Spring 2015

Investigation Into School Lunch Quality Following Healthy Hunger-Free Kids Act Implementation

Katherine N. Smith
Central Washington University, smithkathe84@gmail.com

INVESTIGATION INTO SCHOOL LUNCH QUALITY FOLLOWING HEALTHY HUNGER-FREE KIDS ACT IMPLEMENTATION

A Thesis

Presented to

The Graduate Faculty

Central Washington University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

Nutrition

---

by

Katherine N. Smith

May 2015

CENTRAL WASHINGTON UNIVERSITY

Graduate Studies

We hereby approve the thesis of

Katherine N. Smith

Candidate for the degree of Master of Science

APPROVED FOR THE GRADUATE FACULTY

_____ _____
Dr. Ethan Bergman, Committee Chair

_____ _____
Dr. Tim Englund

_____ _____
Professor Dana Ogan

_____ _____
Dean of Graduate Studies

ABSTRACT

INVESTIGATION INTO SCHOOL LUNCH QUALITY FOLLOWING HEALTHY HUNGER-FREE KIDS ACT IMPLEMENTATION

By

Katherine N. Smith

May 2015

The relationship between school lunch quality and the Healthy Hunger Free Kids Act (HHFKA) revised nutrition standards was investigated. School Lunches from four Washington State elementary schools that earned HealthierUS School Challenge awards. Nutrition content of the meals selected and consumed was assessed using before and after digital photos. Meals were scored using the Healthy Eating Index (HEI) to determine meal quality. Results were based on 1033 lunches (509 pre-HHFKA in Spring 2012 and 524 in Spring 2013) and revealed improved HEI scores for most components post-HHFKA implementation school lunches both served and consumed. Implications of the differences in HEI scores are discussed.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Supportive nutrition is crucial for children's health both short-term and long-term. A healthy diet helps protect against nutrient deficiencies, obesity, and other chronic diseases. Providing an adequate nutritional start has a positive impact not only on a child's physical development, but also their mental and social development. Poor nutrition and its consequences are a major concern in the United States. With millions of children attending public schools, meals offered in schools are a consistent way to help reduce food insecurity, poor nutrition and the complications that result among American youth.

School lunches are offered to every student through the National School Lunch Program (NSLP). The NSLP is also one of the largest nutrition assistance programs in the United States and is the basis of nutrition services in schools. Standards for school lunches have been continuously reevaluated and revised. The most current revision of meal standards for the NSLP were outlined in the final rule of the Healthy Hunger Free Kids Act of 2010 (HHFKA), published in the Federal Register (Federal Register, 2012). The HHFKA required changes in the overall meal structure of lunches served in schools.

CHAPTER II

LITERATURE REVIEW

Nutrition Status of Children in the U.S.

Proper nutrition is essential for the long-term health of children. A healthy diet helps protect against all forms of malnutrition that can lead to nutrient deficiencies, obesity, diabetes, and other chronic disease ("WHO Healthy Diet," 2014)**.** Giving a child a supportive and adequate nutritional start has a positive impact not only on their physical development but also their mental and social development. A study completed in 2013 investigated the nutritional intake of 5200 5th grade student and tested their academic abilities. This study found that students with a higher intake of vegetables and lower caloric intake of fat were significantly less likely to perform poorly on academic assessments (Florence, Asbridge, & Veugelers, 2008). Based on this study and other findings, there is evidence that good nutrition results in better performance in the classroom. On the contrary, those who don't eat a well-balanced diet perform poorly in comparison. Food insecurity refers to the condition that individual or families don't have read access to a secure food source resulting in individuals or families going without food at some point in the year. Food insecurity and its consequences are a major concern in the United States.

In 2013, 19.5% of American households with children were reported to be food insecure at least some point during that year. Almost half of those families (9.9% of the study sample) reported both children and adults experienced food access problems, at various times reduced food intake and altered eating patterns due to limited food resources (Coleman-Jensen, Gregory, , & Singh 2014). Additionally, children from food

insecure households are more likely to be overweight or obese (Casey et al., 2006). According to present Centers Disease Control and Prevention 2007 guidelines, child and adolescent weight classification are based on age and gender norms and include the following categories: (a) “underweight,” defined as having a BMI-for-age (weight in kilograms divided by the square of height in meters) that is less than the 5th percentile (b) “healthy weight,” defined as having a BMI-for-age greater than the 5th percentile and less than the 85thpercentile; (c) “overweight,” defined as having a BMI-for-age at or above the 85th percentile but less than the 95th percentile; and (d) “obese,” defined as having a BMI at or above the 95th percentile (“Healthy Weight,” 2014).

The prevalence of childhood obesity is high in America with approximately 16.9% of 2-19 year olds in the United States being obese during 2011-2012 (Ogden, Carroll., Kit, & Flegal, 2014) The percentage of obesity in America has been steadily increasing. From 1980-2008 the prevalence of obesity in the U.S. has more than doubled among adults and more than tripled among children (Office of the Surgeon General (US), 2010). Even though children are consuming adequate or excessive food calories, they are not meeting the federal Dietary Guidelines for Americans (Smith, Guenther, Subar, Kirkpatrick, & Dodd, 2010) Food insecurity and childhood obesity combined implicate future consequences for children. Overweight and obese children face short and long term complications such as chronic inflammation, cardiovascular disease, type 2 diabetes, metabolic syndrome, mental health disorders, lower self-esteem, and underachievement in school and even increased mortality (Dietz, 1998; Reilly et al., 2003). School meals are a consistent avenue to help alleviate food insecurity, poor nutrition and the complications that result among American youth.

National School Meal Feeding Programs

Children who eat well perform better in class and have a greater opportunity to succeed in school. The rise in childhood obesity has brought scrutiny to the types and amounts foods offered and eaten at school and how that is affecting a child's overall diet intake (Hastert & Babey, 2009) Children spend more waking hours at school than they do at home during the school year and therefore schools are an ideal setting for teaching young people how to adopt and maintain a healthy, active lifestyle (Stang, 2010; Story, Nanney, & Schwartz, 2009)

School lunches are offered to every student through the NSLP. The NSLP is also one of the largest nutrition assistance programs in the United States and is the basis of nutrition services in schools. The NSLP has been in effect since 1946 when President Harry Truman signed it into law. Truman identified childhood nutrition as an important measure of national security. This Act established the NSLP in order to meet one-third to one-half the daily nutrition requirements for a 10-12 year old child in an effort to decrease the number of underweight, undernourished children in the United States. The Act was also structured to model good dietary habits for children and teach families about adequate food offerings by setting nutrition standards for school meals offered ("USDA School Lunch Act", 2010)

Standards for school lunches have been continuously reevaluated and revised based upon the population's needs, political influences, and the most current research. Initially, revisions were directed at the financial aspects of the program. In 1962, there were major revisions made to the National School Lunch Act. One of these revisions included a formula used by Congress to provide special assistance in the form of cash

reimbursement for meals served free or at substantially reduced prices to needy children ("USDA School Lunch Act", 2010). Standards regarding meal quality and nutrient content began to become a major focus on a federal level during 1990s with multiple initiatives and acts created that changed the structure of school lunch offerings.

In 1994, The School Meals Initiative for Healthy Children revised school lunch standards to comply with Dietary Guidelines for Americans for children over the age of 2. This Initiative required that school meals contain less than 30 percent of calories from fat and less than 10 percent of calories from saturated fat over the course of a week (Lutz, S.M., Hirschman, J., & Smallwood, D.M. 1994). In 1996, the Healthy Meals for Children Act created more flexibility in commodities ordering to support increased use of fruits, vegetables, and grains on school menus (House Report 104-561, 1996). The structure and purpose of the NSLP continues to evolve. The NSLP still offers meals with the purpose of decreasing food insecurity and malnourishment. However, the primary nutrition problem has shifted from undernourishment to obesity in children (Guthrie, Newman, & Ralston 2009; Ralston, Newman, Clauson, Guthrie, & Buzby 2008).

Because children spend a significant amount of time at school, the school environment is a feasible area to improve children's diets and reduce their risk of obesity (Briefel, Crepinsek, Cabili, Wilson, & Gleason, 2009). Over one million children attended schools in Washington State during the 2013-2014 school year and 45.9% (roughly 484,363 student) of those students were eligible to receive free or reduced school lunch because their households were at or below 185% of the poverty income level ("Washington State Report Card," 2015). Children who live in poverty are more likely to have food insecurity (Coleman-Jensen et al., 2014).

The NSLP has utilized federal funds to provide low cost or free meals to prevent low food intake. More recently, the NSLP has implemented new guidelines to prevent the overfeeding of low nutrient dense foods that lead to obesity (USDA, 2013). In 2004, the USDA introduced the HealthierUS School Challenge (HUSSC), which is a voluntary initiative for schools that participate in the NSLP to make positive changes to their nutrition and wellness programs. Schools are recognized for creating healthier school environments through promotion of nutrition and physical activity. In 2010, First Lady Michele Obama introduced the "Let's Move" campaign that included encouragement for schools to participate in HUSSC. Schools that participate in this initiative are eligible to receive monetary rewards depending upon how well they adhere to the HUSSC program criteria. HUSSC award levels include Bronze, Silver, Gold, and Gold Award of Distinction ("Child Nutrition Program - HealthierUS School Challenge," 2014). The First Lady announced on February 10, 2012 that 2,862 schools had then met the HealthierUS School Challenge ("Healthy Schools | Let's Move!," 2014). The participation in the program is on a voluntary basis and not all students in the NSLP benefited from the change from these incentives because the criterion for HUSSC are not a requirement for every school and organization participating in the NSLP.

Healthy Hunger-Free Kids Act

The most current revision of meal standards for the NSLP were outlined in the final rule of the Healthy Hunger Free Kids Act of 2010 (HHFKA), published in the Federal Register (2012). The HHFKA is intended to assist school nutrition staff in providing school meals that better align with the Dietary Guidelines for Americans. Requirements of the HHFKA include new professional standards for school food service

staff that include an action plan and ongoing training for school food service positions. Also, the HHFKA introduced changes to the NSLP that added national nutrition standards for all food sold in schools during the school day, including a la carte lines and vending machines. The final rule contains a standardized food-based menu planning system to be used by all schools. HHFKA also includes the requirements that meals be within a caloric range based on the RDA for both minimums and maximums for each grade group (K-6, 6-8, 9-12) and an increase in the amounts of fruits and vegetables required to be served in each school meal. Additionally, the final rule limits the amount of sodium served and requires that foods served do not contain non-naturally occurring trans fats (Federal Register, 2012). Refer to Table 1 for HHFKA requirements compared to the School Meal Initiative Guidelines.

Lunches Brought from Home Compared to Lunches Served in Schools

Implementation of the HHFKA nutrition standards took effect nationwide in the fall of the 2012-2013 academic year. Initial reactions to the lunches served with the HHFKA standards indicate very few school staff perceived strong resistance to change from students (Turner & Chaloupka, 2014). In rural areas, it was reported that parents felt schools were an appropriate place to offer nutritious food, yet the school meal were perceived as bland and unappealing. This indicates that nutritious food that is also appealing can increase fruit and vegetable intake (Jeffries, Thayer, Hennink-Kaminski, & Noar, 2015).

Table 1.

HEI–2010 Components & Scoring Standards

Adequacy:			
Component	**Maximum points**	**Standard for maximum score**	**Standard for minimum score of zero**
Total Fruit[1]	5	≥0.8 cup equiv. per 1,000 kcal	No Fruit
Whole Fruit	5	≥0.4 cup equiv. per 1,000 kcal	No Whole Fruit
Total Vegetables[3]	5	≥1.1 cup equiv. per 1,000 kcal	No Vegetables
Greens and Beans[3]	5	≥0.2 cup equiv. per 1,000 kcal	No Dark Green Vegetables or Beans and Peas
Whole Grains	10	≥1.5 oz equiv. per 1,000 kcal	No Whole Grains
Dairy[4]	10	≥1.3 cup equiv. per 1,000 kcal	No Dairy
Total Protein Foods[5]	5	≥2.5 oz equiv. per 1,000 kcal	No Protein Foods
Seafood and Plant Proteins[5,6]	5	≥0.8 oz equiv. per 1,000 kcal	No Seafood or Plant Proteins
Fatty Acids[7]	10	(PUFAs + MUFAs)/SFAs >2.5	(PUFAs + MUFAs)/SFAs <1.2
Moderation:			
Component	**Maximum points**	**Standard for maximum score**	**Standard for minimum score of zero**
Refined Grains	10	≤1.8 oz equiv. per 1,000 kcal	≥4.3 oz equiv. per 1,000 kcal
Sodium	10	≤1.1 gram per 1,000 kcal	≥2.0 grams per 1,000 kcal
Empty Calories[8]	20	≤19% of energy	≥50% of energy

1: Includes fruit juice.
2: Includes all forms except juice.

3: Includes any beans and peas not counted as Total Protein Foods.
4: Includes all milk products, such as fluid milk, yogurt, and cheese, and fortified soy beverages.
5: Beans and peas are included here (and not with vegetables) when the Total Protein Foods standard is otherwise not met.
6: Includes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted as Total Protein Foods.
7: Ratio of poly- and monounsaturated fatty acids to saturated fatty acids.
8: Calories from solid fats, alcohol, and added sugars; threshold for counting alcohol is >13 grams/1000 kcal.

Adapted from the National Cancer Institute *Developing the Healthy Eating Index-2010*

Since the enactment of HHFKA, much focus has been brought to NSLP meals versus lunches brought from home and the quality of these meals. Research indicates that lunches brought from home are more often nutritionally deficient than lunches served by the school lunch program both before and after the implementation of the HHFKA. Nutrients assessed in two of these studies included total fat, saturated fat, carbohydrates, protein, calcium, total dietary fiber, cholesterol, iron, sodium, vitamin A, and vitamin C. (Farris, et al., 2014; Bergman, et al., 2014). These findings support the thought that school lunch meals have been more nutritious that lunches brought from home, even before the latest NSLP standards.

Research has also been done comparing the nutrient content of NSLP lunches selected and consumed both before and after the implementation of the HHFKA. It was shown that there were improvements in both selected and consumed nutrients when comparing meals before implementation of HHFKA standards to meals after implementation of HHFKA standards. Nutrients assessed included total fat, saturated fat, carbohydrates, protein, calcium, total dietary fiber, cholesterol, iron, sodium, vitamin A, and vitamin C. (Bergman et al., 2014). Investigating NSLP meal quality by assessing nutrient content is an effective way of indicating how nutrient dense NSLP meals

selected and consumed really are. There are multiple ways to reliably evaluate the quality of meals and overall diet of people in the United States. One method that is frequently used is the Healthy Eating Index (HEI). The HHFKA standards are modeled around the food component structure, which also aligns with the structure of the Healthy Eating Index.

Healthy Eating Index

The Healthy Eating Index is a dietary assessment tool that is comprised of 12 components that are designed to measure quality of diets by how well they meet the recommendations of the 2010 Dietary Guidelines for Americans ("Healthy Eating Index | Center for Nutrition Policy and Promotion," 2014)**.** The 12 categories are as follows: Total Fruit, Whole Fruit, Total Vegetables, Greens and Beans, Whole Grains, Dairy, Total Protein Foods, Seafood and Plant Proteins, Fatty Acids, Refined Grains, Sodium, and Empty Calories. Each category has a potential score with all categories maximum scores totaling to a score of 100. The scoring standards are density-based, for example, percent of total calories or per 1,000 calories. This scoring method is used to better assess the different types of food in a relative manner (Guenther et al., 2012).

Diet quality is assessed from two perspectives: nine components being score for adequacy (dietary components in which increased consumption is recommended) and three components being scored for moderation (dietary components that are recommended in limited quantities). For the adequacy components, this means that increasing levels of intake receive increasingly higher scores; whereas for the moderation components, increasing levels of intake receive decreasingly lower scores. Please see Table 1 below for detail on how the HEI score is computed. The higher the total HEI

score the better the adherence to dietary guidelines. The quality of the diets of American children, ages 2-17, was found to be below the dietary guidelines in the years 2003-04,2005-06, and 2007-08 with total HEI scores ranging from 47 to 50 out of 100 (Center for Nutrition Policy and Promotion, 2013). HEI of scores these children could have been improved by increasing intake of vegetables, decreasing the amount of sodium and empty calories and by replacing refined grains with whole grains.

The HHFKA was implemented to increase the meal quality of NSLP meals. Lunches have been found to have an increase in nutrition value; however, further research has shown that, in some areas, school lunches still need some improvements to reach HHFKA standards (Echon, 2014). This research was completed in the school years 2010-11 and 2011-2012 in five states. Further research should be done in other regions before drawing a conclusion to represent the NSLP as a whole. Research is limited in regards to quality of NSLP meals offered and consumed since the implementation of the HHFKA. Additionally, there is limited research investigating NSLP meal quality by food components structure and to truly assess to what degree NSLP meals are meeting the HHFKA goal.

Purpose of the Current Study

Therefore the purpose of this study is to investigate the effect of meal components changes related to the implementation the Healthy Hunger-Free Kids Act of 2010 on school lunch quality and consumption rates using the Healthy Eating Index when compared to school lunch quality and previous to implementation of the Healthy Huger-Free Kids Act.

CHAPTER III
JOURNAL ARTICLE

School Lunch Quality Following Healthy Hunger Free Kids Act Implementation

INTRODUCTION

Proper nutrition is essential for the long-term health of children. According to the World Health Organization (2014), giving a child a supportive and adequate start in life with food and nutrition has a positive impact not only on their physical development, but their mental and social development as well**.** The National School Lunch Program (NSLP) is one of the largest nutrition assistance programs in the United States. The NSLP utilizes federal funds to provide low cost or free meals to prevent inadequate food and nutrient intake. Recently, there have been significant changes involving the nutrition requirements of meals.

In 2004, the United States Department of Agriculture (USDA) introduced the HealthierUS School Challenge (HUSSC). The HUSSC is a voluntary initiative for schools that participate in the NSLP to make positive changes to their nutrition and wellness programs. Schools are recognized for reaching specific program goals. Food-related goals include serving food with lower sodium and fat content and serving more fruits, vegetables, and grains. HUSSC has also set goals on increased physical activity and nutrition education in the school setting ("Let's Move!", 2015; OSPI, 2014)

Most recently, the NSLP has implemented new guidelines set out by the Healthy Hunger Free Kids Act of 2010 (HHFKA) which were published in the January 26, 2012 *Federal Register* (Federal Register, 2013). All NSLP schools are required to participate and abide by HHFKA guidelines. The HHFKA is intended to assist Child Nutrition Professionals (CNPs) in providing school meals that align with the Dietary Guidelines for Americans. Requirements of the HHFKA include new professional standards for CNPs

that include an action plan and ongoing training for school food service positions.

The final rule contains a standardized food-based menu planning system to be used by all schools. Food based menu planning sets daily/weekly requirements for nutrient dense foods from all food groups. HHFKA also includes the requirements that meals be within a caloric range based on the Recommended Daily Allowance (RDA) including both minimums and maximums for each grade group (K-6, 6-8, 9-12). The HHFKA guidelines include an increase in the amounts of fruits and vegetables required to be served in each school meal. Additionally, the final rule limits the amount of sodium served and requires zero non-naturally occurring trans fats (Federal Register, 2013; Lutz, Hirschman, & Smallwood, 1994). Table 2 illustrates HHFKA requirements compared to the previous School Meal Initiative Guidelines.

One of the goals of the HHFKA is to improve children's overall diet, health status, and to prevent the overfeeding of low nutrient density foods that contribute to obesity (USDA, 2013, 2015a). During the academic year, children spend more waking hours at school than they do at home (Story, Nanney, & Schwartz, 2009). Because of the time spent at school, the school environment is an ideal area to improve children's diets and reduce their risk of obesity (Briefel, Crepinsek, Cabili, Wilson, & Gleason, 2009). Bergman et al.(2014) revealed that school lunches selected and consumed post-HHFKA were more nutritious that lunches served prior to implementation of HHFKA. This indicates that CNPs were making improvements to the meal quality in regards to nutrient content.

There are many reliable ways to analyze quality of meal and overall diet quality. One method that is frequently used is the Healthy Eating Index (HEI). The HEI is designed to

Table 2.

Comparison of School Meal Initiative Guidelines and Healthy Hunger-Free Kids Guidelines under Final Rule, "Nutrition Standards in the National School Lunch and School Breakfast Programs" (published January 26, 2012)

Food Group	**School Meal Initiative Guidelines for grades K-3**	**Healthy Hunger-Free Kids Act Guidelines for grades K-5 (as of 7/1/12)**
Fruit and Vegetables	½ - ¾ cup of fruit and vegetables combined per day	¾ - 1 cup of vegetables plus ½ -1 cup of fruit per day
Vegetables	No specifications as to type of vegetable subgroup	Weekly requirement for: •0.5 cups dark green •0.75 cups red/orange •0.5 cups beans/peas (legumes) •0.5 cups starchy •1 cup other (as defined in 2010 Dietary Guidelines)
Meat/Meat Alternate	1.5 – 2 oz eq. (daily minimum)	Daily minimum and weekly ranges: Grades K-5: 1 oz eq. min. daily (8-10 oz weekly)
Grains	8 oz eq. per week (minimum 1 oz per day)	8-9 oz per week
Whole Grains	Encouraged	At least half of the grains must be whole grain-rich beginning July 1, 2012. Beginning July 1, 2014, all grains must be whole grain rich.
Milk	1 cup per day Variety of fat contents allowed; flavored not restricted	1 cup per day Must be fat-free (unflavored/flavored) or 1% Low-fat (unflavored)
Sodium	No set targets	Target 1: SY* 2014-15 for lunch ≤ 1,230 mg (K-5) Target 2: SY 2017-18 for lunch ≤ 935 mg (K-5) Final Target: SY 2022-23 for lunch ≤ 640 mg (K-5)
Calories	Traditional menu planning	Only food-based menu

	Lunch : 633 per day (K-3) 785 per day (4-12)	planning allowed Calorie range (min. & max.) Lunch: 550-650 (grade K-5)
Saturated Fat	<10% of total calories	<10% of total calories
Trans Fat	No limit	0 grams per serving

*SY: School Year

Adapted from the Federal Register (2012) *Nutrition Standards in the National School Lunch and School Breakfast Programs; Final Rule;* and USDA (2012)

measure how well various food components meet the recommendations of the 2010 Dietary Guidelines. The HEI analyzes 12 components: Total Fruit, Whole Fruit, Total Vegetable, Greens and Beans, Whole Grains, Dairy, Total Protein Foods, Seafood and Plant Proteins, Sodium, Fatty Acids, Refined Grains, and Empty Calories. Each component is classified as either an adequacy or a moderation component. Adequacy components receive a higher score with a higher intake of the component. Conversely, moderation components receive a higher score with a lower intake of the component. The scoring model of the HEI aligns closely with the food-based menu planning requirements of the HHFKA, which make the HEI a good score tool to access the quality NSLP lunches.

Purpose

The purpose of this study was to assess NSLP meal quality (selected vs. consumed) before and after implementation of HHFKA, using the HEI meal component- scoring index, in grades 2-5.

METHODOLOGY

This is a secondary study using an existing database. The initial study was conducted during school years 2011-12 and 2012-13 with secondary analysis performed during the spring of 2015.

Validation of Methods and Reliability of Data Collectors

Three trained graduate student researchers completed all visual estimations. These methods are described in a previous study (Bergman et al., 2014)

Participants

Students, grades 2-5, from four Washington State elementary schools in two school districts participated in the study. Schools were selected based on their achievement of a HUSSC award in the school year prior to data collection. One district was located in western Washington. The participating schools had a free and reduced priced meal (FRP) rate of 83%. The other district was located in eastern Washington. The participating schools had a FRP rate of 16%. The kitchens at each location were a production/service system with some onsite preparation including some scratch cooking. All four schools were "offer versus serve" systems where students were given a choice of menu items to place on their trays. All four schools also had daily salad bars for students to select fruit and vegetable options. Trays were consistently sampled from each school for 30 days in the months of April and May during each year.

Procedure

Teachers and administrators were provided a script to explain the study purpose and procedures. On the day of data collection, two laptops and two cameras were set up in the lunchroom. The researcher invited students to participate as they stood in line to pick up their NSLP meals. A photo was taken of the lunch prior to consumption and again after the student finished eating.

A custom computer database management program was created to allow researchers to record and link together "before" and "after" digital photographs of each

NSLP lunch studied. The amounts of food selected and remaining after the lunch period were visually estimated using these photographs. These amounts were then linked via the custom program to the portion sizes provided by the schools.

Information for each food item and the amount served were input into Nutrition Data System for Research software version 2014, developed by the Nutrition Coordinating Center (NCC), University of Minnesota, Minneapolis, MN. The NDSR database includes over 18,000 foods, 160,000 food variations, and values for 165 nutrients, nutrient ratios and food components (34). These data were used to compute an HEI score for each component of each lunch, both served ad consumed. These component scores were totaled to compute the Total HEI score for each lunch.

Statistical Analyses

The mean HEI component scores of the NSLP lunches selected and consumed per NSLP were calculated. Meals selected and meals consumed were scored separately. A multiple analysis of variance (MANOVA) statistical test was conducted to determine if there was a significant difference in the mean HEI component scores of NSLP meals selected and consumed in 2012 versus 2013. This test was followed by post-hoc analyses using multiple *t* tests, which compared the 2012 meals to the 2013 meals data by individual food component HEI scores ($\alpha = 0.05$).

RESULTS AND DISCUSSIONS

The results of this study were based on the analysis of 1033 lunches (509 pre-HHFKA in spring 2012 and 524 post-HHFKA in spring 2013) from elementary school students, grades 2-5.

When the NSLP meals from 2012 and 2013 were compared, the results support

the hypothesis that the implementation of the HHFKA had a significant positive effect on the overall meal quality of NSLP lunches. Summary statistics, displayed in Table 3, show HEI total meal scores were significantly improved for both meals selected (52.17 in 2012 to 56.98 in 2013) and meals consumed (49.83 in 2012 to 53.21 in 2013).

Table 3.

Healthy Eating Index Scores of Four HealthierUS School Challenge Elementary School Lunches Selected and Consumed Compared by Year

	Selected		Consumed	
Component (maximum score)	**2012 (n=509)**	**2013 (n=524)**	**2012 (n=509)**	**2013 (n=524)**
Total Fruit (5)	2.31 ± 0.10[a]	3.72 ± 0.08[a]	2.16 ± 0.10[b]	3.22 ± 0.10[b]
Whole Fruit (5)	2.57 ± 0.11[a]	4.05 ± 0.08[a]	2.35 ± 0.11[b]	3.43 ± 0.10[b]
Total Vegetables (5)	2.07 ± 0.09	2.22 ± 0.086	1.88 ± 0.09	1.88 ± 0.09
Greens and Beans (5)	0.46 ± .064[a]	0.22 ± 0.05[a]	0.42 ± 0.06[b]	0.22 ± .044[b]
Whole Grains (10)	2.78 ± 0.19[a]	2.01 ± 0.14[a]	2.57 ± 0.19[b]	1.66 ± 0.13[b]
Dairy (10)	9.32 ± 0.10[a]	8.95 ± 0.13[a]	8.57 ± 0.14[b]	7.96 ± 0.16[b]
Total Protein Foods (5)	3.68 ± 0.08	3.71 ± 0.07	3.30 ± 0.09	3.47 ± 0.08
Seafood and Plant Proteins (5)	0.47 ± 0.06[a]	1.24 ± 0.09[a]	0.42 ± 0.06[b]	1.05 ± 0.09[b]
Fatty Acids (10)	4.55 ± 0.18	4.49 ± 0.17	4.56 ± 0.18	4.64 ± 0.18
Refined Grains (10)	5.16 ± 0.17	5.51 ± 0.18	5.18 ± 0.18	5.56 ± 0.19
Sodium (10)	4.61 ± 0.16[a]	5.34 ± 0.17[a]	4.60 ±0.16[b]	5.30 ± 0.17[b]
Empty Calories (20)	14.17 ± 0.23[a]	15.39 ± 0.19[a]	13.8 ± 0.25[b]	14.81 ± 0.22[b]
Total Score (100)	52.17 ± 0.62[a]	56.98 ± 0.51[a]	49.82 ± 0.61[b]	53.21 ± 0.53[b]

All scores are mean ± standard error of the mean
Note: School Meal Initiative guidelines were followed in 2012 and HHFKA guidelines were followed in 2013.
[a] Indicates significant difference ($p < 0.05$) between HEI scores (selected) in 2012 and 2013.
[b] Indicates significant difference ($p < 0.05$) between HEI scores (consumed) in 2012 and 2013.

Additionally, there were improvements to the selected and consumed component scores of Total Fruit, Whole Fruit, Seafood and Plant Proteins, Sodium, and Empty Calories. HEI scores for the Greens and Beans, Whole Grains, and Dairy were found to

have decreased in both selected and consumed components.

Changes that result in an increase in HEI score

Improvements in the HEI scores for whole fruit in both NSLP meals selected (2.57 for 2012 to 4.05 in 2013) and consumed (2.35 for 2012 and 3.43 in 2013) were noted. The USDA HEI requires at least 0.4 cup equivalent per 1,000 kcal for a maximum score of 5. The Whole Fruit component score does not include juice. The Total Fruit component (which does include fruit juice) HEI score also improved in both selected (2.31 in 2012 and 3.72 in 2013) and consumed (2.16 in 2012 and 3.22 in 2013) NSLP meals. In the current study, 82% of meals included fresh fruit, compared to 56 % of lunch menus in elementary schools nationwide (32).

The HEI score for sodium improved in both selected meals (4.61 in 2012 to 5.34 in 2013) and consumed meals (4.60 in 2012 to 5.30 in 2013). Meals must have ≤ to 1,100 mg sodium per 1,000 kcal to receive a maximum score of 10. The threshold for a score of zero in this component would require a diet with ≥ 2,200 mg of sodium were preset per 1,000 kcal. A 2013 School Nutrition Dietary Assessment study revealed that, in most schools, the average sodium content of school lunches exceeds recommendations of the 2010 Dietary Guidelines by more than 50% (USDA, 2012a) which indicates that schools participating in HUSSC have lower sodium content than other elementary schools. HUSSC schools had higher standards for their meal offerings than nonparticipating NSLP school. Although, sodium is not a specific goal of HUSSC, it is likely that fewer high sodium foods were offered due to the goal of increasing fruits and vegetables, which are naturally low in sodium. Moreover, HHFKA has selected sodium as one of the nutrients to be incrementally reduced over time, as seen in Table 1 (Federal Register,

2013). Improved sodium and fruit HEI scores from 2012 to 2013 indicate that participating CNPs were making menu and recipe changes to reduce sodium and increase fruit offerings within their schools.

Changes that resulted in a reduction in HEI scores

The HEI score of Whole Grains decreased in both meals selected (2.78 in 2012 to 2.01 in 2013) and consumed (2.57 in 2012 and 1.66 in 2013). The schools participating in this study were "offer versus serve", therefore students may have chosen not to take and consume the whole grain products. Whole grains provide dietary fiber, B vitamins and minerals that reduce the risk of chronic disease (USDA, 2012b). Because of the benefits of including whole grains in the diet, beginning fall 2012, HHFKA required that half of the grains offered during the school week must meet the "whole grain-rich" criteria, which requires the food to be least 50% whole grain (USDA, 2012b). Yet whole grain-rich products do not receive a maximum HEI score because they are not 100% whole grain. In July 1, 2014, all grain products were required to meet the whole grain-rich criteria, which will have a positive effect on future HEI Whole Grain scores.

The Greens and Beans component in NSLP meals both selected (0.46 in 2012 to 0.22 in 2013) and consumed (0.42 in 2012 to 0.22 in 2013) revealed a decrease in the HEI score from year 2012 to 2013. The consumed HEI score for Greens and Beans 2013 was only 4% of the maximum score of 5. Unlike any other HEI score component, bean and peas may contribute to two component scores; either the Total Protein score or the Greens and Beans score. If Total Protein does not receive maximum score (5 points), beans and peas in the meal will be allocated in Total Protein and not the Greens and Beans component. Thus a relatively low protein meal will sufficient beans and peas may

have a low Greens and Beans component score (Guenther et al., 2012).

In the current study, the Total Protein HEI score not at the maximum and therefore did not receive a maximum score of 5 in the meals selected and consumed in both 2012 and 2013. Consequently, the beans or peas were not accounted for within the Greens and Beans component. This indicates that although some improvements have been made to non-animal protein sources (like beans and lentils) being utilized in menus, there is still room for improvement to increase selection and consumption of proteins, greens, and beans.

In summary, CNPs are making positive changes to their menus, resulting in overall improvement in nutrition quality of meals when comparing lunches pre-HHFKA (2012) to post-HHFKA (2013) years. Additionally, actual intake of many food components after implementation of HHFKA has either improved or remained constant, which illustrates that school nutrition professionals are offering healthier foods that are still appealing to students.

CONCLUSIONS AND APPLICATION

The results of this study suggest that HHFKA had a positive impact on total meal quality and meal components. From 2012 to 2013, total mean HEI scores improved for both selected and consumed meals. Specific improvements were observed in the mean HEI component scores for Total Fruit, Whole Fruit, Greens and Beans, Seafood and Plant proteins, and Sodium.

Negative findings in the four schools sampled were the reduced HEI score of Whole Grains and the consistently low HEI score for Greens and Beans. HEI scores range from 0 to 100, with higher scores indicating better diet quality. HEI scores greater

than 80 indicate a "good" diet, scores ranging from 51 to 80 reflect a diet that "needs improvement," and HEI scores below 51 imply a "poor" diet (Kennedy, Bowman, Lino, Gerrior, & Basiotis, 1998)

Table 4 illustrates the percentage of maximum score of each HEI component in the current study. When assessing each component using the HEI score and how they translate to diet quality as previously stated, it is apparent the Whole Grains component and Greens and Beans component are the lowest diet quality of the components consumed in 2013 NSLP lunches as they easily scored into the "poor" diet quality category. Assuming the Whole Grains and Greens and Beans components are low in other schools, CNPs are to target these components and increase amounts offered to assure a balanced menu selection that provides increased meal quality and higher HEI meal components scores to provide increased nutrition support to students participating in the NSLP.

A practical way for CNPs to increase whole grain selection and consumption would be to make food items that students prefer, such as pizza crusts or muffins, with 100% whole grain. This could potentially increase the likelihood of students' acceptability of the new product. It would be beneficial for CNPs to actively participate in scratch cooking, recipe development, and taste panels to get feedback on food acceptability. These practices could assist in creating recipes that would meet both HHFKA requirements and improve palatability to increase student acceptance and consumption of these modified products.

Table 4.

HEI Component Scores and Percentage of Maximum Score for HEI Component for NSLP Meals Consumed in Spring 2013

HEI Component	HEI Component Score 2013 Consumed	Maximum Score	Percentage of Maximum Score
Greens and Beans	0.22	5	4%
Whole Grains	1.66	10	17%
Seafood and Plant Proteins	1.05	5	21%
Total Vegetables	1.88	5	37%
Fatty Acids	4.64	10	46%
Sodium	5.30	10	53%
Refined Grains	5.56	10	56%
Total Fruit	3.22	5	64%
Whole Fruit	3.44	5	69%
Total Protein Foods	3.47	5	69%
Empty Calories	14.81	20	74%
Dairy	7.96	10	80%
Total Meal Score	52.2	100	53%

Adapting existing recipes to include finely chopped spinach, broccoli or kale with chili, spaghetti or other saucy entrées is one way to increase Greens and Beans.

Additionally, utilizing beans to cook, mash and add into sauces, and placing scratch-made hummus on sandwiches are a few more ideas to increase these important components. For example, pureeing 2 2/3 - #10 cans (1 gal, 1 ¾ qt) of great northern beans to a 100-serving macaroni and cheese recipe would provide enough plant protein per serving (.5oz equivalent) to improve the plant protein from 1.05 to a score of 5 for that component (Newman Elementary School, 2014). This single change in the menu could improve the total HEI score from 53.21 to over 57.

Increasing protein in NSLP would also help improve the Greens and Beans HEI score, without having to change the Greens and Beans offerings. The use of unsalted nuts or seeds on salads, side dishes or in baked goods would increase protein amounts of

lunches offered.

The HEI Fatty Acids score of 4.64 representing 46% of the maximum score of 10 also falls in the "poor diet" range of less that 51. CNPs could improve upon this component by offering more fish, seafood, beans and lentils and offering other plant-based protein sources while limiting sources of saturated fat like beef, butter and shortening. One way to reduce butter and shortening in recipes is by substituting applesauce for fat in baking. For example ¼ cup of applesauce can replace ½ cup of butter to moisten and hold baked goods together and lower the calories and saturated fat content. Another idea is to offer a vegetarian option for students to select. Stir frying using kidney beans and vegetables, black bean burgers, and tofu seasoned and tossed into burritos are all options that would effectively decrease saturated fat and increase HEI score for Fatty Acids.

In summary, the current study indicates that changes in the meal components required by the HHFKA meals standards improved the overall quality of the NSLP meals within the four elementary schools participating in this study. However, the low to mid-level HEI scores of all meal components illustrate that there is still significant room for improvement. Although these results are based on limited data in four schools, it is worthwhile for CNPs to be innovative in recipe development and meal planning to address areas of inadequacy. Ways that this can be accomplished include incorporating more beans and legumes, 100% whole grains, and combining greens and beans into sauces, meats and soups.

Study Strengths and Limitations

Strengths of the current study include the reliability of the methodology.

Additional strengths included the timing of the data collection. Data were collected in two years in the same four schools. During the time of data collection, the NSLP meal standards changed from the School Meal Initiative standards to the HHFKA standards. One set of data was collected during the School Meal Initiative school meal standards. The second set of data collection was collected during the first year of the new HHFKA standards. Collecting data from the same four schools controlled other factors from one year to another that could have affected school meals and therefore gave confidence that differences seen were because of implementation of HHFKA. Additionally, comparing food components to analyze the effectiveness of HHFKA on meal quality is more aligned with HHFKA menu planning guidelines than analyzing based on nutrient density, as seen in Bergman et al (2014), due to the food component structure of the new meal pattern guidelines of HHFKA.

Limitations to the current study include the use of a convenience sample of only four HUSSC schools in one state. The results from these schools may not be generalizable to all schools that participate in the NSLP. Future studies should include sampling from various regions of the country to get a better representation of the population. Future studies including non-HUSCC schools are also warranted.

ACKNOWLEDGEMENTS

This project was funded at least in part with federal funds from the US Department of Agriculture, Food and Nutrition Service through an agreement with the National Food Service Management Institute (NFSMI) at the University of Mississippi. The contents of this publication do not necessarily reflects the views or policies of the US Department of Agriculture, nor does mention of trade names, commercial products, or organizations imply endorsement by the US government.

REFERENCES

Bergman, E.A., Englund, T., Weight Taylor,K., Watkins, T., Schepman, S., & Rushing, K. (2014). School Lunch Before and After Implementation of the Healthy Hunger-Free Kids Act. *The Journal of Child Nutrition & Management, 38*(2). Retrieved from https://schoolnutrition.org/uploadedFiles/5_News_and_Publications/4_The_Journal_of_Child_Nutrition_and_Management/Fall_2014/SchoolLunchBeforeandAfterImplementationHealthyHungerFreeKidsAct.pdf

Bergman, E.A., Saade, C., Shaw, E., Englund, T., Cashman, L., Weight Taylor, K., …Rushing, K. (2014). Lunches Selected and Consumed from the National School Lunch Program in Schools Designate as HealthierUS School Challenge Schools Are More Nutritious than Lunches Brought from Home. *The Journal of Child Nutrition & Management, 38*(2). http://doi.org/https://schoolnutrition.org/uploadedFiles/5_News_and_Publications/4_The_Journal_of_Child_Nutrition_and_Management/Fall_2014/LunchesSelectedandConsumedfromtheNationalSchoolLunchProgram.pdf

Briefel, R. R., Crepinsek, M. K., Cabili, C., Wilson, A., & Gleason, P. M. (2009). School Food Environments and Practices Affect Dietary Behaviors of US Public School Children. *Journal of the American Dietetic Association, 109*(2), S91–S107. http://doi.org/10.1016/j.jada.2008.10.059

Casey, P. H., Simpson, P. M., Gossett, J. M., Bogle, M. L., Champagne, C. M., Connell, C., … Weber, J. (2006). The Association of Child and Household Food Insecurity With Childhood Overweight Status. *Pediatrics, 118*(5), e1406–e1413. http://doi.org/10.1542/peds.2006-0097

Center for Nutrition Policy and Promotion. (2013). *Diet Quality of Children Age 2-17 Years as Measured by the Healthy Eating Index-2010* (Nutrition Insight No. 52). United States Department of Agriculture. Retrieved from http://www.cnpp.usda.gov/sites/default/files/nutrition_insights_uploads/Insight52.pdf

Coleman-Jensen, A., Gregory, C., & Singh, A. (2014). *Household Food Security in the United States in 2013* (Economic Research Report No. 173) (p. 12). Washington D.C: United States Department of Agriculture. Retrieved from http://ageconsearch.umn.edu/bitstream/183589/2/ERR173.pdf

Dietz, W. H. (1998). Health Consequences of Obesity in Youth: Childhood Predictors of Adult Disease. *Pediatrics, 101*(Supplement 2), 518–525.

Echon, R.M., (2014). Quantitative Evaluation of HHFKA Nutrition Standards for School Lunch Servings and Patterns of Consumption. *The Journal of Child Nutrition & Management, 38*(1). Retrieved from http://schoolnutrition.org/5--News-and-Publications/4--The-Journal-of-Child-Nutrition-and-Management/Spring-2014/Volume-38,-Issue-1,-Spring-2014---Echon/\

Farris, A.R., Misyak, S., Duffey, K.J., Davis, G.C., Hosig, K., Atzaba-Poria, N., & McFerren. M.M (2014). Nutritional Comparison of Packed and School Lunches in Pre-Kindergarted and Kindergarten Children Following the Implementation of the 2012-2013 National School Lunch Program Standards. *Journal of Nutrition Education and Behavior, 46*(6), 621–626.

http://doi.org/http://dx.doi.org/10.1016/j.jneb.2014.07.007

Federal Register. (2013, February 28). Federal Register | Child Nutrition Programs: Nondiscretionary Amendments Related to the Healthy, Hunger-Free Kids Act of 2010. Retrieved May 14, 2015, from https://www.federalregister.gov/articles/2013/02/28/2013-04116/child-nutrition-programs-nondiscretionary-amendments-related-to-the-healthy-hunger-free-kids-act-of

Florence, M. D., Asbridge, M., & Veugelers, P. J. (2008). Diet Quality and Academic Performance*. *Journal of School Health*, *78*(4), 209–215. http://doi.org/10.1111/j.1746-1561.2008.00288.x

Guenther, P.M., Casavale, K.O., Reedy, J., Kirkpatrick, S.I., Hiza, H.A., Kuczynski, K.J., … Krebs-Smith, S.M. (2012). Update of the Healthy Eating Index: HEI-2010. *Journal of the Academy of Nutrition and Dietetics*. http://doi.org/10.1016/j.jand.2012.12.016

Guthrie, J., Newman, C., & Ralston. K., (2009). USDA School Meal Programs Face New Challenges, *24*(3).

Hastert, T. A., & Babey, S. H. (2009). School Lunch Source and Adolescent Dietary Behavior. *Preventing Chronic Disease*, *6*(4). Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2774631/

Healthy Eating Index | Center for Nutrition Policy and Promotion. (n.d.). Retrieved May 14, 2015, from http://www.cnpp.usda.gov/healthyeatingindex

Healthy Schools | Let's Move! (2015). [government]. Retrieved May 14, 2015, from http://www.letsmove.gov/healthy-schools

Healthy Weight: Assessing Your Weight: BMI: About BMI for Children and Teens | DNPAO | CDC. (2014). Retrieved May 11, 2015, from http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html#What%20is%20BMI%20percentile

House Report 104-561 (1996, May 7). Retrieved May 14, 2015, from http://www.gpo.gov/fdsys/pkg/CRPT-104hrpt561/html/CRPT-104hrpt561.htm

Jeffries, J. K., Thayer, L. M., Hennink-Kaminski, H., & Noar, S. M. (2015). Rural Adults' Perspectives on School Food in a North Carolina County. *Preventing Chronic Disease*, *12*. http://doi.org/10.5888/pcd12.140484

Kennedy, E., Bowman, S.A., Lino M., Gerrior, S.A., & Basiotis, P.P. (1998). Diet Quality of Americans. USDA. Retrieved from http://www.ers.usda.gov/media/91034/aib750e_1_.pdf

Lutz, S.M, Hirschman, J., & Smallwood, D.M. (1994). Policy Development and Economic Impacts. In *National School Lunch and School Breakfast Program Reforms* (pp. 371–384). Washington D.C: United States Department of Agriculture. Retrieved from http://www.ers.usda.gov/media/91088/aib750r_1_.pdf

National School Lunch Act | Food and Nutrition Service. (2010, June 17). [United States Department of Agriculture]. Retrieved May 14, 2015, from http://www.fns.usda.gov/nslp/history_5#natact

Newman Elementary School. (2014). Purple Power Bean Wrap. USDA. Retrieved from http://www.fns.usda.gov/sites/default/files/purplewrap-cc.pdf

Office of the Surgeon General (US). (2010). *The Surgeon General's Vision for a Healthy and Fit Nation*. Rockville (MD): Office of the Surgeon General (US). Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK44660/

Ogden, C.L., Carroll, M.D., Kit, B.K., & Flegal. K.M., (2014). Prevalence of Childhood and Adult Obesity in the United States, 2011-2012. *Journal of the American Medical Association, 311*(8). http://doi.org/doi:10.1001/jama.2014.732

OSPI. (2014). Child Nutrition Program - HealthierUS School Challenge [government]. Retrieved May 14, 2015, from http://www.k12.wa.us/ChildNutrition/HealthierSchool/default.aspx

Ralston, K., Newman, C., Clauson, A., Guthrie, J., & Buzby. J. (2008). *The National School Lunch Program Background, Trends, and Issues* (Economic Research Report No. 61). Washington D.C: United States Department of Agriculture. Retrieved from http://files.eric.ed.gov/fulltext/ED502404.pdf

Reilly, J. J., Methven, E., McDowell, Z. C., Hacking, B., Alexander, D., Stewart, L., & Kelnar, C. J. H. (2003). Health consequences of obesity. *Archives of Disease in Childhood*, *88*(9), 748–752. http://doi.org/10.1136/adc.88.9.748

Smith, S. M. K., Guenther, P. M., Subar, A. F., Kirkpatrick, S. I., & Dodd, K. W. (2010). Americans Do Not Meet Federal Dietary Recommendations. *The Journal of Nutrition*, jn.110.124826. http://doi.org/10.3945/jn.110.124826

Stang, J. (2010). Position of the American Dietetic Association: Child and Adolescent Nutrition Assistance Programs. *Journal of the American Dietetic Association*, *110*(5), 791–799. http://doi.org/10.1016/j.jada.2010.02.025

Story, M., Nanney, M. S., & Schwartz, M. B. (2009). Schools and Obesity Prevention: Creating School Environments and Policies to Promote Healthy Eating and Physical Activity. *Milbank Quarterly*, *87*(1), 71–100. http://doi.org/10.1111/j.1468-0009.2009.00548.x

Turner, L., & Chaloupka, F. J. (2014). Perceived Reactions of Elementary School Students to Changes in School Lunches after Implementation of the United States Department of Agriculture's New Meals Standards: Minimal Backlash, but Rural and Socioeconomic Disparities Exist. *Childhood Obesity*, *10*(4), 349–356. http://doi.org/10.1089/chi.2014.0038

USDA. (2012, April 26). Grain Requirements for the National School Lunch Program and

School Breakfast Program. USDA. Retrieved from http://www.fns.usda.gov/sites/default/files/SP30-2012os.pdf

USDA. (2013, September). National School Lunch Program Facts Sheet. Retrieved from http://www.fns.usda.gov/sites/default/files/NSLPFactSheet.pdf

USDA. (2015a). Healthy Hunger-Free Kids Act | Food and Nutrition Service. Retrieved May 19, 2015, from http://www.fns.usda.gov/school-meals/healthy-hunger-free-kids-act

USDA. (2015b, May 8). Nation School Lunch Program Annual Summary. United States Department of Agriculture. Retrieved from http://www.fns.usda.gov/sites/default/files/pd/36slmonthly.pdf

Washington State Report Card. (2015). Retrieved May 14, 2015, from http://reportcard.ospi.k12.wa.us/summary.aspx?groupLevel=District&schoolId=1&reportLevel=State&year=2013-14

WHO Healthy diet. (2014). Retrieved May 11, 2015, from http://www.who.int/mediacentre/factsheets/fs394/en/