady, Considine, & Mattes, 2012). Intake of SSB may increase weight gain, by adding empty calories to the diet. The addition of SSB reduces diet quality by displacing nutrient-rich foods (Ebbeling et al., 2012; Malik, Schulze & Hu, 2006; Vartanian, Schwartz & Brownell, 2007). Reduced SSB intake reduces prevalence of overweight/obesity and related disease (Hu, 2013). Liquid calories in diets of US children have declined (See Figure 3), however, room for improvement remains (Briefel, Wilson, Cabili, & Dodd, 2013; Mesirow & Welch, 2015; LaRowe, Moeller, & Adams, 2007).

Beverage selection appears to impact not only weight, but also other health related develpments. Childhood consumption of SSB leads to continued intake patterns throughout childhood and adolescence (Fiorito et al., 2009; Fiorito et al., 2010). Early initiation predicted continued intake and increased empty calories in the diet. SSB ingestion also predicted the degree of adiposity and increased weight gain in childhood and adolescence (Fiorito et al., 2009; Fiorito et al., 2010). SSB are not appropriate daily beverage choices for children and adolescents.

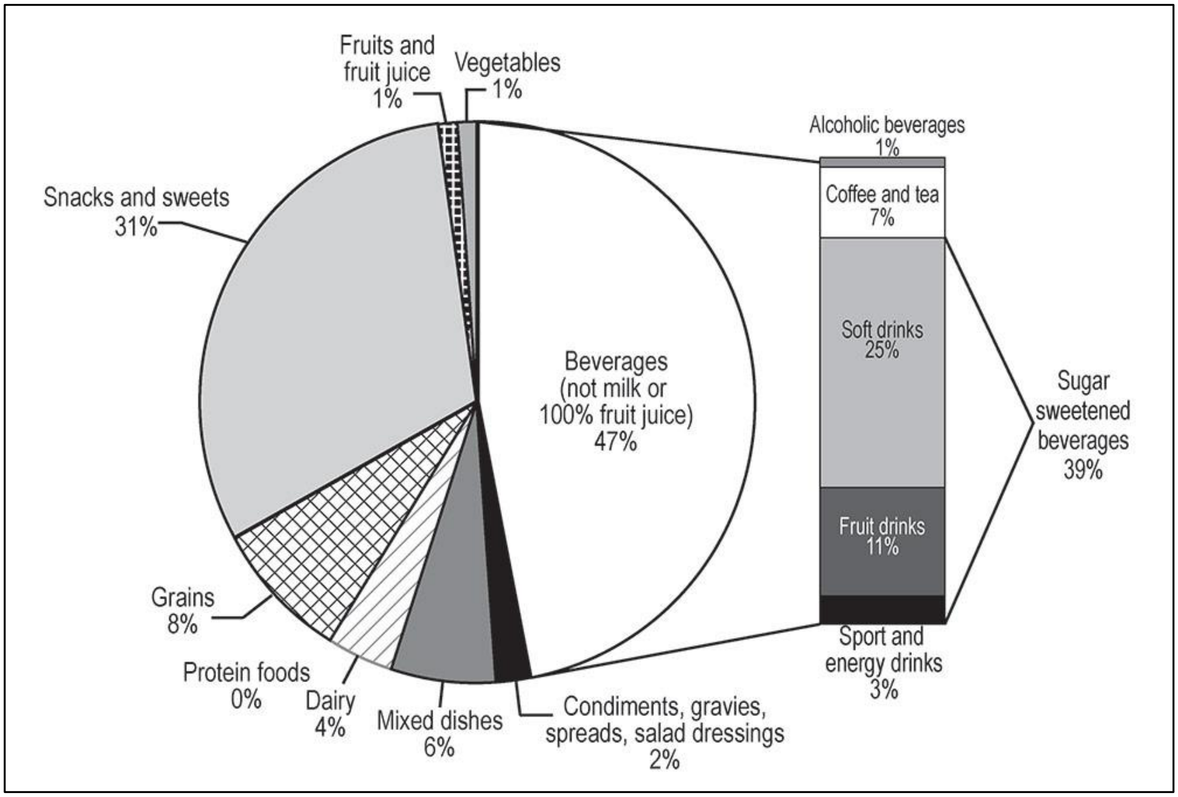

Figure 3. Food Sources of Added Sugar in US Population
(Rhodes, Clemens, Goldman, Lacomb & Moshfegh, 2012).

A recent randomized clinical trial showed that replacing caloric beverages with water or diet drinks produced a modest reduction in weight in adults (Tate, et al., 2012). In children, a simple substitution to remove empty calories may aid in energy balance; however, adequate nutrients are also vital in the diet of a growing child. Replacing SSB with water or non-caloric beverages may not meet the nutrient demands of a growing child; therefore milk, or milk alternatives, may be more suitable for this population.

SSB consumption is linked to development of overweight or obesity (Malik, Schulze & Hu, 2006; Vartanian, Schwartz & Brownell, 2007). Various researchers over the last three decades show consuming sugar/SSB develops addiction-like behaviors (Benton, 2010; Gearhardt, et al., 2012; Palmer, 1977). Overweight or obesity is linked to food addiction behaviors (Fortuna, 2012). Despite differences in SSB dietary behavior by race/ethnicity, minorities consuming more, in connection to overweight or obesity in US school children, it is still vital to reduce the amount of empty calories consumed by US children (Dodd, Briefel, Cabili, Wilson, & Crepinsek, 2013). Although SSB intake of US children has decreased in recent years, consumption levels remain a primary health concern (ODPHP, 2015). Decreased SSB intake may reduce the rates of overweight and related diseases among children (Hu, 2013; Mesirow & Welch, 2015).

Most children spend about 30 to 35 hours per week at school and 1-2 meals are consumed during that time. Researchers have identified schools, and school meals, as vital aspects of consideration for the obesity epidemic puzzle (Finkelstein, Hill, & Whitaker, 2008; Juby & Meyer, 2011; Storey, Nanney, & Schwartz, 2009). Understandings of the social forces, demographic influences, and physiological mechanisms driving the obesity epidemic would aid development of effective school policies needed to turn the tide (Pickering, Alsiö, Hulting & Schiöth, 2009).

The National School Lunch Program (NSLP) originated in the 1940s to nourish our country's school children, during a time of war and poverty, to support learning and development. Approximately 30 million children eat NSLP meals on any given day during the school year (School Nutrition Association, 2013). During academic years, children are at school a majority of the day; it is appropriate to address dietary concerns associated with meals eaten there (Finkelstein, Hill, & Whitaker, 2008; Juby & Meyer, 2011). Time spent at school, combined with the educational functionality and dietary patterns in the environment, can improve dietary habits, reducing obesity risk (Briefel, Crepinsek, Cabili, Wilson, & Gleason, 2009; Poti, Slining & Popkin, 2013).

Lunches brought from home (LBFH) have always been a part of eating at school. There are also positive and negative aspects to bringing lunch from home. Lunches brought from home (LBFH) are consumed by 41% of children (Hubbard, Must, Eliasziw, Folta, & Goldberg, 2014). NSLP meals have been widely studied have been studied by several investigations (Crepinsek, Gordon, McKinney, Condon, & Wilson, 2009; Stang, & Bayerl, 2003; Briggs, Mueller, & Fleischhacker, 2010; Terry-McElrath, O'Malley, Delva, & Johnston, 2009). Food consumed away from home impacts overall dietary quality for children (Mancino, Todd, Guthrie, & Lin, 2010).

Unfortunately there is limited research available regarding food items and nutrient content of LBFH. Rainville (2001) analyzed nutrient content of lunches selected and consumed. The data collection was limited to two school districts in southeast Michigan. Johnson et al. (2009) conducted a study in two north Texas schools and only compared home packed meals to NSLP standards. Johnston and colleagues (2000) investigated food item differences between LBFH and NSLP lunches, but without a nutrient analysis and only in second graders in one large suburban school district. Bergman and fellow researchers (2014) compared individual nutrients in Healthier United States Schools Challenge (HUSSC) schools comparing NSLP school lunches with LBFH.

School Lunch Beverage Components

Fluid milk has been an aspect of school lunch since the origination of NSLP in the early 1940s. The presence of milk grew and became formalized in the 1960s. In the 1970s beverage companies began placing SSB vending machines in schools and marketing their products to schoolchildren. Although milk was still available, it was in direct competition with SSB. Furthermore, competitive foods (non-NSLP food items sold in schools: vending machines/school stores) or a la carte (individually priced food items sold in cafeterias aside from to NSLP meals) became regular options in school lunchrooms, allowing students to purchase alternative meal items (like cookies, chips, soda or candy) (Levine, 2010; Poppendick, 2010).

Beverage selection has a profound impact on nutritional quality of a meal. Mental and physical performance is crucial for students during their school day for attention to lessons, physical education or other extracurricular activities. Beverage selection options are a vital aspect of lunch. Recent research shows that students who have milk or juice with their meals at school have better participation in physical education classes (Chen & Wang, 2013). Nutritionally superior beverage choices, like 1% plain milk or non-fat flavored milk are associated with improved academic performance and testing scores (Edwards, Mauch, & Winkelman, 2011). Intake of one hundred percent orange juice improved overall diet quality, compared to consumption of SSB, while showing no increased risk for overweight and obesity in children (O'Neil, Nicklas, Rampersaud, & Fulgoni, 2011).

Introduction of flavored milk showed an increase in calcium consumption during school lunch as early as Guthrie (1977) and subsequent studies have shown mixed results. Subsequent studies showed similar results, although plain milk is more nutrient dense. Students who drink flavored milk tend to consume more milk overall, but they also consume more added sugars (Murphy, Douglass, Johnson & Spence, 2008). Noel et al. (2013) revealed consistent consumption of flavored milk over time increased body weight in both normal weight and overweight children (Noel, Ness, Northstone, Emmett, & Newby, 2013). Sales of NSLP meals declined 7% when flavored milk was eliminated from menu options (Hanks, Just, & Wansink, 2014, Quann & Adams, 2013). Removing flavored milk may result in fewer students opting for a NSLP meal, which may reduce their overall nutrient intake (Henry et al., 2015).

Proper hydration is necessary to avoid fatigue and other dehydration symptoms which may impair focus, visual memory, and mood, while increasing perception of task difficulty, anxiety, and general fatigue (Armstrong et al., 2012; Ganio et al., 2011). Hydration is an important function of beverages in the diet. Children require 24 to 48 ounces of fluid daily (Campbell, 2004). More than half of children, 54%, do not achieve adequate hydration; and furthermore, 25% of children do not drink any water as part of their fluid intake, often selecting SSB instead (Kenney, Long, Cradock, & Gortmaker, 2015). Students, however, who select milk or juice at lunch show better-quality academic performance and participation in physical education (Chen & Wang, 2013; Rausch, 2013). Children who consumed 100% juice showed improved Meal Quality

(MQ), compared to those who consumed SSB and without increased risk for weight gain (O'Neil, Nicklas, Rampersaud, & Fulgoni, 2011).

Healthy Hunger-Free Kids Act of 2010

The National School Lunch Program has come under heavy scrutiny, steady evaluations, and criticism for many years. A 2010 American Dietetic Association (ADA) position paper on school lunch noted several issues (Bergman, 2010). Fruits and vegetables previously had little distinction or specifications as to types of fruits or vegetable served. A serving of fresh whole fruit was considered equivalent to canned juice. Grains and breads had no specifications or requirements for whole grains. Milk had no specifications, leaving whole milk and sweetened flavored milk equivalent to 1% percent or non-fat plain milk. Caloric guidelines had a minimum level, with no maximum, which allowed for unnecessary addition of sugars and fat calories. Additionally, guidelines for the amount of sodium were constricted (Briggs, Mueller, & Fleischhacker, 2010). In the 2010 position paper cited above, the ADA proposed schools should be nutritionally safe zones for children, which indicated many ways to make this happen; which included: nutrition standard improvements, wellness policies, new product/recipe development, social marketing, fresh fruit/vegetable programs, farm-to-school, integrated nutritional instruction (Bergman, 2010).

NSLP criticism and high rates of childhood overweight and obesity have been driving changes in federal and local school lunch regulations. Healthy Hunger-Free Kids Act (HHFKA) of 2010 was implemented in the 2011-2012 school year and are outlined in Table 2 (Schilling, 2012; S. 3307-111th Congress, 2010). Increases and distinctions were set for fruits and vegetables. Minimums were established for dark green and orange vegetables and maximums set for starchy vegetables. The new HHFKA guidelines limit fruit served as juice to half of the full requirement. A similar standard required one half of the grain items served to be whole-grain-rich foods (defined as 51% or more whole grain). As of the 2014-2015 School year all grains served were required to be whole grain rich, unless granted a hardship exemption by their state through the Consolidated and Further Continuing Appropriations Act of 2015 (public law 113-235). Milk offered must be either fat-free, 1% plain or fat-free flavored milk. NSLP is allowed to substitute appropriate non-dairy milk alternatives when physician documented allergies or other medical conditions warrant. Schools are now required to have water available for students in the lunch room. The regulations set a limit for the upper end of calorie content, sodium, saturated fat and sodium (Schilling, 2012; S. 3307-111th Congress, 2010).

Initial research suggests that the new regulations have positive effects on nutritious meal component selection and consumption (Bergman et al. 2014, Cohen et al., 2014). This area of research has been primarily targeted on foods, rather than beverages. Therefore further examination of beverage selection and consumption, and the effect on meal quality is necessary. Schools are only allowed to offer water, plain 1% milk, flavored nonfat milk, and 100% juice to students. No regulations apply to LBFH.

Table 3. NSLP Meal Components[a] Before and After HHFKA 2010 Implementation.

Food Groups	Pre-HHFKA Requirements K-12	2012-2013 Requirements K-12
Milk	1 cup; variety of fat contents allowed; flavor not restricted	1 cup; must be fat free (unflavored/flavored) or 1% low fat(unflavored)
Fruits and Vegetables	No specifications as to type of vegetable subgroup	Weekly requirement: (1) dark green; (2) red/orange; (3) legumes; (4) starchy; (5) other (as defined in 2010 Dietary Guidelines)
Whole grains	No requirement	At least half of the grains must be whole grain rich. Beginning July 1, 2014, all grains must be whole grain rich (51% or more), unless granted a hardship exemption by their state through Consolidated and Further Continuing Appropriations Act of 2015 (public law 113-235).
Nutrient Standards		
Calories	Minimum only (based on grade)	Minimum and maximum (based on grade)
Sodium	No requirement	Limits (based on grade), with the target levels decreasing over the next 10 years
Saturated fats	<10% of total calories	<10% of total calories
Trans fats	No requirement	0 g per serving[c]

[a]Adapted from “Comparison of Previous and Current Regulatory Requirements under Final Rule “Nutrition Standards in the National School Lunch and School Breakfast Programs”

[b]Although students must be offered 0.75 to1 cup of vegetables and 0.5 to1 cup of fruits per day (versus previous requirements that allowed students to be offered a combined total of 0.5 to 0.75 cup fruit and vegetables), students are allowed to select only 0.5 cup of fruits or vegetables (previous requirements allowed students to select only 0.125 cup of fruits or vegetables)

[c]Products with less than 0.5 grams per serving count as 0. (Schilling, 2012; S. 3307-111th Congress, 2010).

HHFKA was implemented during the 2012-2013 school year. It conforms school meals to Dietary Guidelines (USDA, 2011). It utilizes a standardized food-based menu planning system. Food-based menu requirements coincide with Healthy Eating Index 2010 - a dietary quality scoring system an assessment tool for Meal Quality (MQ) in schools (Erinosho, Ball, Hanson, Vaughn, & Ward, 2013

Digital Plate Waste

The advent of digital imaging provides for more efficient data gathering of plate waste. Digital images allow for analysis after the data collection. Digital Plate Waste (DPW) is valid and reliable, comparable to the previous real-time method of plate waste estimation (Parent et al., 2012). Weights on all meal items are not required, since NSLP meal components are the standard portion sizes (Williamson et al., 2003). For the purpose of this study, weights were taken in grams for mixed food items brought from home like casseroles or cut fruit, for reference later in data processing. Its usefulness is especially apparent in school settings where food is standard portions, and the plating conforms to standard serving sizes (Adams, Pelletier, Zive, & Sallis 2005; Cohen et al., 2013).

Nutrition Data Software for Research

Nutrition Data Software for Research (NDSR) is a comprehensive, food and nutrient database software program, developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, and was utilized to obtain nutritional data for each food item present in the meals (Schakel, Buzzard, & Gebhardt, 2001). NDSR is designed to produce files formatted for research analysis. A vital quality of NDSR is the ability to convert each food item in plate waste data to standard food groups, or meal components, utilized by USDA and NSLP in their Guidelines for Healthy Eating and HHFKA regulations. For the purpose of this study, NDSR was used to break any given item, based on ingredients, into the particular serving equivalents of each meal component food group it provides.

NDSR was utilized for nutritional data on each food item, including: food group serving equivalents for each food item and comprehensive nutrient analysis for each item. Output was used for calculation of food component and total HEI-2010 scores. Standard food group serving equivalents are defined as the portion of each food which makes a serving [example: 4 ounces of fresh tomato (one whole vegetable serving) = 2 tablespoons of tomato paste (one whole vegetable serving) = ½ cup tomato sauce (one whole vegetable serving)] (USDA, 2011). Serving equivalents are utilized by the USDA in the Guidelines for Healthy Eating, NSLP and HHFKA regulations. It was vital to have a software system to calculate the partial servings of food group components present in the large variety of foods in the research data, especially LBFH and foods as consumed.

Healthy Eating Index - 2010

Healthy Eating Index 2010 is a meal quality scoring system that corresponds to the dietary guidelines as put forth by the U.S. Department of Agriculture Center for Nutrition Policy and Promotion (USDA, 2011). Prior to HEI-2010, HEI-2005 was scored in studies utilizing data from NDSR (Miller et al., 2010). Higher HEI-2010 scores are associated with more nutrient dense meal diet quality, and tend to predict better health (Xu B, et al., 2012). HEI-2010 evaluates empty calories that come from either added sugar or saturated fat. Empty calories decrease overall diet quality. This is reflected in HEI-2010 scoring. Table 3 displays the HEI-2010 components and scoring standards.

Table 4. HEI–2010 Components and Scoring Standards

Max Score 100	Score	Standard for maximum score	Standard for score of 0
HEI-2010[1]			
Adequacy:			
Total Fruit[2]	5	≥0.8 cup equiv. : 1,000 kcal[10]	No Fruit
Whole Fruit[3]	5	≥0.4 cup equiv. : 1,000 kcal[10]	No Whole Fruit
Total Vegetables[4]	5	≥1.1 cup equiv. : 1,000 kcal[10]	No Vegetables
Greens and Beans[4]	5	≥ 0.2 cup equiv. : 1,000 kcal[10]	No dk greens or legumes
Whole Grains	10	≥1.5 oz equiv. : 1,000 kcal [10]	No Whole Grains
Dairy[5]	10	≥1.3 cup equiv. : 1,000 kcal[10]	No Dairy
Total Protein Foods[6]	5	≥2.5 oz equiv. : 1,000 kcal[10]	No Protein Foods
Seafood and Plant Proteins[6,7]	5	≥0.8 oz equiv. : 1,000 kcal [10]	No Seafood or Plant Proteins
Fatty Acids[8]	10	(pufas + mufas) [11] / sfas > 2.5[12]	(pufas+mufas)/sfas<1.2
Moderation:			
Refined Grains	10	≤1.8 oz equiv. : 1,000 kcal [10]	≥4.3 oz equiv : 1,000kcal
Sodium	10	≤1.1 gram : 1,000 kcal [10]	≥2.0 grams : 1,000 kcal
Empty Calories[9]	20	≤19% of energy [10]	≥50% of energy

[1]Intakes between the minimum and maximum standards are scored proportionately.
[2]Includes fruit juice.
[3]Includes all forms except juice.
[4]Includes any beans and peas (called legumes in HEI-2005) not counted as Total Protein Foods (called Meat and Beans in HEI-2005).
[5]Includes all milk products, such as fluid milk, yogurt, and cheese, and fortified soy beverages.
[6]Beans and peas are included here (and not with vegetables) when the Total Protein Foods (called Meat and Beans in HEI-2005) standard is otherwise not met.
[7]Includes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted as Total Protein Foods.
[8]Ratio of poly- and monounsaturated fatty acids to saturated fatty acids.
[9]Calories from solid fats, alcohol, and added sugars; threshold for counting alcohol is >13 grams/1000 kcal.
[10]Intakes between the minimum and maximum standards are scored proportionately, except for Saturated Fat and Sodium (see note 12).
[11]Includes non-hydrogenated vegetable oils and oils in fish, nuts, and seeds.
[12]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. Intakes between standards for scores of 0-8 and between 8-10 are scored proportionately.

For the current study, HEI-2010 scoring was utilized to evaluate food components by USDA Dietary Guidelines. The Adequacy Food Components are scored with points accumulated with increased intake (shown with maximum point distribution): Total Fruit (5pts), Whole Fruit (5pts), Total Vegetables (5pts), Greens and Beans (5pts), Whole Grains (10pts), Dairy (10pts), Total Protein Foods (5pts), Seafood and Plant Proteins (5pts), and Fatty Acids (10pts). Moderation Food Components are scored with points accumulating with decreased intake (shown with maximum point distribution): Refined Grains (10pts), Sodium (10pts), Empty Calories, from solid fats, or added sugars (20pts). Maximum or fractions of point values are given based on a ratio of the guideline amount per 1000 in the diet (Guenther et al., 2013).

The current update of the Healthy Eating Index: HEI-2010 is valid and reliable for use in scoring diet quality based on the 2010 Dietary Guidelines for Americans (Guenther et al., 2013 & 2014). HEI-2010 is in agreement with the position of the Academy of Nutrition and Dietetics, which recommends a Total Diet Approach to healthy eating (Freeland-Graves & Nitzke, 2013). Average scores for US adults are 50-53/100 points (Guenther et al., 2014) Average scores for US children are 47-50/100 (Hiza, Guenther, & Rihane, 2013). Higher scores indicate lower disease risks and are associated with lower BMIs (Schwingshackl & Hoffmann, 2015). Higher scores also predict better physical performance (Xu et al., 2012).

It is also valid to use HEI when working with individual meals. Young, Ptomey, Craven, Swanson and Gibson (2014) inquired into comparisons of farm-to-school NSLP meals and standard NSLP meals using farm-to school sourcing; NDSR was utilized for nutritional and food group data to determine the meals' HEI score. The findings showed that farm-to-school NSLP meals resulted in higher HEI-2010 meal quality scores than typical NSLP meals in the same schools (Young et al., 2014). Another study examined only lunch meals served in 20 childcare centers ; resulting in an HEI-2005 mean 59.12 and indicate a need to improve meal quality. This article established that lunch meals scores correlated to overall diet scores; NDSR was used to determine food group servings and other nutritional data required for calculating HEI scores (Erinosho et al., 2013).

Guenther et al (2014) took four exemplary eating plans: 2010 USDA Food Patterns, DASH Eating Plan, Harvard Healthy Eating Pyramid, and AHA No-Fad Diet, then evaluated their menus for HEI; menus scored 93-99/100. These diets set the standard for HEI-2010. The researchers also took dietary recalls from NHANES, mean scores for these dietary recalls for men were 49.8, and women 52.7, and other group means also followed as predicted from established literature (Guenther et al., 2014). HEI is valid for assessing overall diet quality in any defined food set, and single meals because HEI scoring utilizes a ratio based on 1000 calories and so is independent of individuals' caloric needs. HEI-2010 is a reliable indicator of overall diet quality.

Policy Shaped by Data

Understanding of differences in meal component selection versus meal component consumption may make it possible to develop school lunch policies that support healthier choices. This is particularly important because some schools are developing independent policies beyond the requirements of the USDA and the NSLP. Removing flavored milk may result in fewer students opting for a NSLP meal, which may reduce their overall nutrient intake. Furthermore, 25% of plain milk is then thrown away and wasted (Henry et al., 2015). Some schools have banned lunches brought from home entirely; one Chicago school does not allow elementary students to pack lunch meals or snacks from home to encourage healthful eating (Eng & Hood, 2011). Recent research shows LBFH are less nutritious than those provided at school by the NSLP (Bergman et al., 2013). A decade earlier, researchers in Michigan showed LBFH offered a lower nutritional value than meals provided by NSLP (Rainville, 2001). Because much of a child's diet may be consumed at school, it is clear that these meals affect children's overall diet quality (Mancino, Todd, Guthri, & Lin, 2010).

Cafeteria environment factors can influence beverage selection. Shared experience, modeling by adults, educational posters, product packaging, cafeteria rules, and dining area design all influence beverage selection and consumption (Just & Wansink, 2009; Reicks et al., 2012). Cafeterias are uniquely positioned to offer both a sensory experience and nutritional education. Schools can be effective in obesity prevention by creating environments and policies promoting healthy eating and physical activity (Cawley, 2010; Connors, Bednar & Klammer, 2001; Story, Nanney & Schwartz, 2009).

Daily Applications in the Lunchroom

It is possible to shape policies based on existing behavioral and policy research pertaining to beverage options at school to motivate healthier selection. Motivational approaches vary and range from the cafeteria, to the classroom, to the schoolyard garden, to community nutrition education programs addressing the nutritional and health concerns of the broader community and family. These factors may positively influence meal component selection in the lunchroom.

Research has shown many viable lunchroom intervention options for motivating students to select healthier options when available. Ease of purchasing healthful beverages promotes healthier selections. Providing a “milk only” line for children with LBFH; and allowing children more than one nutritionally dense beverage are ideas to consider (Richie et al., 2015). Providing reliable cold storage for LBFH may also improve meal quality and beverage selection. Concern about spoilage from lack of a temperature control may cause parents to send whole fruits, rather than cut; or SSB, which are shelf stable, rather than milks (Almansour et al., 2011; Hudson, & Walley, 2009). Placing sliced fruits and vegetables as impulse-buy items at the beginning of lunch lines may increase selection of these items (Just & Wansink, 2009).   Increasing portion size of fruits and vegetables by an eighth cup may improve consumption without reducing intake of other meal components (Miller, 2013). Displaying pictures of fruits and vegetables as well as nutrient-dense beverages on sample NSLP cafeteria trays improves healthful meal choices time spent in line becomes educational (Reicks et al., 2012).

Efficiency of the design of food service stations and student lines can impact foods choices and amounts consumed. Lunch lines can be valuable marketing time to motivate healthful meal component choices (Johnson et al, 2009; Story et al, 2009). Additionally, a longer lunch period is associated with less plate waste and better consumption of more nutritious meal components. Limited time to eat creates issues associated with mechanics of eating and social aspects of shared meals (Bergman, 2010). Healthy foods, specifically raw fruits and vegetables, contain fiber. Fiber requires more chewing than processed foods; necessitating more time spent on each bite of food. Balancing time allotment adequacy for students' healthful food intake and socialization, improves food component selection and consumption (Bergman et al., 2004; Rainville, Wolf & Carr, 2006). Design of efficient lunchrooms lines, and increasing the duration of the lunch period, would allow children more time for exemplary meal consumption behaviors. A relaxed and sociable meal has a beneficial effect on both nutritious selections, but also intake (Bergman, 2003; Bergman, 2010; Johnson et al., 2009; Poppendick, 2010; Story et al., 2009).

Daily Applications in the Classroom

Nutrition education in public elementary school classrooms, grades K-5, improves selection and consumption of healthful meal components, as this increases familiarity with healthful selections (Celebuski, & Farris, 2000). Pittman et al., (2011) taught children about healthier meal selections in the classroom and added labels next to lunchroom trayline; when healthful items were selected, the child was allowed to announce it to their peers by ringing a bell. Children increased selections of healthier meal components and decreased plate waste resulted (Pittman et al., 2011). The novelty of ringing a bell is may be insufficient incentive to promote healthful choices long term, but the combination of classroom instruction and lunchroom intervention shows repeated successes (O'Neil, Nicklas, Rampersaud & Fulgoni, 2011; Wechsler, Basch, Zybert & Shea, 1998).

A combination of classroom instruction and minimal intervention in the lunchroom was useful in promoting healthful food choice. Initial classroom instruction introduced healthy foods. Then pictures of children showing healthier plated meals were placed in the lunch room. The images significantly increased the selection of the healthful meal options and reduced plate waste (Reicks et al., 2012). Another study was designed to promote the selection of low-fat plain milk in elementary school cafeterias of an inner-city Latino community. Through education and support, researchers were able to successfully promote selection of low-fat milk rather than the culturally familiar whole milk preference (Wechsler, Basch, Zybert, & Shea, 1998). Further evaluation of the intervention showed that it was successful in promoting selection of more nutrient rich meals. Additionally, the results showed a reduced risk of overweight status (O'Neil, Nicklas, Rampersaud, Fulgoni, 2011). Furthermore, exposure to milk or water at preschool lunch for three months influenced children's beverage choice once they were in elementary school (Koivisto, Edlund, & Sjödén, 1994).

Applications in the Broader School Environment

School gardens can provide students and teachers with hands-on nutrition education. Growing foods used in school lunch connects children with what is served in the lunchroom. Children who participate in school garden programs have improved nutritional quality in school lunch meals. In these school settings students perform better academically, with fewer absences due to illness, potentially due to improved nutritional status (Stone & Barlow, 2012). Small vegetable gardening lessons improved attitudes toward vegetables (Lineberger & Zajicek, 2000). Students in school garden projects have increased fruit and vegetable intake, at home and school; resulting in increased Vitamin A, Vitamin C and fiber intake (McAleese & Rankin, 2007). Additionally, farm-to-school programs allow for menu planning with the freshest produce options available. This may increase nutritional quality of the meal by eliminating nutrient losses from processing, storage and transportation (Rickman, Barrett, & Bruhn, 2007). Farm-to-school sourced NSLP meals have a higher MQ as scored by HEI (Young, Ptomey, Craven, Swanson, & Gibson, 2014). Farmers benefit by selling fresh produce to local schools and students benefit from more fresh produce in school meals (Allen & Guthman, 2006).

In 2001, fifteen New York State school districts utilized a multifaceted approach to resolving the multifaceted issues present in school lunch. The program was funded by the *Steps to a Healthier New York* program and was designed to "help public schools control costs and provide quality programs by sharing services." The program design included a "Power Up with Breakfast" component, nutritional standard improvements for both traditional lunch and a la carte options, news spots, television and radio advertisements and classroom instruction. The program included multiple advertising catch phrases, such as "Choose Sensibly," "Give Me Five," and "Step it Up! For Health and Wellness," which carried fun and trendy motivational wording with healthful undertones and were easy to remember and recognize (Johnson et al., 2009). This multifaceted approach appeared to motivate improved food choices and higher activity levels (Johnson et al., 2009). This approach was found to be so useful and beneficial that the entire state of New York adopted it (Johnson et al., 2009; Stone & Barlow, 2012).

The Academy of Nutrition and Dietetics, additionally, takes the position that it is not only the responsibility of schools to provide influence upon children's food conceptions, along with high-quality nutritious food, but that the broader community has a share in the responsibility for accomplishing both of these mandates. These approaches should include not just higher nutritional standards, but also new product development, farm-to-school programs, fresh fruit and vegetable programs, wellness policies, integration of nutritional instruction both at school and at home, limiting of competitive al a carte foods and vending machine options, disclosure of nutritional content, and marketing of child nutritional programs through media among other things (Bergman & Gordon, 2010). "In living rooms and lunch rooms, in meeting halls and school kitchens, there's a quiet revolution going on. Parents are banding together to make sure kids eat healthy at school," says Dr. Marion Nestle, PhD., a professor of Nutrition Food Studies and Public Health at New York University and author of the books *Food Politics* and *What to Eat* (Poppendick, 2010). Although low income students are particularly susceptible to malnutrition and weight issues, policymakers can make a difference in mediating the risks of obesity for children (Juby & Meyer, 2011).

Hope of Health

Research shows that school food environments, practices and policies do change dietary behaviors of US public school children (Briefel et al., 2009). A 2010 position paper of the Academy of Nutrition and Dietetics stated that school lunches should be the standard for healthful eating, and that all meal components, should be available to all students (Bergman, 2010). High childhood obesity rates in North America, and increasing rates worldwide, concern health professionals. Early obesity indicates vulnerability to lifelong health repercussions. Selection and consumption of meal components obscure clear origins of obesity's contributing factors. Most children spend many hours at school expecting to learn various facts, skills, and behaviors to serve them healthfully as they mature. Beverages, a standard meal component, vary considerably in caloric and nutritional meal contributions, potentially impacting health. Incomplete understanding of beverages' effects on overall meal quality limits the implementation of obesity countermeasure policy.

Improvement in nutrition at school is a multifaceted issue. Necessitating a coordinated community effort and a multifaceted approach: nutrition standard improvements, wellness policies, new product/recipe development, social marketing, fresh fruit/vegetable programs, farm-to-school, integrated nutritional instruction in the classroom, the home and the community. Results from undertaking these efforts would be better food choices and higher activity levels (Bergman, 2010; Johnson et al, 2009b)

The purpose of this study was to: 1) analyze beverage selections of elementary students consuming NSLP and LBFH, 2) compare overall MQ of NSLP and LBFH by food components using HEI-2010, and 3) investigate the impact of beverage selections on MQ.

CHAPTER II

JOURNAL ARTICLE

BEVERAGE SELECTIONS AND PRESENCE AFFECT HEALTHY EATING INDEX SCORES IN LUNCHES OF ELEMENTARY AGE CHILDREN, WHETHER FROM HOME OR SCHOOL

Introduction

Though the rate of growth for obesity is slowing for the adult population of the United States (US) in the past six years, the current proportion remains high at 32% (Ogden, Carroll, Kit, & Flegal, 2012). Overweight children tend to remain so as adults, facing reduced quality of life, underachievement in school, and shortened lifespan related to increased risk for various diseases (Cunningham, Kramer, & Venkat Narayan, 2014).

Healthy Hunger-free Kids Act of 2010 (HHFKA), was implemented during the 2012-2013 school year. HHFKA regulations help to conform school meals with the Dietary Guidelines for Americans (USDA, 2011). A primary change provided by HHFKA is a standardized universal food-based menu planning system. HHFKA's food-based menu requirements coincide with Healthy Eating Index 2010 (HEI-2010), a dietary quality scoring system, which has been validated as an assessment tool for Meal Quality (MQ) in schools (Erinosho, Ball, Hanson, Vaughn, & Ward, 2013).

HEI-2010 produces scores ranging from 0 to 100, with higher scores indicating closer alignment with the Dietary Guidelines for Americans 2010; average HEI-2010 scores for US adults are 50-53 points (Guenther et al., 2014), while average HEI-2010 scores for US children are 47-50 points (Hiza, Guenther, & Rihane, 2013). Higher HEI-2010 scores indicate lower disease risks (Schwingshackl & Hoffmann, 2015), are associated with lower Body Mass Index (Schwingshackl & Hoffmann, 2015), and more nutrient-dense diets. Higher scores also predict better physical performance (Xu et al., 2012). HEI-2010 is more useful in determining dietary quality than individual nutrient analysis because it eliminates the infuence of outliers which may skew data and it closely aligns with current food component based dietary recommendations. As a ratio based on 1000 calories, it also accounts for variation in caloric intake needs.

Sugar-Sweetened Beverage (SSB) (drinks with added sugar) consumption is associated with weight gain in adults and children (Malik, Schulze & Hu, 2006; Vartanian, Schwartz & Brownell, 2007). Although SSB intake of US children has decreased in recent years, consumption levels remain a primary health concern (ODPHP, 2015). Decreased SSB intake may reduce the rates of overweight and related diseases among children (Hu, 2013; Mesirow & Welch, 2015).

Proper hydration is necessary to avoid fatigue and other dehydration symptoms which may impair focus, visual memory, and mood, while increasing perception of task difficulty, anxiety, and general fatigue (Armstrong et al., 2012; Ganio et al., 2011). Hydration is an important function of beverages in the diet. Children require 24 to 48 ounces of fluid daily (Campbell, 2004). More than half of children, 54%, do not achieve adequate hydration; and furthermore, 25% of children do not drink any water as part of their fluid intake (Kenney, Long, Cradock, & Gortmaker, 2015). Students who select milk or juice at lunch show better-quality academic performance and participation in physical education (Chen & Wang, 2013; Rausch, 2013). Children who consumed 100% juice showed improved Meal Quality (MQ), compared to those who consumed SSB and without increased risk for weight gain (O'Neil, Nicklas, Rampersaud, & Fulgoni, 2011).

The use of flavored milk in school lunch has been widely debated. Early research indicated that introduction of flavored milk in the NSLP increased calcium consumption (Guthrie, 1977). Subsequent studies showed similar results, although plain milk is more nutrient dense. Students who drink flavored milk tend to consume more milk overall, but they also consume more added sugars (Murphy, Douglass, Johnson & Spence, 2008). Noel et al., (2013) revealed consistent consumption of flavored milk over time increased body weight in both normal weight and overweight children (Noel, Ness, Northstone, Emmett, & Newby, 2013). Sales of NSLP meals declined 7% when flavored milk was eliminated from menu options (Hanks, Just, & Wansink, 2014; Quann & Adams, 2013). Removing flavored milk may result in fewer students opting for a NSLP meal which may reduce their overall nutrient intake. Furthermore, 25% of plain milk is then thrown away and wasted (Henry et al., 2015).

Food consumed away from home impacts overall dietary quality for children (Mancino, Todd, Guthrie, & Lin, 2010). Approximately 30 million children eat NSLP meals daily (SNA, 2013, USDA, 2014a). During the academic year, children are at school a majority of their day; therefore it is appropriate to address dietary concerns associated with meals consumed at school (Juby & Meyer, 2011). Lunches brought from home (LBFH) are consumed by 41% of children (Hubbard, Must, Eliasziw, Folta, & Goldberg, 2014). Minimal research has been undertaken examining LBFH for individual food items (Hubbard, et al., 2014), nutrient content (Johnson, Bednar, Kwon, & Gustof, 2009), and food component groups (Johnston, Moreno, El-Mubasher, & Woehler, 2012). The current study sought to expand underdanding of LBFH MQ using standard USDA healthy eating guidelines, parallel to requirements of NSLP.

The purpose of this study was to: 1) analyze beverage selections of elementary students consuming NSLP and LBFH, 2) compare overall MQ of NSLP and LBFH by food components using HEI-2010, and 3) investigate the impact of beverage selections on MQ.

Methodology

The current study is a secondary analysis of digital plate waste data gathered during the 2011-2012 academic year, that examined individual nutrient differences between NSLP and LBFH. Digital plate waste is valid, reliable, and comparable to the previous real-time method of plate waste estimation (Parent, Niezgoda, Keller, Chambers & Daly, 2012; Williamson et al., 2003). Four elementary schools participated in this study. Data was gathered from 834 students in 2nd-5th grades; 509 NSLP meals and 524 LBFH meals, 1,033 meals total. Additional demographic data was collected to control for sex, age, and socio-economic status. No demographic criteria confounded results in the investigation; further methods are available from a previous publication (Bergman et al., 2014a).

Dietary intake data were collected and analyzed using Nutrition Data System for Research (NDSR) 2014, developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, and was utilized to obtain nutritional data for each food item present in the meals (Schakel, Buzzard, & Gebhardt, 2001). NDSR calculated Food Group/Component breakdowns for each food item in serving equivalents and a comprehensive nutrient analysis for each item. Output data from NDSR was used to calculate each food component and total HEI-2010 scores to analyze overall meal quality. A vital quality of NDSR is the ability to convert each food item to standard food groups/components utilized by USDA in the Guidelines for Healthy Eating, NSLP and HHFKA regulations.

For the current study, HEI-2010 scoring was utilized to evaluate food components by USDA Dietary Guidelines. The Adequacy Food Components are scored with points accumulated with increased intake (shown with maximum point distribution): Total Fruit (5pts), Whole Fruit (5pts), Total Vegetables (5pts), Greens and Beans (5pts), Whole Grains (10pts), Dairy (10pts), Total Protein Foods (5pts), Seafood and Plant Proteins (5pts), and Fatty Acids (10pts). Moderation Food Components are scored with points accumulating with decreased intake (shown with maximum point distribution): Refined Grains (10pts), Sodium (10pts), Empty Calories, from solid fats, or added sugars (20pts).

Maximum or fractions of point values are given based on a ratio of the guideline amount per 1000 in the diet (Guenther, et al., 2013).

Statistical analysis was completed with IBM's SPSS 21.0, with significance level set to $\alpha = 0.05$ (IBM Corp, 2013). Multiple Analysis of Variance (MANOVA) with post hoc t-tests, determined significant differences in mean food component scores and mean total HEI-2010 scores between NSLP meals and LBFH, both as served (selected) and as consumed (eaten). Cohen's *d* calculations of effect size were performed for each significantly different pair, along with the percent of the possible score.

Investigations within each meal origin (NSLP and LBFH) were made to determine the beverage selection distribution in each group. Two One-Way Analysis of Variance (ANOVA) tests were run, one for each meal origin. Two sets of post hoc Tukey's pairwise comparisons, one for each meal origin respectively, determined differences in HEI-2010 mean food component scores and mean HEI-2010 scores by beverage selections.

Results and Discussion

NSLP meals (n=509) had six beverage selection options: Water/None (9%), 100% Fruit Juice (1%), Non-fat Flavored Milk (64%), Non-fat Flavored Milk plus 100% Fruit Juice (2%), 1% Plain Milk (23%), and 1% Plain Milk Plus 100% Fruit Juice(1%). Some NSLP students selected two beverages for their meal. The beverages in LBFH (n=524) fell into five categories: Water/None (45%), SSB (30%), 100% Fruit Juice (12%), Non-fat Flavored Milk (10%), and 1% Plain Milk (3%). LBFH with no beverage as part of the meal occurred at a rate of 45%. It is notable that no NSLP meals included SSBs. Selection of milks accounted for 90% of NSLP, but only 13% of LBFH. Results are displayed in Figure 1.

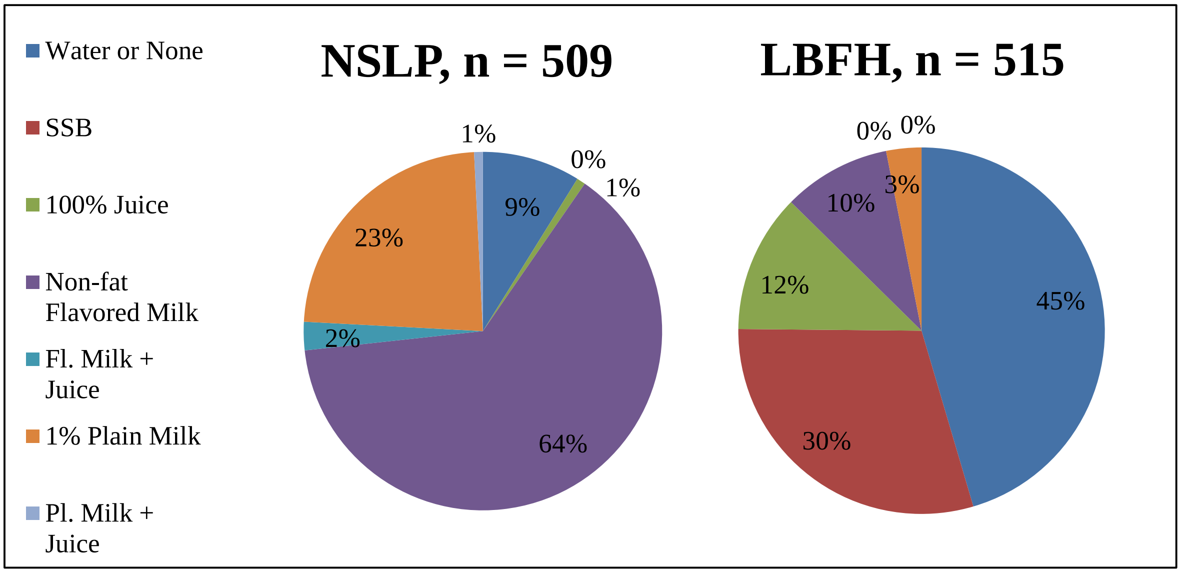

Figure 1. Beverage Selections by Meal Origin: National School Lunch Program (NSLP) and Lunches Brought From Home (LBFH).

NSLP Meal Components and HEI-2010 score comparisons by beverage selection showed many differences, displayed in Table 1. HEI-2010 scores, 100 points possible, for meals containing Water/None (45.6 served, 44.6 consumed) were significantly lower compared to other solo beverage options. The highest solo score came from meals containing 1% Plain Milk (55.7 served, 53.9 consumed). Non-fat Flavored Milk (51.2 served, 48.7 consumed) was significantly higher than Water/None, and significantly lower than 1% Plain Milk. One hundred percent Juice (57.9 served, 54.3 consumed) was not significantly different from any of the other beverage choices, either solo or paired with another beverage.

HEI-2010 scores in NSLP meals of students who chose two beverages, either: 1% Plain Milk plus 100% Juice (65.1 served, 61.6 consumed) or Non-fat Flavored Milk plus 100% Juice (61.6 served, 55.1consumed) were significantly higher than Water/None, or Non-fat Flavored Milk alone, but were not significantly different from 100% Juice alone or 1% Plain Milk alone. See Table 1. A selection of multiple nutrient-rich beverages has the potential to improve HEI-2010 scores. Improvement is lost, however, when 100% Juice is paired with Non-fat Flavored Milk, due to empty calories from added sugar which reduces the HEI-2010 score. In Non-fat Flavored Milks, added sugars increase empty calories (total solid fat and added sugars) to 40% of total calories. It is recommended to limit empty calories to ≤ 258 calories/2000 calorie diet. Nonfat Flavored milks have more than double the empty calories present in 1% Plain Milk (USDA, 2015):

Non-fat Chocolate Milk, per 8 oz: Total Calories 140, Empty Calories 56 (Solid Fats Calories 4 plus Added Sugars Calories 52, Protein 9g, Carbohydrate 27g, Dietary Fiber 1g, Total Sugars 25g, Added Sugars 13g, Total Fat 1g, Saturated Fat 0.5g, Polyunsaturated Fat 0g, Monounsaturated Fat 0.5g.

1% Plain Milk, per 8 oz: Total Calories 102, Empty Calories 18 (Solid Fats Calories 18 plus Added Sugars Calories 0), Protein 8g, Carbohydrate 12g, Dietary Fiber 0g, Total Sugars 13g, Added Sugars 0g, Total Fat 2.5g, Saturated Fat 1.5g, Polyunsaturated Fat 0.5g, Monounsaturated Fat 0.5g

Table 1.HEI SCORE Means with Standard Deviation

Beverages by Component	Water/ None, n=45	Juice, n=4	Fl. Milk, n=324	Fl. Milk & Juice, n=13	Pl. Milk, n=119	Pl. Milk & Juice, n=4
NSLP--- AS SERVED ---						
Tot. Fruit (5)	3.0 ± 2.3^{abc}	4.7 ± 0.6^{de}	2.6 ± 2.3^{adef}	5.0 ± 0.2^{bfg}	2.1 ± 2.2^{cg}	3.8 ± 2.5
Wh. Fruit (5)	3.2 ± 2.4^{a}	5.0 ± 0.0^{bc}	2.4 ± 2.5^{abcd}	4.6 ± 1.4^{de}	2.5 ± 2.5^{e}	3.8 ± 2.5
Total Veg. (5)	1.9 ± 2.0^{a}	0.0 ± 0.0^{abc}	2.1 ± 1.9^{bdef}	0.0 ± 0.0^{dg}	2.5 ± 2.0^{cegh}	0.0 ± 0.0^{fh}
Greens/Beans Veg. (5)	0.2 ± 1.0	0.0 ± 0.0	0.5 ± 1.5	0.0 ± 0.0	0.6 ± 1.6	0.0 ± 0.0
Whole Grain (10)	2.2 ± 3.8^{abc}	8.0 ± 2.3^{ade}	2.6 ± 4.3^{df}	5.4 ± 0.5^{bf}	3.0 ± 4.5^{e}	6.8 ± 2.2^{c}
Dairy (10)	3.9 ± 4.4^{abcde}	0.0 ± 0.0^{afghi}	9.9 ± 0.4^{bf}	9.6 ± 0.5^{cg}	10.0 ± 0.2^{dh}	9.9 ± 0.1^{ei}
Total Protein (5)	3.6 ± 1.9	3.4 ± 2.4	3.6 ± 1.9	4.5 ± 1.4	3.8 ± 1.7	3.7 ± 2.5
Seafood/Plant Protein (5)	1.0 ± 1.9^{ab}	0.0 ± 0.0	0.4 ± 1.2^{a}	0.0 ± 0.0^{b}	0.6 ± 1.4	0.0 ± 0.0
Fat Ratio (10)	4.1 ± 4.0^{ab}	9.2 ± 0.9^{acd}	4.5 ± 4.1^{ce}	8.2 ± 0.8^{bef}	4.2 ± 4.1^{df}	6.7 ± 2.3
Refined Grain(10)	3.1 ± 4.0^{abcd}	7.2 ± 2.9^{a}	5.3 ± 3.8^{b}	5.8 ± 1.2^{c}	5.4 ± 4.1^{d}	6.4 ± 2.6
Sodium (10)	5.9 ± 3.6^{abcd}	8.3 ± 2.1^{ef}	4.7 ± 3.4^{aegh}	9.2 ± 0.7^{bgi}	4.6 ± 3.5^{cfij}	10.0 ± 0.0^{dhj}
Empty Calories (20)	13.5 ± 6.5^{ab}	12.1 ± 5.3	13.6 ± 5.0^{cd}	9.30 ± 1.8^{ace}	16.6 ± 4.1^{bde}	14.1 ± 4.0
Total Index(100)	45.6 ± 15.9^{abcd}	57.9 ± 8.6	51.2 ± 13.4^{aefg}	61.6 ± 2.2^{be}	55.7 ± 13.9^{cf}	65.1 ± 6.9^{dg}
NSLP-- AS CONSUMED ---						
Tot. Fruit (5)	2.7 ± 2.4^{ab}	4.4 ± 1.1^{cd}	2.0 ± 2.3^{abce}	5.0 ± 0.1^{e}	2.0 ± 2.3^{d}	3.7 ± 2.5
Wh. Fruit (5)	2.9 ± 2.4^{a}	2.8 ± 2.7	2.2 ± 2.5^{b}	4.6 ± 1.4^{abc}	2.2 ± 2.5^{c}	2.5 ± 2.9
Total Veg. (5)	1.9 ± 2.1^{a}	0.0 ± 0.0^{b}	1.8 ± 1.9^{cd}	0.0 ± 0.0^{ac}	2.5 ± 2.1^{bd}	0.0 ± 0.0
Greens/Beans Veg. (5)	0.2 ± 1.0	0.0 ± 0.0	0.5 ± 1.4	0.0 ± 0.0	0.5 ± 1.5	0.0 ± 0.0
Whole Grains (10)	2.2 ± 4.0^{abc}	8.0 ± 2.4^{ade}	2.3 ± 4.1^{dfg}	5.6 ± 2.4^{bf}	2.7 ± 4.4^{e}	6.8 ± 2.7^{cg}
Dairy (10)	3.9 ± 4.4^{abcde}	0.0 ± 0.0^{afghi}	9.3 ± 2.1^{bfj}	5.9 ± 4.4^{cgjk}	9.1 ± 2.2^{dhk}	7.5 ± 5.0^{ei}
Total Pro (5)	3.2 ± 2.2	2.5 ± 2.9	3.2 ± 2.1^{a}	3.4 ± 2.3	3.6 ± 1.8^{a}	3.8 ± 2.5
Seafood/Plant Proteins (5)	0.7 ± 1.7	0.0 ± 0.0	0.4 ± 1.2	0.0 ± 0.0	0.5 ± 1.4	0.0 ± 0.0
Fat Ratio (10)	4.7 ± 3.8^{ab}	8.9 ± 1.4^{acd}	4.5 ± 4.1^{ce}	8.0 ± 2.1^{bef}	4.2 ± 4.2^{df}	6.2 ± 2.6
Refined Grains (10)	3.5 ± 4.2^{ab}	5.5 ± 3.2	5.3 ± 4.1^{a}	4.6 ± 3.5	5.5 ± 4.2^{b}	6.3 ± 2.6
Sodium (10)	5.6 ± 3.9^{abc}	8.0 ± 2.8^{d}	4.2 ± 3.6^{adef}	9.1 ± 1.0^{beg}	4.5 ± 3.7^{gh}	9.7 ± 0.4^{cfh}
Empty Calories (20)	13.5 ± 6.8^{ab}	14.2 ± 4.6	13.1 ± 5.6^{cd}	8.8 ± 4.6^{acef}	16.6 ± 4.3^{bde}	15.2 ± 4.2^{f}
Total Index (100)	44.6 ± 14.1^{abc}	54.3 ± 3.3	48.7 ± 13.9^{d}	55.1 ± 5.9^{a}	53.9 ± 12.9^{bd}	61.6 ± 3.5^{c}

Superscripts ^{abcdefghijk} show Tukey's pairwise significant differences ($\alpha < 0.05$) in each component row.

LBFH Meal Components and HEI-2010score comparisons by beverage selection are in Table 2. HEI-2010scores for meals containing SSB (45.9 served, 43.2 consumed) were significantly lower compared to all other beverage options, while highest scores came from meals containing 1% Plain Milk (62.1served, 60.5 consumed). HEI-2010scores for Water/None (52.6), 100% Juice (54.0) and Non-fat Flavored Milk (53.1), although not significantly different from each other, were higher than SSB, but lower than 1% Plain Milk.

In LBFH, Dairy food group/component scores for Non-fat Flavored Milk (of 10 points possible, 9.6 served, 9.6 consumed) or 1% Plain Milk (9.5 served, 8.4 consumed) were significantly higher than all other beverage categories (see Table 2). Dairy food group/component scores in LBFH meals including milk were similar to the Dairy food group/component mean of NSLP meals (9.3 served, 8.6 consumed, seen in Table 3). MQ of LBFH could be greatly improved by including milk, instead of SSB.

Table 2.HEI SCORE Means with Standard Deviations

LBFH--- AS SERVED ---					
Beverage Selection by HEI Component	Water or None, n = 234	Sugar Sweetened Bev. (SSB), n = 153	100% Juice, n = 63	Flavored Nonfat Milk, n = 49	Plain 1% Milk, n = 16
Total Fruit (5)	2.7 ± 2.2^{abc}	2.2 ± 2.7^{ad}	4.5 ± 1.5^{bdef}	1.6 ± 2.0^{ceg}	2.8 ±2.2^{fg}
Whole Fruit (5)	3.1 ± 2.4^{ab}	2.3 ± 2.5^{a}	2.8 ± 2.5	2.0 ± 2.4^{b}	3.3 ± 2.3
Total Veg. (5)	1.3 ± 2.0	1.0 ± 1.7^{ab}	1.8 ± 2.2^{a}	1.9 ± 2.3^{b}	1.4 ± 2.0
Greens/Beans (5)	0.1 ± 0.8^{ab}	0.1 ± 0.6^{cd}	0.0 ± 0.0^{ef}	0.8 ± 1.8^{ace}	0.6 ± 1.7^{bdf}
Whole Grains (10)	5.1 ± 4.8^{a}	4.8 ± 4.6	3.5 ± 4.5^{a}	3.9 ± 4.8	5.4 ± 4.9
Dairy (10)	3.9 ± 4.3^{abc}	3.7 ± 4.2^{def}	5.1 ± 4.5^{adgh}	9.6 ± 1.4^{beg}	9.5 ± 1.2^{cfh}
Total Protein (5)	3.8 ± 1.8^{a}	3.5 ± 1.9	3.4 ± 2.1	3.2 ± 2.1^{a}	4.0 ± 1.6
Seafood/Plant Proteins (5)	1.8 ± 2.4	1.8 ± 2.4	1.2 ± 2.2	1.4 ± 2.3	1.9 ± 2.5
Fats Ratio (10)	6.1 ± 4.1^{a}	5.9 ± 4.3^{b}	4.9 ± 4.5	4.1 ± 4.4^{ab}	5.6 ± 4.4
Refined Grain (10)	5.0 ± 4.5	5.3 ± 4.1	5.2 ± 4.0	6.0 ± 4.2	5.0 ± 4.9
Sodium (10)	5.0 ± 4.4^{a}	6.0 ± 6.4^{a}	6.1 ± 4.1	5.5 ± 4.3	4.8 ± 4.1
Empty Calories (20)	14.6 ± 5.6^{ab}	9.4 ± 15.5^{acde}	15.6 ± 5.4^{cf}	13.0 ± 5.9^{dfg}	17.9 ± 3.6^{beg}
Total Index (100)	52.6 ±14.5^{ab}	45.9 ± 15.5^{acde}	54.0 ± 15.4^{c}	53.1 ± 15.4^{df}	62.1 ± 18.7^{bef}
LBFH--- AS SERVED ---					
Total Fruit (5)	2.6 ± 2.3^{abc}	1.8 ± 2.2^{ad}	4.3 ± 1.8^{bdef}	1.2 ± 1.9^{ceg}	2.7 ± 2.4^{fg}
Whole Fruit (5)	2.9 ± 2.4^{ab}	1.9 ± 2.4^{a}	2.5 ± 2.5^{c}	1.6 ± 2.3^{bc}	2.9 ± 2.5
Total Veg. (5)	1.2 ± 2.0^{a}	0.9 ± 1.7	1.5 ± 2.1^{a}	1.5 ± 2.0	1.3 ± 1.9
Greens/Beans (5)	0.1 ± 0.8^{ab}	0.1 ± 0.6^{cd}	0.0 ± 0.0^{ef}	0.7 ± 1.8^{ace}	0.6 ± 0.7^{bdf}
Whole Grains (10)	4.9 ± 4.8^{a}	4.4 ± 4.6	3.4 ± 4.5^{a}	3.6 ± 4.7	4.5 ± 5.2
Dairy (10)	3.7 ± 4.3^{abc}	3.5 ± 4.2^{def}	5.3 ± 4.6^{adgh}	9.6 ± 1.4^{beg}	8.4 ± 2.8^{cfh}
Total Protein (5)	3.8 ± 1.9^{ab}	3.4 ± 2.0^{ac}	3.4 ± 2.1	3.1 ± 2.2^{bd}	4.4 ± 1.5^{cd}
Seafood/Plant Proteins (5)	1.8 ± 2.4^{a}	1.6 ± 2.4	1.1 ± 2.1^{a}	1.2 ± 2.2	1.9 ± 2.5
Fats Ratio (10)	6.1 ± 4.2^{a}	5.8 ± 4.4^{b}	4.9 ± 4.7	4.0 ± 4.3^{ab}	6.0 ± 4.5
Refined Grain (10)	5.7 ± 4.5	5.1 ± 4.2	5.0 ± 4.3	6.0 ± 4.1	5.4 ± 4.6
Sodium (10)	5.1 ± 4.5^{a}	6.1 ± 4.4^{a}	5.7 ± 4.2	5.4 ± 4.3	4.7 ± 4.2
Empty Calories (20)	14.7 ± 5.8^{abc}	8.7 ± 6.9^{adef}	15.0 ± 6.1^{dg}	12.3 ± 6.0^{begh}	17.5 ± 3.2^{cfh}
Total Index (100)	51.6 ± 14.9^{ab}	43.2 ±15.1^{acde}	52.1 ± 15.3^{cf}	50.4 ± 15.4^{dg}	60.5 ± 21.2^{befg}
Superscripts ^{abcdefghijk} show Tukey’s pairwise significant differences (α <0.05) between beverage groups in each meal component row.					

Further comparison between NSLP and LBFH meals by HEI food component and HEI-2010 scores were conducted and can be viewed in Table 3. “Good” quality HEI-2010 scores are greater than 80 as set by HEI-2010. Scores from 51 to 80 are considered “Need Improvement,” while “Poor” quality diets score are 50 or less (Kennedy, Bowman, Lino, Gerrior, & Basiotis, 1998; USDA, 2015). In the current study, NSLP meals averaged a HEI-2010 score of 50 to 52, with LBFH averaging scores of 49 to 51. HEI-2010 Score of both meal origins parallels the national average of US children, which is 47 to 50 (Hiza et al., 2013). Both meal origins in this study, and the average diet of US children, fall in the “Poor” quality range, while overlapping slightly into the “Needs Improvement” category, according to HEI-2010 (Kennedy et al., 1998).

Although the HEI-2010 scores of NSLP and LBFH were not significantly different, nearly all food component categories showed significant differences between lunch origins, among both the served and consumed data. NSLP meals were stronger suppliers of Total Vegetables (of 5 points possible, served: NSLP 2.1 vs. LBFH 1.3; consumed: NSLP 1.9 vs. LBFH 1.2), Greens and Beans (of 5 points possible, served: NSLP 0.7 vs. LBFH 0.2; consumed: NSLP 0.4 vs. LBFH 0.2), and Dairy (of 10 points possible, served: NSLP 9.3 vs. LBFH 4.7; consumed: NSLP 8.8 vs. LBFH 4.5). NSLP offered less Empty Calories (of 20 points possible, served: NSLP 14.2 vs. LBFH 13.1; consumed: NSLP 13.8 pts vs. LBFH 12.6 pts). Note that Empty Calories is one of the moderation food components in the HEI-2010 analysis, where lower quantities earn higher scores. LBFH, however, provided significantly more Whole Grains (of 5 points possible, served: NSLP 2.8 vs. LBFH 4.7; consumed: NSLP 2.6 vs. LBFH 4.4), Seafood and Plant Proteins (of 5 points possible, served: NSLP 0.5 vs. LBFH 1.7; consumed: NSLP 0.4 vs. LBFH 1.6), and a better Fatty Acid Ratio (of 10 points possible, served: NSLP 4.6 vs. LBFH 5.7; consumed: NSLP 4.6 vs. LBFH 5.7). Table 3 shows full results for the comparisons of component and HEI-2010 scores for NSLP meals and LBFH.

Table 3. Mean HEI Score Points with Standard Deviation Comparing NSLP and LBFH

		NSLP n=509	% Max	LBFH n=515	% Max	Effect Size[s]
Total Fruit	served	2.3 ± 2.3[a]	46	2.7 ± 2.3[a]	54	0.18
(5)	consumed	2.7 ± 2.3	54	2.4 ± 2.3	48	0.00
Whole Fruit	served	2.6 ± 2.5	52	2.7 ± 2.5	54	0.00
(5)	consumed	2.4 ± 2.5	48	2.4 ± 2.4	48	0.00
Total Veg.	served	2.1 ± 2.0[b]	42	1.3 ± 2.0[b]	26	0.38
(5)	consumed	1.9 ± 2.0[c]	38	1.2 ± 1.9[c]	24	0.34
Greens /Beans	served	0.7 ± 1.6[d]	14	0.2 ± 0.9[d]	4	0.19
(5)	consumed	0.4 ± 1.4[e]	8	0.2 ± 0.9[e]	4	0.17
Whole Grain	served	2.8 ± 4.3[f]	56	4.7 ± 4.7[f]	94	0.60
(5)	consumed	2.6 ± 4.2[g]	52	4.4 ± 4.7[g]	88	0.60
Dairy	served	9.3 ± 2.3[h]	93	4.7 ± 4.4[h]	47	1.80
(10)	consumed	8.6 ± 3.1[i]	86	4.5 ± 4.9[i]	45	1.50
Total Protein	served	3.7 ± 1.9	74	3.6 ± 1.9	72	0.00
(5)	consumed	3.3 ± 2.0[j]	66	3.6 ± 2.0[j]	72	0.10
Seafood /Plant	served	0.5 ± 1.3[k]	1	1.7 ± 2.4[k]	34	0.60
(5)	consumed	0.4 ± 1.3[l]	8	1.6 ± 2.3[l]	32	0.60
Fatty Acids	served	4.6 ± 4.1[m]	46	5.7 ± 4.3[m]	57	0.40
(10)	consumed	4.6 ± 4.1[n]	46	5.7 ± 4.3[n]	57	0.40
Refined Grain	served	5.2 ± 3.9	52	5.2 ± 4.3	52	0.00
(10)	consumed	5.2 ± 4.1	52	5.3 ± 4.4	53	0.00
Sodium	served	4.6 ± 3.6[o]	46	5.5 ± 4.4[o]	55	0.31
(10)	consumed	4.6 ± 3.7[p]	46	5.5 ± 4.4[p]	55	0.31
Empty Calorie	served	14.2 ± 5.1[q]	71	13.1 ± 6.3[q]	66	0.31
(20)	consumed	13.8 ± 5.7[r]	69	12.6 ± 6.7[r]	63	0.34
Total Index	served	52.2 ± 13.9	52	51.1 ± 15.6	51	0.00
(100)	consumed	49.8 ± 13.7	50	49.3 ± 15.8	49	0.00

Healthy Eating Index Component maximum possible scores are in parentheses

[abcdefghijklmnopqr] indicate Significant Difference pairs ($\alpha < 0.05$)

[s]Effect size, indicating the magnitude of the significant difference, calculated by Cohen's d. Scores: ≥ 0.20 indicate a small effect, ≥ 0.50 a moderate effect, and ≥ 0.8 a large effect.

The effect size (see Table 3) for most findings were fairly small, meaning the actual effect of the differences seen, although they may be statistically significant, have a small impact overall. According to Cohen (1988) effect size greater than 0.8 has a large effect, 0.5 to 0.8 has a moderate effect, 0.2 to 0.5 has a small effect and less that 0.2 has a minimal effect. LBFH served more Whole Grains and Seafood/Plant Proteins; the significantly higher amounts had moderate effect size of 0.6 in both food components. The NSLP provided significantly higher amounts of Dairy in comparison to LBFH, with a large effect size (1.8 served, 1.6 consumed). The high level of provision of Dairy foods by the NSLP suggests a need to improve the presence of dairy foods in LBFH.

LBFH provided more Total Fruit as served. There was no difference, however, as consumed (of 5 points possible, served: NSLP 2.3 vs. LBFH 2.7; consumed: NSLP 2.7 vs. LBFH 2.4). Scores reflect a tendency for children with NSLP meals to eat more of fruits served, while more fruit items present in LBFH remain uneaten or wasted. Though this difference's magnitude is small, it could originate in preparation. Research shows children are more likely to consume fruit cut into bite size pieces, which is a common practice in NSLP meals (Miller, 2013). Concern about spoilage from lack of a temperature control for LBFH may cause parents to send whole fruits, which are fairly shelf stable rather than cut portions, which are more perishable without refrigeration (Almansour et al., 2011; Hudson, & Walley, 2009).

This study was limited due to all four schools having HUSSC designations during the timeframe of data acquisition (USDA, 2014c). This is a benefit to the study, in that the schools were early voluntary adopters of the type of changes that are mandated in the HHFKA of 2010, and so the data delivers results readily applicable to current NSLP regulations for meal components (Jordan et al., 2008). It is a limitation; however, as currently only 7,022 US schools participate in the HUSSC program. Some schools do not participate in the NSLP limiting application of these results to those institutions.

Conclusions and Applications

Nearly all food component categories in this study were below the HEI-2010 HEI-2010 scores that would indicate 'Good Meal Quality", both in NSLP and LBFH meals. This is most notable in the areas of Greens/Bean Vegetables and in Seafood/Plant Proteins, which showed selection and consumption levels at 1-14% of recommended amounts (see Table 1). To address these nutritional inadequacies and to further improve school meal quality, three areas of focus are recommended: within the lunchroom, in the wider school environment, and within the broader community.

Currently, in the lunchroom, Child Nutrition Professionals (CNPs) provide and encourage selection/consumption of nutritious beverages like 1% plain milk, non-fat flavored milk, and 100% juice, which meet NSLP guidelines appropriately. The current study revealed highest HEI-2010 scores with a beverage selection of 1% plain milk. CNP's can further improve HEI-2010 scores by promoting consumption of 1% plain milk, or perhaps, only offering non-fat flavored milk on certain days. To ease selection and purchasing of healthful beverages, CNPs can provide a "milk only" line especially for children with LBFH. CNPs can create awareness of nutritional differences between beverages, and milk's availability at school for LBFH by providing educational materials in the lunchroom, classroom and to parents. Providing reliable cold storage for LBFH may also improve meal quality and beverage selection (Almansour et al., 2011; Hudson, & Walley, 2009).

Rethinking lunchroom organization can improve healthful selections. Placing sliced fruits and vegetables, as impulse buy items at the beginning of lunch lines can increase selection (Just & Wansink, 2009). Displaying pictures of fruits, vegetables, and nutrient-dense beverages on sample NSLP cafeteria trays improves motivation of healthful meal choices (Reicks et al., 2012). Allowing children to select more than one nutritionally dense beverage per meal, with options like 100% juice, and milk, can increase nutrient consumption to improve overall MQ (Richie et al., 2015). Lastly, increasing the portion size of fruits and vegetables by an eighth cup (which has fairly low-cost implications) may improve consumption without reducing intake of other meal components (Miller, 2013).

In the larger school environment, wide-ranging nutrition education programs and incentives are necessary. Free programs, like HUSSC, include nutritional and physical fitness components (USDA, 2014c). HUSSC helps guide school policies to build school environments that align with the Dietary Guidelines for Americans. HUSSC emphasizes school wellness policies, which encompass the whole school, district, school board, parents and greater community. HUSSC recommended policies regulate foods given for reward in the classroom, birthday party food, activity/recess times, and nutritional education (USDA, 2014c).

Increasing meal time duration may also improve MQ. Limited time to eat creates issues associated with the mechanics of eating and the social aspects of shared meals. An important part of healthy foods, specifically raw fruits and vegetables, is fiber (Bergman, 2010). Fiber, increases the bulk of food items and requires more chewing than processed foods, thus necessitating more time spent on each bite of food. Policy development should consider balancing time allotment for lunch sessions and its adequacy for students' healthful food intake and socialization. Recess before lunch has also been shown to improve food component selection and consumption (Bergman et al., 2004; Rainville, Wolf & Carr, 2006). Recess before lunch would also ensure thirst. With nutrient-rich beverages available to thirsty students, overall MQ would likely to improve with recess before lunch.

Additionally, CNPs may need to review their water availability in the lunchroom for students who do no not have an alternative beverage. Water consumption is one method for ensuring both hydration and limiting caloric consumption while many children do not drink any water, those that do tend to have more healthful diets and normal weight status (Kenney et al., 2015; Park, Blanck, Sherry, Brener, & O'Toole, 2012). Unlimited access to water throughout the day improves fluid intake in children (Kaushik, Mullee, Bryan, & Hill, 2007). Water bottle filling stations, similar in appearance to soda machine dispensers, have been shown to increase water consumption and reduce waste from plastic water bottles (Franklin & Madalinski, 2009). While water would not overtly increase any particular component area of HEI-2010 scores, it may decrease SSB consumption, reducing Empty Calories resulting in higher HEI-2010 scores, and ensuring appropriate hydration.

School gardens can provide students and teachers with hands-on nutrition education. Growing foods used in school lunch connects children with what is served in the lunchroom. Children who participate in school garden programs have improved nutritional quality in school lunch meals. In these school settings students perform better academically, with fewer absences due to illness, potentially due to improved nutritional status (Stone & Barlow, 2012). Small vegetable gardening lessons improved attitudes toward vegetables (Lineberger & Zajicek, 2000). Students in school garden projects have increased fruit and vegetable intake, at home and school; resulting in increased Vitamin A, Vitamin C and fiber intake (McAleese & Rankin, 2007).

Farm-to-school programs allow for menu planning with the freshest produce options available. This may increase nutritional quality of the meal by eliminating nutrient losses from processing, storage and transportation (Rickman, Barrett, & Bruhn, 2007). Farm-to-school sourced NSLP meals have a higher MQ as scored by HEI (Young, Ptomey, Craven, Swanson, & Gibson, 2014). Farmers benefit by selling fresh produce to local schools and students benefit from more fresh produce in school meals (Allen & Guthman, 2006). A coordinated community effort, including nutrition standard improvements, social marketing, farm-to-school efforts and classroom instruction can effectively motivate better food choices and higher activity levels in schools (Johnson et al, 2009b). The Academy of Nutrition and Dietetics supports a multifaceted approach to improvements in school nutrition. Approaches include: new product/recipe development, farm-to-school, fresh fruit/vegetable programs, wellness policies, and integrated nutritional instruction, at school, in the home and community. Disclosure of nutrient content and marketing nutritional programs through media should also be pursued (Bergman, 2010).

HHFKA regulations are continuing to improve MQ in NSLP meals (Bergman et al., 2014b). Increasing the number or size of selection options can further improve overall meal quality. Allowing students to select one fruit and two vegetables per meal, instead of two fruits and one vegetable, may improve overall numbers for vegetable selections and consumption, while maintaining current fruit intake level; additionally, lowering caloric intake; thus, improving nutrient density of the meal (Cullen, Chen, Dave, & Jensen, 2015). In a 2014 study conducted after HHFKA implementation, students selecting fruit increased 23% when new regulations increased the amount of total fruit and vegetables offered daily; the number of selected portions of entrée and vegetables remained the same, however consumption amounts of both entrée and vegetables expanded by 15-16% (Cohen, Richardson, Parker, Catalano, & Rimm, 2014). In the same study, milk selections and intake both decreased, however, due to a policy change implemented by the school district banning flavored milk (Cohen et al., 2015).

The current study concludes that NSLP meals are marginally higher than the national average for MQ compared to the overall the diet of US children. NSLP meals are performing well in providing children with Dairy, Total Protein, and Reduced Empty Calories, while improvements are still necessary for Greens/Bean Vegetables and Seafood/Plant Proteins. Further research is called for, however, as HHFKA regulations are implemented, to investigate changes in MQ. This additional research should include the influence of beverages on NSLP MQ. In addition, further inquiry into the nutritional quality of LBFH, is warranted in more schools better representing the diversity found in the US.

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APPENDIXES

Appendix A

Extended International (IOTF) Body Mass Index Cut-Offs for Thinness, Overweight and Obesity in Children: Boys

Boys									
BMI (kg/m²) at age 18 years									
Age (months)	Age (years)	16	17	18.5	23	25	27	30	35
24	2	13.6	14.29	15.24	17.54	18.36	19.07	19.99	21.2
25	2.08	13.58	14.26	15.2	17.49	18.31	19.03	19.95	21.16
26	2.17	13.55	14.23	15.16	17.45	18.26	18.98	19.9	21.11
27	2.25	13.52	14.2	15.13	17.41	18.22	18.93	19.85	21.07
28	2.33	13.5	14.17	15.09	17.36	18.17	18.89	19.81	21.03
29	2.42	13.47	14.14	15.06	17.32	18.13	18.85	19.77	20.99
30	2.5	13.44	14.11	15.02	17.28	18.09	18.8	19.73	20.95
31	2.58	13.42	14.08	14.99	17.24	18.05	18.76	19.68	20.91
32	2.67	13.39	14.05	14.95	17.2	18	18.72	19.64	20.88
33	2.75	13.37	14.02	14.92	17.16	17.97	18.68	19.61	20.84
34	2.83	13.34	13.99	14.89	17.12	17.93	18.64	19.57	20.81
35	2.92	13.32	13.96	14.86	17.08	17.89	18.61	19.54	20.78
36	3	13.3	13.94	14.83	17.05	17.85	18.57	19.5	20.75
37	3.08	13.27	13.91	14.8	17.01	17.82	18.54	19.47	20.72
38	3.17	13.25	13.89	14.77	16.98	17.79	18.5	19.44	20.7
39	3.25	13.23	13.86	14.74	16.95	17.75	18.47	19.41	20.67
40	3.33	13.21	13.84	14.71	16.91	17.72	18.44	19.38	20.65
41	3.42	13.19	13.81	14.68	16.88	17.69	18.41	19.36	20.63
42	3.5	13.16	13.79	14.66	16.85	17.66	18.38	19.33	20.61
43	3.58	13.14	13.76	14.63	16.83	17.63	18.36	19.31	20.6
44	3.67	13.12	13.74	14.61	16.8	17.61	18.33	19.29	20.59
45	3.75	13.1	13.72	14.58	16.77	17.58	18.31	19.27	20.57
46	3.83	13.08	13.7	14.56	16.75	17.56	18.29	19.25	20.56
47	3.92	13.06	13.67	14.53	16.72	17.54	18.27	19.24	20.56
48	4	13.04	13.65	14.51	16.7	17.52	18.25	19.23	20.56
49	4.08	13.02	13.63	14.49	16.68	17.5	18.24	19.21	20.56
50	4.17	13	13.61	14.46	16.66	17.48	18.22	19.21	20.56
51	4.25	12.98	13.59	14.44	16.64	17.46	18.21	19.2	20.56
52	4.33	12.96	13.57	14.42	16.62	17.45	18.2	19.2	20.57
53	4.42	12.94	13.55	14.4	16.61	17.44	18.19	19.2	20.59

54	4.5	12.92	13.53	14.38	16.59	17.43	18.19	19.2	20.6
55	4.58	12.9	13.51	14.36	16.58	17.42	18.18	19.2	20.63
56	4.67	12.88	13.49	14.34	16.56	17.41	18.18	19.21	20.65
57	4.75	12.86	13.47	14.32	16.55	17.4	18.18	19.22	20.68
58	4.83	12.84	13.44	14.3	16.54	17.4	18.18	19.23	20.71
59	4.92	12.82	13.42	14.28	16.53	17.39	18.19	19.25	20.75
60	5	12.8	13.4	14.26	16.52	17.39	18.19	19.27	20.79
61	5.08	12.78	13.38	14.24	16.51	17.39	18.2	19.29	20.84
62	5.17	12.75	13.36	14.22	16.51	17.4	18.21	19.32	20.89
63	5.25	12.73	13.34	14.2	16.5	17.4	18.23	19.35	20.95
64	5.33	12.71	13.32	14.18	16.5	17.41	18.24	19.38	21.01
65	5.42	12.69	13.3	14.17	16.5	17.41	18.26	19.42	21.08
66	5.5	12.66	13.27	14.15	16.5	17.42	18.28	19.46	21.15
67	5.58	12.64	13.25	14.13	16.5	17.44	18.31	19.5	21.23
68	5.67	12.62	13.23	14.11	16.5	17.45	18.33	19.55	21.31
69	5.75	12.6	13.21	14.1	16.51	17.46	18.36	19.59	21.4
70	5.83	12.58	13.19	14.08	16.51	17.48	18.39	19.65	21.49
71	5.92	12.56	13.18	14.07	16.52	17.5	18.42	19.7	21.59
72	6	12.54	13.16	14.06	16.52	17.52	18.45	19.76	21.69
73	6.08	12.52	13.14	14.04	16.53	17.54	18.49	19.82	21.79
74	6.17	12.5	13.12	14.03	16.54	17.56	18.53	19.88	21.9
75	6.25	12.48	13.11	14.02	16.56	17.59	18.57	19.94	22.01
76	6.33	12.47	13.1	14.01	16.57	17.62	18.61	20.01	22.12
77	6.42	12.45	13.08	14.01	16.58	17.64	18.65	20.08	22.24
78	6.5	12.44	13.07	14	16.6	17.67	18.7	20.15	22.35
79	6.58	12.43	13.06	14	16.62	17.7	18.74	20.22	22.47
80	6.67	12.42	13.06	13.99	16.64	17.73	18.79	20.29	22.59
81	6.75	12.41	13.05	13.99	16.66	17.77	18.84	20.36	22.71
82	6.83	12.4	13.05	13.99	16.68	17.8	18.89	20.44	22.83
83	6.92	12.39	13.04	13.99	16.7	17.84	18.94	20.51	22.96
84	7	12.39	13.04	14	16.73	17.88	18.99	20.59	23.08
85	7.08	12.39	13.04	14	16.75	17.91	19.04	20.66	23.21
86	7.17	12.39	13.04	14.01	16.78	17.95	19.09	20.74	23.33
87	7.25	12.39	13.04	14.02	16.81	17.99	19.15	20.82	23.45
88	7.33	12.39	13.05	14.02	16.84	18.04	19.2	20.9	23.58
89	7.42	12.39	13.05	14.04	16.87	18.08	19.26	20.98	23.7
90	7.5	12.39	13.06	14.05	16.9	18.12	19.32	21.06	23.83
91	7.58	12.4	13.07	14.06	16.93	18.17	19.38	21.14	23.95

92	7.67	12.4	13.07	14.07	16.97	18.21	19.43	21.22	24.08
93	7.75	12.41	13.08	14.09	17	18.26	19.5	21.3	24.21
94	7.83	12.41	13.09	14.1	17.04	18.31	19.56	21.39	24.34
95	7.92	12.42	13.1	14.12	17.08	18.36	19.62	21.47	24.47
96	8	12.43	13.11	14.13	17.12	18.41	19.68	21.56	24.6
97	8.08	12.44	13.13	14.15	17.15	18.46	19.75	21.65	24.74
98	8.17	12.44	13.14	14.17	17.19	18.51	19.81	21.74	24.88
99	8.25	12.45	13.15	14.18	17.23	18.56	19.88	21.83	25.02
100	8.33	12.46	13.16	14.2	17.27	18.62	19.95	21.92	25.16
101	8.42	12.47	13.17	14.22	17.32	18.67	20.02	22.02	25.31
102	8.5	12.48	13.19	14.24	17.36	18.73	20.09	22.11	25.45
103	8.58	12.49	13.2	14.26	17.4	18.78	20.16	22.21	25.61
104	8.67	12.5	13.21	14.28	17.44	18.84	20.23	22.31	25.76
105	8.75	12.51	13.23	14.3	17.49	18.9	20.3	22.41	25.92
106	8.83	12.52	13.24	14.32	17.53	18.95	20.37	22.51	26.07
107	8.92	12.53	13.25	14.34	17.57	19.01	20.45	22.61	26.23
108	9	12.54	13.27	14.36	17.62	19.07	20.52	22.71	26.4
109	9.08	12.55	13.28	14.38	17.67	19.13	20.6	22.82	26.56
110	9.17	12.56	13.3	14.4	17.71	19.19	20.67	22.92	26.72
111	9.25	12.58	13.31	14.42	17.76	19.25	20.75	23.03	26.89
112	9.33	12.59	13.33	14.44	17.8	19.31	20.83	23.13	27.05
113	9.42	12.6	13.35	14.47	17.85	19.37	20.9	23.24	27.22
114	9.5	12.61	13.36	14.49	17.9	19.43	20.98	23.34	27.39
115	9.58	12.63	13.38	14.51	17.94	19.49	21.06	23.45	27.55
116	9.67	12.64	13.4	14.53	17.99	19.55	21.13	23.55	27.71
117	9.75	12.65	13.41	14.56	18.04	19.61	21.21	23.66	27.88
118	9.83	12.67	13.43	14.58	18.09	19.67	21.29	23.76	28.04
119	9.92	12.68	13.45	14.61	18.13	19.74	21.36	23.86	28.2
120	10	12.7	13.47	14.63	18.18	19.8	21.44	23.96	28.35
121	10.08	12.71	13.49	14.66	18.23	19.86	21.51	24.06	28.51
122	10.17	12.73	13.51	14.68	18.28	19.92	21.59	24.16	28.65
123	10.25	12.74	13.53	14.71	18.32	19.97	21.66	24.25	28.8
124	10.33	12.76	13.55	14.73	18.37	20.04	21.73	24.35	28.94
125	10.42	12.78	13.57	14.76	18.42	20.09	21.8	24.44	29.08
126	10.5	12.8	13.59	14.79	18.47	20.15	21.88	24.54	29.22
127	10.58	12.81	13.61	14.82	18.52	20.21	21.95	24.63	29.35
128	10.67	12.83	13.63	14.84	18.56	20.27	22.02	24.72	29.48
129	10.75	12.85	13.66	14.87	18.61	20.33	22.09	24.81	29.61

130	10.83	12.87	13.68	14.9	18.66	20.39	22.16	24.9	29.73
131	10.92	12.89	13.7	14.93	18.71	20.45	22.23	24.98	29.86
132	11	12.91	13.73	14.96	18.76	20.51	22.29	25.07	29.97
133	11.08	12.94	13.75	14.99	18.81	20.56	22.36	25.15	30.09
134	11.17	12.96	13.78	15.02	18.86	20.62	22.43	25.24	30.2
135	11.25	12.98	13.8	15.05	18.91	20.68	22.5	25.32	30.31
136	11.33	13	13.83	15.08	18.95	20.74	22.56	25.4	30.42
137	11.42	13.03	13.86	15.12	19	20.79	22.63	25.48	30.52
138	11.5	13.05	13.89	15.15	19.05	20.85	22.7	25.56	30.63
139	11.58	13.08	13.92	15.18	19.1	20.91	22.76	25.64	30.73
140	11.67	13.1	13.94	15.22	19.15	20.97	22.83	25.72	30.83
141	11.75	13.13	13.97	15.25	19.2	21.03	22.89	25.79	30.93
142	11.83	13.16	14.01	15.29	19.25	21.08	22.96	25.87	31.02
143	11.92	13.19	14.04	15.32	19.31	21.14	23.02	25.94	31.12
144	12	13.21	14.07	15.36	19.36	21.2	23.09	26.02	31.21
145	12.08	13.24	14.1	15.4	19.41	21.25	23.15	26.09	31.3
146	12.17	13.28	14.13	15.44	19.46	21.31	23.22	26.17	31.39
147	12.25	13.31	14.17	15.47	19.51	21.37	23.28	26.24	31.47
148	12.33	13.34	14.2	15.51	19.56	21.43	23.34	26.31	31.56
149	12.42	13.37	14.24	15.55	19.61	21.49	23.4	26.38	31.64
150	12.5	13.4	14.27	15.59	19.67	21.54	23.47	26.45	31.73
151	12.58	13.44	14.31	15.63	19.72	21.6	23.53	26.52	31.81
152	12.67	13.47	14.34	15.67	19.77	21.66	23.6	26.59	31.89
153	12.75	13.5	14.38	15.71	19.82	21.72	23.66	26.66	31.97
154	12.83	13.54	14.42	15.75	19.88	21.78	23.72	26.73	32.04
155	12.92	13.58	14.46	15.8	19.93	21.83	23.78	26.8	32.12
156	13	13.61	14.5	15.84	19.99	21.89	23.84	26.87	32.19
157	13.08	13.65	14.54	15.88	20.04	21.95	23.91	26.94	32.27
158	13.17	13.69	14.58	15.93	20.09	22.01	23.97	27	32.33
159	13.25	13.73	14.62	15.97	20.15	22.07	24.03	27.07	32.41
160	13.33	13.76	14.66	16.02	20.2	22.13	24.1	27.14	32.48
161	13.42	13.8	14.7	16.06	20.26	22.19	24.15	27.2	32.54
162	13.5	13.84	14.74	16.11	20.31	22.24	24.22	27.26	32.6
163	13.58	13.88	14.79	16.16	20.37	22.3	24.28	27.33	32.67
164	13.67	13.93	14.83	16.2	20.43	22.36	24.34	27.39	32.74
165	13.75	13.97	14.87	16.25	20.48	22.42	24.4	27.46	32.8
166	13.83	14.01	14.92	16.3	20.54	22.48	24.46	27.52	32.86
167	13.92	14.05	14.96	16.35	20.6	22.54	24.53	27.58	32.92

168	14	14.09	15.01	16.39	20.65	22.6	24.59	27.64	32.97
169	14.08	14.14	15.05	16.44	20.71	22.66	24.65	27.7	33.03
170	14.17	14.18	15.1	16.49	20.76	22.72	24.71	27.76	33.08
171	14.25	14.22	15.14	16.54	20.82	22.77	24.76	27.82	33.14
172	14.33	14.26	15.19	16.59	20.88	22.83	24.82	27.88	33.19
173	14.42	14.31	15.23	16.64	20.93	22.89	24.88	27.94	33.25
174	14.5	14.35	15.28	16.68	20.99	22.95	24.94	28	33.3
175	14.58	14.4	15.33	16.73	21.04	23	25	28.05	33.34
176	14.67	14.44	15.37	16.78	21.1	23.06	25.06	28.11	33.39
177	14.75	14.48	15.42	16.83	21.15	23.12	25.11	28.16	33.43
178	14.83	14.53	15.46	16.88	21.21	23.17	25.17	28.22	33.47
179	14.92	14.57	15.51	16.93	21.26	23.23	25.22	28.27	33.52
180	15	14.61	15.55	16.98	21.31	23.28	25.27	28.32	33.56
181	15.08	14.66	15.6	17.02	21.37	23.33	25.33	28.37	33.6
182	15.17	14.7	15.64	17.07	21.42	23.39	25.38	28.42	33.64
183	15.25	14.74	15.69	17.12	21.47	23.44	25.43	28.47	33.67
184	15.33	14.78	15.73	17.16	21.52	23.49	25.48	28.52	33.71
185	15.42	14.83	15.78	17.21	21.57	23.54	25.53	28.56	33.74
186	15.5	14.87	15.82	17.26	21.62	23.59	25.58	28.61	33.78
187	15.58	14.91	15.87	17.3	21.67	23.64	25.63	28.66	33.81
188	15.67	14.95	15.91	17.35	21.72	23.69	25.68	28.7	33.85
189	15.75	15	15.95	17.4	21.77	23.74	25.73	28.75	33.88
190	15.83	15.04	16	17.44	21.82	23.79	25.78	28.8	33.92
191	15.92	15.08	16.04	17.49	21.87	23.84	25.83	28.84	33.95
192	16	15.12	16.08	17.53	21.92	23.89	25.88	28.89	33.98
193	16.08	15.16	16.12	17.57	21.97	23.94	25.92	28.93	34.01
194	16.17	15.2	16.17	17.62	22.01	23.99	25.97	28.97	34.05
195	16.25	15.24	16.21	17.66	22.06	24.04	26.02	29.02	34.08
196	16.33	15.28	16.25	17.71	22.11	24.08	26.07	29.06	34.12
197	16.42	15.32	16.29	17.75	22.16	24.13	26.11	29.11	34.15
198	16.5	15.36	16.33	17.79	22.2	24.18	26.16	29.15	34.19
199	16.58	15.4	16.37	17.83	22.25	24.22	26.21	29.2	34.23
200	16.67	15.44	16.41	17.88	22.29	24.27	26.25	29.24	34.26
201	16.75	15.47	16.45	17.92	22.34	24.32	26.3	29.29	34.31
202	16.83	15.51	16.49	17.96	22.39	24.37	26.35	29.34	34.35
203	16.92	15.55	16.53	18	22.43	24.41	26.4	29.38	34.39
204	17	15.59	16.57	18.04	22.48	24.46	26.44	29.43	34.43
205	17.08	15.62	16.6	18.08	22.52	24.5	26.49	29.48	34.48

206	17.17	15.66	16.64	18.12	22.57	24.55	26.54	29.52	34.52
207	17.25	15.69	16.68	18.16	22.61	24.6	26.58	29.57	34.57
208	17.33	15.73	16.72	18.2	22.66	24.64	26.63	29.62	34.61
209	17.42	15.76	16.75	18.24	22.7	24.69	26.68	29.67	34.66
210	17.5	15.8	16.79	18.28	22.74	24.73	26.72	29.71	34.7
211	17.58	15.83	16.83	18.31	22.79	24.78	26.77	29.76	34.75
212	17.67	15.87	16.86	18.35	22.83	24.82	26.81	29.81	34.8
213	17.75	15.9	16.9	18.39	22.87	24.87	26.86	29.86	34.85
214	17.83	15.93	16.93	18.43	22.91	24.91	26.91	29.9	34.9
215	17.92	15.97	16.97	18.46	22.96	24.96	26.95	29.95	34.95
216	18	16	17	18.5	23	25	27	30	35

(Cole & Lobstein, 2012)

Appendix B

Extended International (IOTF) Body Mass Index Cut-Offs for Thinness, Overweight and Obesity in Children: Girls

Girls									
BMI (kg/m²) at age 18 years									
Age (months)	Age (years)	16	17	18.5	23	25	27	30	35
24	2	13.4	14.05	14.96	17.25	18.09	18.83	19.81	21.13
25	2.08	13.37	14.02	14.93	17.21	18.05	18.79	19.77	21.09
26	2.17	13.35	14	14.9	17.17	18	18.75	19.73	21.05
27	2.25	13.32	13.97	14.86	17.13	17.96	18.71	19.68	21.01
28	2.33	13.3	13.94	14.83	17.09	17.92	18.67	19.64	20.97
29	2.42	13.27	13.91	14.8	17.05	17.88	18.63	19.6	20.94
30	2.5	13.25	13.88	14.77	17.01	17.84	18.59	19.57	20.9
31	2.58	13.22	13.86	14.74	16.98	17.81	18.55	19.53	20.87
32	2.67	13.2	13.83	14.71	16.94	17.77	18.52	19.5	20.84
33	2.75	13.18	13.8	14.68	16.91	17.74	18.48	19.47	20.81
34	2.83	13.15	13.78	14.65	16.88	17.71	18.45	19.44	20.79
35	2.92	13.13	13.75	14.62	16.85	17.68	18.42	19.41	20.77
36	3	13.11	13.73	14.6	16.82	17.64	18.39	19.38	20.74
37	3.08	13.09	13.7	14.57	16.79	17.62	18.36	19.36	20.72
38	3.17	13.07	13.68	14.54	16.76	17.59	18.34	19.33	20.7
39	3.25	13.04	13.66	14.52	16.73	17.56	18.31	19.31	20.69
40	3.33	13.02	13.63	14.49	16.7	17.53	18.29	19.29	20.67
41	3.42	13	13.61	14.47	16.68	17.51	18.26	19.27	20.66
42	3.5	12.98	13.59	14.44	16.65	17.48	18.24	19.25	20.65
43	3.58	12.96	13.56	14.42	16.62	17.46	18.22	19.23	20.64
44	3.67	12.94	13.54	14.39	16.6	17.44	18.2	19.21	20.63
45	3.75	12.91	13.52	14.37	16.58	17.41	18.18	19.2	20.62
46	3.83	12.89	13.49	14.34	16.55	17.39	18.16	19.18	20.62
47	3.92	12.87	13.47	14.32	16.53	17.37	18.14	19.17	20.62
48	4	12.85	13.45	14.3	16.51	17.35	18.13	19.16	20.61
49	4.08	12.83	13.43	14.27	16.49	17.34	18.11	19.15	20.62
50	4.17	12.81	13.4	14.25	16.47	17.32	18.1	19.15	20.62
51	4.25	12.78	13.38	14.23	16.45	17.31	18.09	19.14	20.63
52	4.33	12.76	13.36	14.2	16.43	17.29	18.08	19.14	20.64
53	4.42	12.74	13.34	14.18	16.42	17.28	18.07	19.14	20.66

54	4.5	12.72	13.31	14.16	16.4	17.27	18.06	19.14	20.67
55	4.58	12.7	13.29	14.14	16.39	17.26	18.06	19.15	20.69
56	4.67	12.67	13.27	14.12	16.37	17.25	18.06	19.15	20.72
57	4.75	12.65	13.25	14.1	16.36	17.24	18.06	19.16	20.74
58	4.83	12.63	13.23	14.08	16.35	17.24	18.06	19.17	20.77
59	4.92	12.61	13.21	14.06	16.34	17.23	18.06	19.19	20.81
60	5	12.59	13.18	14.04	16.33	17.23	18.06	19.2	20.84
61	5.08	12.56	13.16	14.02	16.32	17.23	18.07	19.22	20.89
62	5.17	12.54	13.14	14	16.32	17.23	18.08	19.24	20.93
63	5.25	12.52	13.12	13.98	16.31	17.23	18.09	19.27	20.98
64	5.33	12.5	13.1	13.97	16.31	17.24	18.1	19.3	21.04
65	5.42	12.48	13.08	13.95	16.3	17.24	18.12	19.33	21.09
66	5.5	12.45	13.06	13.93	16.3	17.25	18.13	19.36	21.16
67	5.58	12.43	13.04	13.92	16.3	17.26	18.15	19.4	21.22
68	5.67	12.41	13.02	13.9	16.3	17.27	18.18	19.43	21.29
69	5.75	12.39	13	13.89	16.31	17.28	18.2	19.48	21.37
70	5.83	12.37	12.99	13.87	16.31	17.3	18.22	19.52	21.44
71	5.92	12.36	12.97	13.86	16.32	17.31	18.25	19.57	21.52
72	6	12.34	12.96	13.85	16.32	17.33	18.28	19.61	21.61
73	6.08	12.32	12.94	13.84	16.33	17.35	18.31	19.67	21.7
74	6.17	12.31	12.93	13.83	16.34	17.37	18.35	19.72	21.79
75	6.25	12.29	12.92	13.82	16.36	17.39	18.38	19.78	21.89
76	6.33	12.28	12.9	13.82	16.37	17.42	18.42	19.84	21.99
77	6.42	12.27	12.9	13.81	16.39	17.45	18.46	19.9	22.09
78	6.5	12.26	12.89	13.81	16.4	17.48	18.5	19.96	22.19
79	6.58	12.25	12.88	13.81	16.42	17.51	18.55	20.03	22.3
80	6.67	12.24	12.88	13.81	16.44	17.54	18.59	20.1	22.41
81	6.75	12.23	12.87	13.81	16.47	17.58	18.64	20.17	22.53
82	6.83	12.23	12.87	13.81	16.49	17.61	18.69	20.24	22.64
83	6.92	12.23	12.87	13.82	16.52	17.65	18.74	20.32	22.76
84	7	12.23	12.87	13.83	16.54	17.69	18.8	20.39	22.88
85	7.08	12.23	12.88	13.83	16.57	17.73	18.85	20.47	23
86	7.17	12.23	12.88	13.84	16.61	17.78	18.91	20.55	23.13
87	7.25	12.23	12.89	13.86	16.64	17.82	18.97	20.63	23.26
88	7.33	12.24	12.9	13.87	16.67	17.87	19.03	20.72	23.39
89	7.42	12.24	12.9	13.88	16.71	17.91	19.09	20.8	23.52
90	7.5	12.25	12.91	13.9	16.74	17.96	19.15	20.89	23.65
91	7.58	12.25	12.92	13.91	16.78	18.01	19.22	20.98	23.79

92	7.67	12.26	12.93	13.93	16.82	18.07	19.28	21.07	23.93
93	7.75	12.27	12.95	13.95	16.86	18.12	19.35	21.16	24.07
94	7.83	12.28	12.96	13.96	16.9	18.17	19.42	21.25	24.21
95	7.92	12.29	12.97	13.98	16.94	18.23	19.49	21.35	24.36
96	8	12.3	12.98	14	16.99	18.28	19.56	21.44	24.5
97	8.08	12.31	13	14.02	17.03	18.34	19.63	21.54	24.65
98	8.17	12.32	13.01	14.04	17.07	18.39	19.7	21.64	24.8
99	8.25	12.33	13.03	14.06	17.12	18.45	19.77	21.74	24.95
100	8.33	12.34	13.04	14.08	17.16	18.51	19.85	21.84	25.1
101	8.42	12.35	13.06	14.1	17.21	18.57	19.92	21.94	25.26
102	8.5	12.37	13.07	14.12	17.25	18.63	20	22.04	25.42
103	8.58	12.38	13.09	14.15	17.3	18.69	20.07	22.14	25.58
104	8.67	12.39	13.1	14.17	17.34	18.75	20.15	22.24	25.74
105	8.75	12.4	13.12	14.19	17.39	18.81	20.22	22.35	25.9
106	8.83	12.41	13.13	14.21	17.44	18.87	20.3	22.45	26.06
107	8.92	12.42	13.15	14.23	17.48	18.93	20.38	22.56	26.22
108	9	12.44	13.16	14.26	17.53	18.99	20.46	22.66	26.39
109	9.08	12.45	13.18	14.28	17.58	19.05	20.53	22.77	26.55
110	9.17	12.46	13.2	14.3	17.63	19.12	20.61	22.88	26.72
111	9.25	12.47	13.22	14.33	17.68	19.18	20.69	22.99	26.88
112	9.33	12.49	13.23	14.35	17.73	19.24	20.77	23.09	27.05
113	9.42	12.5	13.25	14.38	17.78	19.31	20.85	23.2	27.21
114	9.5	12.52	13.27	14.4	17.83	19.38	20.94	23.31	27.38
115	9.58	12.53	13.29	14.43	17.88	19.44	21.02	23.42	27.55
116	9.67	12.55	13.31	14.46	17.94	19.51	21.1	23.53	27.71
117	9.75	12.57	13.33	14.49	17.99	19.58	21.18	23.64	27.88
118	9.83	12.59	13.36	14.52	18.04	19.64	21.27	23.75	28.04
119	9.92	12.61	13.38	14.55	18.1	19.71	21.35	23.86	28.2
120	10	12.63	13.4	14.58	18.16	19.78	21.43	23.97	28.36
121	10.08	12.65	13.43	14.61	18.21	19.85	21.52	24.08	28.52
122	10.17	12.67	13.46	14.64	18.27	19.92	21.6	24.19	28.68
123	10.25	12.69	13.48	14.68	18.33	19.99	21.69	24.29	28.83
124	10.33	12.72	13.51	14.71	18.39	20.07	21.77	24.4	28.98
125	10.42	12.74	13.54	14.75	18.45	20.14	21.86	24.51	29.14
126	10.5	12.77	13.57	14.78	18.51	20.21	21.95	24.62	29.28
127	10.58	12.79	13.6	14.82	18.57	20.28	22.03	24.72	29.43
128	10.67	12.82	13.63	14.86	18.63	20.36	22.12	24.83	29.58
129	10.75	12.85	13.67	14.9	18.7	20.43	22.2	24.94	29.72

130	10.83	12.88	13.7	14.94	18.76	20.51	22.29	25.04	29.86
131	10.92	12.91	13.74	14.98	18.82	20.58	22.38	25.15	30
132	11	12.94	13.77	15.03	18.89	20.66	22.47	25.25	30.14
133	11.08	12.97	13.81	15.07	18.95	20.73	22.55	25.36	30.28
134	11.17	13.01	13.84	15.11	19.02	20.81	22.64	25.46	30.41
135	11.25	13.04	13.88	15.16	19.09	20.89	22.73	25.57	30.54
136	11.33	13.08	13.92	15.2	19.15	20.96	22.81	25.67	30.67
137	11.42	13.11	13.96	15.25	19.22	21.04	22.9	25.77	30.8
138	11.5	13.15	14	15.3	19.29	21.12	22.99	25.87	30.93
139	11.58	13.18	14.04	15.35	19.36	21.2	23.08	25.98	31.05
140	11.67	13.22	14.09	15.39	19.42	21.27	23.16	26.08	31.17
141	11.75	13.26	14.13	15.44	19.49	21.35	23.25	26.18	31.3
142	11.83	13.3	14.17	15.49	19.56	21.43	23.34	26.28	31.42
143	11.92	13.34	14.22	15.54	19.63	21.51	23.42	26.38	31.54
144	12	13.38	14.26	15.59	19.7	21.59	23.51	26.47	31.66
145	12.08	13.42	14.31	15.65	19.77	21.66	23.59	26.57	31.77
146	12.17	13.47	14.35	15.7	19.84	21.74	23.68	26.67	31.89
147	12.25	13.51	14.4	15.75	19.91	21.82	23.76	26.76	32
148	12.33	13.55	14.45	15.8	19.98	21.9	23.85	26.86	32.11
149	12.42	13.6	14.5	15.86	20.05	21.97	23.93	26.95	32.22
150	12.5	13.64	14.54	15.91	20.12	22.05	24.02	27.05	32.33
151	12.58	13.69	14.59	15.96	20.19	22.12	24.1	27.14	32.43
152	12.67	13.73	14.64	16.02	20.26	22.2	24.18	27.22	32.53
153	12.75	13.78	14.69	16.07	20.33	22.27	24.26	27.31	32.63
154	12.83	13.82	14.74	16.13	20.39	22.35	24.34	27.4	32.73
155	12.92	13.87	14.79	16.18	20.46	22.42	24.42	27.49	32.82
156	13	13.92	14.84	16.23	20.53	22.49	24.49	27.57	32.91
157	13.08	13.96	14.89	16.29	20.59	22.56	24.57	27.65	33
158	13.17	14.01	14.94	16.34	20.66	22.63	24.64	27.73	33.09
159	13.25	14.06	14.99	16.4	20.72	22.7	24.71	27.81	33.17
160	13.33	14.1	15.04	16.45	20.79	22.77	24.79	27.88	33.24
161	13.42	14.15	15.09	16.5	20.85	22.84	24.86	27.96	33.32
162	13.5	14.2	15.13	16.55	20.91	22.9	24.92	28.03	33.39
163	13.58	14.24	15.18	16.61	20.98	22.97	24.99	28.1	33.47
164	13.67	14.29	15.23	16.66	21.04	23.03	25.06	28.16	33.53
165	13.75	14.34	15.28	16.71	21.1	23.09	25.12	28.23	33.6
166	13.83	14.38	15.33	16.76	21.15	23.15	25.18	28.29	33.66
167	13.92	14.43	15.38	16.81	21.21	23.21	25.25	28.36	33.72

168	14	14.47	15.42	16.86	21.27	23.27	25.31	28.42	33.78
169	14.08	14.52	15.47	16.91	21.33	23.33	25.37	28.48	33.83
170	14.17	14.57	15.52	16.96	21.38	23.39	25.42	28.53	33.88
171	14.25	14.61	15.57	17.01	21.43	23.44	25.48	28.59	33.93
172	14.33	14.65	15.61	17.06	21.49	23.5	25.53	28.64	33.98
173	14.42	14.7	15.66	17.11	21.54	23.55	25.59	28.69	34.03
174	14.5	14.74	15.71	17.16	21.59	23.6	25.64	28.74	34.07
175	14.58	14.79	15.75	17.2	21.64	23.65	25.69	28.79	34.11
176	14.67	14.83	15.8	17.25	21.69	23.7	25.74	28.84	34.15
177	14.75	14.87	15.84	17.3	21.74	23.75	25.78	28.88	34.18
178	14.83	14.92	15.88	17.34	21.79	23.8	25.83	28.92	34.21
179	14.92	14.96	15.93	17.39	21.83	23.84	25.87	28.97	34.25
180	15	15	15.97	17.43	21.88	23.89	25.92	29.01	34.28
181	15.08	15.04	16.01	17.47	21.92	23.93	25.96	29.05	34.31
182	15.17	15.08	16.05	17.51	21.96	23.97	26	29.08	34.33
183	15.25	15.12	16.09	17.56	22.01	24.01	26.04	29.12	34.36
184	15.33	15.16	16.13	17.6	22.05	24.05	26.08	29.15	34.39
185	15.42	15.2	16.17	17.64	22.09	24.09	26.12	29.19	34.41
186	15.5	15.24	16.21	17.68	22.13	24.13	26.15	29.22	34.43
187	15.58	15.27	16.25	17.72	22.17	24.17	26.19	29.25	34.45
188	15.67	15.31	16.28	17.75	22.2	24.21	26.23	29.29	34.48
189	15.75	15.34	16.32	17.79	22.24	24.24	26.26	29.31	34.49
190	15.83	15.38	16.36	17.82	22.28	24.28	26.29	29.34	34.51
191	15.92	15.41	16.39	17.86	22.31	24.31	26.32	29.37	34.53
192	16	15.45	16.42	17.9	22.35	24.34	26.36	29.4	34.54
193	16.08	15.48	16.46	17.93	22.38	24.38	26.39	29.42	34.56
194	16.17	15.51	16.49	17.96	22.41	24.41	26.42	29.45	34.58
195	16.25	15.54	16.52	17.99	22.44	24.44	26.45	29.48	34.6
196	16.33	15.57	16.55	18.02	22.48	24.47	26.48	29.5	34.62
197	16.42	15.6	16.58	18.06	22.51	24.5	26.5	29.53	34.63
198	16.5	15.63	16.61	18.08	22.54	24.53	26.53	29.55	34.64
199	16.58	15.65	16.64	18.11	22.57	24.56	26.56	29.58	34.66
200	16.67	15.68	16.66	18.14	22.59	24.59	26.59	29.6	34.68
201	16.75	15.7	16.69	18.17	22.62	24.61	26.61	29.63	34.7
202	16.83	15.73	16.71	18.19	22.65	24.64	26.64	29.65	34.71
203	16.92	15.75	16.74	18.22	22.68	24.67	26.67	29.68	34.73
204	17	15.78	16.76	18.24	22.7	24.7	26.69	29.7	34.75
205	17.08	15.8	16.78	18.27	22.73	24.72	26.72	29.73	34.77

206	17.17	15.82	16.81	18.29	22.76	24.75	26.74	29.75	34.78
207	17.25	15.84	16.83	18.31	22.78	24.77	26.77	29.77	34.8
208	17.33	15.86	16.85	18.34	22.81	24.8	26.8	29.8	34.82
209	17.42	15.88	16.87	18.36	22.83	24.82	26.82	29.82	34.84
210	17.5	15.9	16.89	18.38	22.86	24.85	26.85	29.85	34.87
211	17.58	15.91	16.91	18.4	22.88	24.88	26.87	29.87	34.89
212	17.67	15.93	16.93	18.42	22.9	24.9	26.9	29.9	34.91
213	17.75	15.95	16.95	18.44	22.93	24.93	26.92	29.92	34.93
214	17.83	15.97	16.96	18.46	22.95	24.95	26.95	29.95	34.95
215	17.92	15.98	16.98	18.48	22.98	24.98	26.97	29.98	34.98
216	18	16	17	18.5	23	25	27	30	35

(Cole & Lobstein, 2012)

Appendix C

HHFKA of 2010 Dietary Specifications

Final Rule Nutrition Standards in NSLP & School Breakfast Program --- Jan. 2012

	Breakfast Meal Pattern			**Lunch Meal Pattern**		
	Grades K-5[a]	***Grades 6-8[a]***	***Grades 9-12[a]***	***Grades K-5***	***Grades 6-8***	***Grades 9-12***
Meal Pattern	**Amount of Food[b] Per Week (Minimum Per Day)**					
Fruits (cups)[c,d]	5 (1) [e]	5 (1) [e]	5 (1) [e]	2½ (½)	2½ (½)	5 (1)
Vegetables (cups)[c,d]	0	0	0	3¾ (¾)	3¾ (¾)	5 (1)
Dark green [f]	0	0	0	½	½	½
Red/Orange [f]	0	0	0	¾	¾	1¼
Beans/Peas (Legumes)[f]	0	0	0	½	½	½
Starchy[f]	0	0	0	½	½	½
Other [f,g]	0	0	0	½	½	¾
Additional to Reach Total[h]	0	0	0	1	1	1½
Grains (oz eq)[i]	7-10 (1) [j]	8-10 (1) [j]	9-10 (1) [j]	8-9 (1)	8-10 (1)	10-12 (2)
Meats/Meat Alternates (oz eq)	0 [k]	0 [k]	0 [k]	8-10 (1)	9-10 (1)	10-12 (2)
Fluid milk/Milk Alternates (cups) [l]	5 (1)	5 (1)	5 (1)	5 (1)	5 (1)	5 (1)
Other Specifications: Daily Amount Based on the Average for a 5-Day Week						
Min-max calories (kcal)[m,n,o]	350-500	400-550	450-600	550-650	600-700	750-850
Saturated fat (% of total calories)[n,o]	< 10	< 10	< 10	< 10	< 10	< 10
Sodium (mg)[n, p]	< 430	< 470	< 500	< 640	< 710	< 740
Trans fat[n,o]	Nutrition label or manufacturer specifications must indicate zero grams of trans fat per serving.					

[a]In the SBP, the above age-grade groups are required beginning July 1, 2013 (SY 2013-14). In SY 2012-2013 only, schools may continue to use the meal pattern for grades K-12 (see § 220.23).

[b] Food items included in each food group and subgroup and amount equivalents. Minimum creditable serving is ⅛ cup.

[c]One quarter-cup of dried fruit counts as ½ cup of fruit; 1 cup of leafy greens counts as ½ cup of vegetables. No more than half of the fruit or vegetable offerings may be in the form of juice. All juice must be 100% full-strength.

[d]For breakfast, vegetables may be substituted for fruits, but the first two cups per week of any such substitution must be from the dark green, red/orange, beans and peas (legumes) or “Other vegetables” subgroups as defined in §210.10(c)(2)(iii).

[e]The fruit quantity requirement for the SBP (5 cups/week and a minimum of 1 cup/day) is effective July 1, 2014 (SY 2014- 2015).

[f]Larger amounts of these vegetables may be served.

[g] This category consists of “Other vegetables” as defined in §210.10(c)(2)(iii)(E). For the purposes of the NSLP, “Other vegetables” requirement may be met with any additional amounts from the dark green, red/orange, and beans/peas (legumes) vegetable subgroups as defined in §210.10(c)(2)(iii).

[h]Any vegetable subgroup may be offered to meet the total weekly vegetable requirement.

[i]At least half of the grains offered must be whole grain-rich in the NSLP beginning July 1, 2012 (SY 2012-2013), and in the SBP beginning July 1, 2013 (SY 2013-2014). All grains must be whole grain-rich in both the NSLP and the SBP beginning July 1, 2014 (SY 2014-15).

[j]In the SBP, the grain ranges must be offered beginning July 1, 2013 (SY 2013-2014).

[k]There is no separate meat/meat alternate component in the SBP. Beginning July 1, 2013 (SY 2013-2014), schools may substitute 1 oz. eq. of meat/meat alternate for 1 oz. eq. of grains after the minimum daily grains requirement is met.

[l]Fluid milk must be low-fat (1 percent milk fat or less, unflavored) or fat-free (unflavored or flavored).

[m]The average daily amount of calories for a 5-day school week must be within the range (at least the minimum and no more than the maximum values).

[n]Discretionary sources of calories (solid fats and added sugars) may be added to the meal pattern if within the specifications for calories, saturated fat, trans fat, and sodium. Foods of minimal nutritional value and fluid milk with fat content greater than 1 percent milk fat are not allowed.

[o]In the SBP, calories and trans fat specifications take effect beginning July 1, 2013 (SY 2013-2014).

[p]Final sodium specifications are to be reached by SY 2022-2023 or July 1, 2022. Intermediate sodium specifications are established for SY 2014-2015 and 2017-2018. See required intermediate specifications in § 210.10(f)(3) for lunches and § 220.8(f)(3) for breakfast