School Lunch Entree Components Before and After Implementation of the Healthy, Hunger-Free Kids Act of 2010: A Secondary Data Analysis

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Abstract

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Background The Healthy, Hunger-Free Kids Act (HHFKA) 2010 updated standards to increase the quality and quantity of healthy items offered to students. Since HHFKA implementation, studies have focused primarily on fruit and vegetable selection and consumption, nutrient quality of whole meals, and plate waste.

Objective Complete existing descriptions of the HHFKA's impact by examining changes in nutrient quality and entrée quantity without inclusion of the required vegetable and fruit servings.

Design Descriptive, longitudinal study analyzing 1.7 million student selected lunch entrées in eight entrée categories 16 months before and 15 months after HHFKA implementation.

Participants/ setting Three middle schools (MS) and three high schools (HS) in a Washington State urban school district.

Main Outcome Measures Nutritional quality was assessed by analyzing Mean Adequacy Ratio (MAR), Energy Density (ED), and Energy per serving (ES). Quantity was determined by analyzing number of meals available and selected by students pre-and post-implementation.

Statistical Analyses Performed Satterthwaite method was used to assumed unequal variances and Wilcoxon two-sample test with t approximation and two-sided alternative for small sample size and non-normal distributions.

Results Post-implementation, significant improvement for nutritional quality was seen in MS (n=5) and HS (n=2). Every category with a significant increase in MAR also had a significant decrease in ES. Significance was seen for Salads ($p = .0328$ and $p= .0172$), Burritos ($p= .0008$ and $p= .0015$) and Pizza ($p= .0156$ and $p= .0038$) in MS, and Hot Sandwiches ($p = .0023$ and $p <.0001$) and Burritos ($p = .0075$ and $p= .0068$) in HS. For ED, MS also had significant decreases for Casseroles ($p = .042$) and Salads ($p = .0265$), with no significant changes in HS. The variety of entrées decreased by 44% and significant changes ($p<.0001$) in selection were seen for all categories except MS Casseroles.

Conclusion HHFKA policy resulted in improvements in the nutritional quality of lunch entrees.

INTRODUCTION

The Healthy, Hunger-Free Kids Act (HHFKA), signed by President Obama in 2010, resulted in major changes to the National School Lunch Program (NSLP) standards for the first time since the 1990's[1, 2]. NSLP, the second largest food and nutrition assistance program in the United States, is under the umbrella of USDA's Federal Assistance Child Nutrition Programs (CNP)[3]. The HHFKA guidelines also influenced all CNP nutrition standards[4]. The policy was designed to improve the nutritional quality of school meals served to K-12 students, meet the Institute of Medicine recommendations and current Dietary Guidelines[5], and set into action a plan to increase spending on meal and operation costs. Financial cuts over previous years[2,8] strained the NSLP's ability to offer healthy lunches, causing schools to outsource meal production to foodservice management companies[7,8] and rely on revenue from competitive foods, previously unregulated by federal guidelines[6]. Policy implementation began at the start of the 2012-2013 school year, and changes were incremental to ensure schools had time to comply with the new standards[5].

Schools have a unique opportunity to guide student food choices. Every year roughly 5 billion school lunches are served[9], with 31 million children and teens served daily by NSLP[10]. The majority (66.5%) of these school lunches are served free[11] to students who quality. School meals also make up approximately fifty percent of daily consumed calories for students[12]. The food that produces school lunch meals comes from USDA commodities (20%)[13, 14, 15] and commercial markets (80%)[13] paid for by USDA federal reimbursement rates, state and local funds, student payments for reduced price and paid lunches, and proceeds from competitive foods[13]. The partnership between American agricultural producers and the NSLP is well established[14, 16]. Annually, the USDA spends around 1 billion dollars for the commodities

schools get for free[15]. However, the amount paid to farmers differs across commodities. Dairy and meat farmers are paid four times more than fruit and vegetable farmers[7]. Changing school lunch requirements can strain farmers to produce more and diverse items at the same cost, or reduce or eliminate a high cash crop. Prior to the Final Rule, the HHFKA set a limit on starchy vegetables per week in school meals[17]. Arguments were made that limiting starchy vegetables would decrease vegetable consumption overall and student participation in the NSLP. Potatoes were identified as being high in minerals, vitamins and fiber and naturally low in sodium and fat[17]. Therefore, the requirement was changed to allow schools to serve any vegetable that is consistent with the 2010 Dietary Guidelines in limited quantities as shown in Appendix A.

The USDA commodities are often sent to food processors and foodservice management companies for further processing, preparation and delivery at the school's cost[15]. The demands of HHFKA, which set limits on grain, protein, sodium, saturated fat and energy, caused the Food Industry (i.e., food processors, foodservice management and commercial producers) to reformulate or eliminate food items that did not meet the new regulations. In response to the policy requirements, the Food Industry spent millions of dollars lobbying Congress to change or stop HHFKA[8, 15, 18], even arguing that children may not want to eat healthier foods[18]. The Food Industry also notably used its financial sponsorship of over half of the School Nutrition Association's (SNA) annual budget to change SNA's position from support to opposition of HHFKA[18]. So, although scientific evidence was the driver of HHFKA changes, Food Industry and farmer interests were influential in the final policy.

Prior Research

Research since implementation of HHFKA focused on fruit and vegetable selection and consumption, nutrient quality of whole meals, and plate waste. These studies were done primarily in elementary and middle schools[19- 29, 31-33, 34-36] and focused mainly on meal components identified by HHFKA (fruit, vegetables, whole-grains, sodium, milk)[5]. Studies found significant increases in the selection and/ or consumption of fruit and vegetables[19, 24, 26, 32, 35] and entrees[24, 31]. When nutritional value was analyzed, results showed a significant increase in nutrient quality[21, 29, 32, 35, 36], with notable and significant improvements for sodium[21, 29, 32], protein[21, 26, 27, 29] and fiber[21, 23, 26, 27, 29, 32, 35, 36]. Results were based on analysis of a combination of entrée, vegetable/ fruit sides and milk[20, 21, 29, 32]. When plate waste was calculated, the percentage of meal items wasted differed depending on the study[19, 22, 25, 26, 28, 29, 33]. Entree waste also differed by grade level and gender[33] and decreased when popular entrées and vegetables were paired[29]. Finally, one study looked at the school nutrition employees and directors' response to HHFKA[37]. Concerns included financial impact, menu development and student acceptance. However, another study found that approximately 40% of school nutrition directors had little to no implementation challenges with another 37% only having some challenges[38].

Continuing research on policies that impact student health builds a library of evidence for policy makers to reference when considering policy modifications. Therefore, the aim of this study was to examine the changes in nutrient quality (i.e., MAR, ED, Energy) and entrée quantity (i.e., available and selected) of eight lunch entrée categories. This information helps to complete existing descriptions of the full impact of the 2010 HHFKA policy.

METHODS

Sample and Setting

This is a secondary data analysis of research conducted by the University of Washington's Center for Public Health Nutrition to examine the changes in lunch quality in response to the nutrition standards resulting from the 2010 HHFKA. This analysis is a descriptive, longitudinal study of student selected lunch entrees collected from three middle schools (MS) and three high schools (HS) in an urban school district in Washington State between January 2011 and January 2014 (pre: 289 days, post: 267 days). During the study period, there were approximately 7200 students (28% non-Hispanic white) enrolled in the six schools analyzed with 52% of students in the district eligible for free and reduced priced lunch. Quantities represented in this study illustrate only the number of lunch entrees selected by students during the 31-month study period. Therefore, no informed or passive consent was needed.

Data

Production records for all six schools were acquired from the school food service manager and used to identify type and number of entrees selected during the study period. Individual entrees were then assigned to one of eight categories (Table 1) by the school district food service manager.

Table 1. Examples of Entrees Included in Each School Lunch Entrée Category

Category	Examples
1. Rice Bowls	Rice Bowls (variety), Chicken Lo Mein, Beef Teriyaki Dippers
2. Hot Sandwiches	Burgers (variety), Fish Sandwiches, Hot Pockets (variety), Grilled Cheese
3. Cold Sandwiches	Hoagies, PB&J Sandwich, Hummus Box
4. Casseroles	Macaroni and Cheese, Spaghetti, Beef Nachos
5. Grilled Items	Hot Dogs (variety), Chicken Nuggets, Fish Sticks
6. Salads	Taco, Caesar, Garden, Chef
7. Burritos	Chili Cheese Wrap, Soft Taco and Burritos (variety)
8. Pizzas	French Bread, Pepperoni, Stuffed Breadstick w/ Sauce

Categories were determined based on standard school menus during the time of study. Entrées were assigned to categories based on similarity of components and/or preparation. The Salad category only includes prefixed entrée salads and not salad bar items. Beverages, side items, desserts, salad bar selections and competitive foods were also excluded from the analysis. Standard menus for the study period were also used to identify entrees typically served with either fries or jojos ("potatoes"). The inclusion of potatoes in our analysis is due to the district analyses post-implementation which reflected combined entrée and potato serving nutrients. Binary coding of '0' for No and '1' for Yes was used to identify pre-implementation period entrees that should include potatoes in their nutrient content for accurate comparisons across study periods. Entrée nutrient content was provided by the school district's Nutrition Services Department, using NUTRIKIDS nutrition analysis software (Heartland Payment Systems Inc.).

Statistical Analysis

The nutritional quality of 1.7 million school entrées was analyzed using Mean Adequacy Ratio (MAR), Energy Density (ED) and Energy per serving (ES) to compare nutritional quality pre-and post-implementation. MAR was calculated as the mean percentage of the daily value (DV) of six nutrients (protein, calcium, iron, vitamin C, vitamin A and dietary fiber) per entrée category. These nutrients are noted to be important for children and adolescents. Recommended DV (based on a 2,000-calorie diet for adults and children above the age of four) set by the FDA are as follows: Protein - 50 g, Calcium – 1000 mg, iron – 18 mg, Vitamin A – 5000 IU, Vitamin C – 60 mg and Dietary fiber – 25 g[39]. ED was calculated as available energy divided by the weight (kilocalories per gram) of entrees selected in each category. Entrees with lower ED are generally foods with either a higher water or fiber content, or are lower in fat (i.e., fruit and vegetables). These nutritional values were determined by conducting statistical analyses using

the statistical software package SAS version 9.4 (SAS Institute Inc., © 2002-2012)[40]. The first analysis, Wilcoxon two-sample test, was used to compare the three nutritional value indicators across the two study periods. Wilcoxon two-sample tests accounted for the small sample size, and the resulting likelihood of non-normal distributions. Additionally, recipe changes of entrees pre- and post-implementation of HHKFA, make the assumption of independent samples tenable[41]. A comparison of the mean number of student selected entrees per category were analyzed with Satterthwaite method T-test. This method accounts for unequal variances between the study periods.

RESULTS

After HHFKA implementation, MS saw significant improvement in nutritional quality of a greater number of entrée categories (n=5) than HS (n=2). For both MS and HS, categories that had a significant increase in MAR also had a significant decrease in ES. In MS, the increase in MAR and decrease in ES were significant for Salads ($p = .0328$ and $p= .0172$), Burritos ($p= .0008$ and $p= .0015$) and Pizza ($p= .0156$ and $p= .0038$). In HS, significant changes in increases in MAR and decreases in ES were seen for Hot Sandwiches ($p = .0023$ and $p <.0001$) and Burritos ($p = .0075$ and $p= .0068$) (Table 2A and 2C). For ED, MS had significant decreases for both Casseroles ($p = .042$) and Salads ($p = .0265$), with no significant changes seen in HS (Table 2B).

Table 2A. Comparison of the **mean nutrient content (MAR)** per Categories of food, pre-policy and post-policy implementation

	Middle Schools					High Schools				
	Pre-policy		Post-policy			Pre-policy		Post-policy		
	N	Mean	N	Mean	p-value*	N	Mean	N	Mean	p-value*
1. Rice Bowls	8	53.61	2	44.06	0.3846	16	56.72	5	63.97	0.3137
2. Hot Sandwiches	36	37.79	13	48.62	0.0745	36	37.15	16	53.59	0.0023
3. Cold Sandwiches	7	39.04	4	82.68	0.3231	1	45.41	3	97.94	1.0000
4. Casseroles	11	51.90	8	52.90	0.7758	19	54.03	11	51.19	0.5236
5. Grilled Items	17	32.73	14	35.53	0.2351	17	31.29	11	31.59	0.7441
6. Salads	10	105.39	6	212.36	0.0328	8	100.92	6	160.30	0.0526
7. Burritos	15	40.90	11	66.70	0.0008	12	41.65	7	70.46	0.0075
8. Pizza	15	48.00	12	55.57	0.0156	4	44.57	2	55.49	0.1661

* Wilcoxon two-sample test with t approximation and two-sided alternative

Table 2B. Comparison of the **mean energy density (ED)** per Categories of food, pre-policy and post-policy implementation

	Middle Schools					High Schools				
	Pre-policy		Post-policy			Pre-policy		Post-policy		
	N	Mean	N	Mean	p-value*	N	Mean	N	Mean	p-value*
1. Rice Bowls	8	1.567	2	1.699	0.7044	16	1.480	5	1.704	0.1877
2. Hot Sandwiches	36	2.136	13	2.237	0.2068	36	2.119	16	2.087	0.6431
3. Cold Sandwiches	7	2.534	4	2.567	0.9266	1	1.621	3	2.336	1.0000
4. Casseroles	11	1.789	8	1.406	0.0420	19	1.626	11	1.449	0.2219
5. Grilled Items	17	2.150	14	2.295	0.2135	17	2.180	11	2.281	0.2144
6. Salads	10	1.394	6	0.976	0.0265	8	1.396	6	1.141	0.3501
7. Burritos	15	2.153	11	2.112	0.6078	12	2.158	7	2.122	0.3634
8. Pizza	15	2.497	12	2.366	0.6467	4	2.589	2	2.317	0.8261

* Wilcoxon two-sample test with t approximation and two-sided alternative

Table 2C. Comparison of the **mean energy per serving (ES)** per Categories of food, pre-policy and post-policy implementation

	Middle Schools					High Schools				
	Pre-policy		Post-policy			Pre-policy		Post-policy		
	N	Mean	N	Mean	p-value*	N	Mean	N	Mean	p-value*
1. Rice Bowls	8	399.63	2	290.00	0.5302	16	510.63	5	423.00	0.1418
2. Hot Sandwiches	36	462.67	13	316.31	<0.0001	36	468.00	16	310.75	<0.0001
3. Cold Sandwiches	7	327.71	4	391.75	0.1021	1	480.00	3	405.33	0.4370
4. Casseroles	11	503.73	8	435.75	0.2794	19	478.26	11	470.45	0.6093
5. Grilled Items	17	454.24	14	416.86	0.1865	17	467.18	11	467.55	0.7092
6. Salads	10	424.80	6	284.33	0.0172	8	469.75	6	357.50	0.1611
7. Burritos	15	519.67	11	344.55	0.0015	12	529.58	7	350.86	0.0068
8. Pizza	15	433.87	12	314.42	0.0038	4	540.50	2	325.50	0.1661

* Wilcoxon two-sample test with t approximation and two-sided alternative

The school district used a six-week menu cycle pre- and post-implementation for MS and HS. In both study periods, four entrees were offered in MS, and eight were offered in HS each school day. Yet, the variety of entrees offered post-implementation was reduced for all categories except HS Cold Sandwiches. The greatest reductions were seen in Rice Bowls (MS: 75%, HS: 68.8%) and Hot Sandwiches (MS: 63.9%, HS: 55.6%) (Table 2A and 2C). For selection, the total number of entrees selected decreased for both MS (9.8%) and HS (3.4%). MS showed significant changes ($p < .0001$) in selection for seven entrée categories with no portion change for Casseroles. HS saw significant changes ($p < .0001$) in selection for all eight categories. Despite these reductions, Hot Sandwiches and Pizza were the top selected categories for both MS and HS across study periods. MS students also selected Grilled Items the most in both study periods, while HS students selected Salads the most pre-implementation but Cold Sandwiches more post-implementation (Table 3).

Table 3. A comparison of the **mean number of food items** per meal pre- and post-policy implementation

	Middle Schools			High Schools		
	Pre-policy (N = 535,793) Mean	Post-policy (N = 483,494) Mean	P-value*	Pre-policy (N = 365,613) Mean	Post-policy (N = 353,132) Mean	P-value*
1 Rice Bowls	0.030	0.018	<0.0001	0.076	0.067	<0.0001
2 Hot Sandwiches	0.361	0.318	<0.0001	0.291	0.199	<0.0001
3 Cold Sandwiches	0.030	0.053	<0.0001	0.066	0.150	<0.0001
4 Casseroles	0.078	0.078	0.2495	0.088	0.107	<0.0001
5 Grilled Items	0.248	0.283	<0.0001	0.088	0.139	<0.0001
6 Salads	0.007	0.010	<0.0001	0.104	0.130	<0.0001
7 Burritos	0.077	0.058	<0.0001	0.020	0.010	<0.0001
8 Pizza	0.179	0.198	<0.0001	0.290	0.225	<0.0001

* T-test using Satterthwaite method that assumes unequal variances
N = number of meals

DISCUSSION

This descriptive, longitudinal study examined the changes in nutritional quality and entrée quantity of eight lunch entrée categories in six schools in an urban school district in Washington State in response to HHFKA policy.

The findings of this study are consistent with other research that found improvements in the nutritional quality of school lunches post-implementation. Our study analyzed the same or similar nutrients as other research[21, 23, 29, 33], but is unique as it illustrates the nutritional changes made to lunch entrees without inclusion of other meal components. The results show that >50% of MS and 25% of HS entrée categories had significant nutritional improvement. For MS, the significant change in entrée Salads could be attributed to the removal of higher fat or calorie containing ingredients (e.g., croutons, cheese) from some of the entrée choices. In the other categories, changes could be related to the increased requirement for inclusion of whole grains. The policy mandated that whole grains in mixed dishes (e.g., pizza, corn dogs) had to be the primary grain ingredient by weight[5] and whole grain-rich products, such as pasta, should be 50% whole grain by July 2012 (Appendix A). The increase in whole grain would increase the fiber content and, therefore, could decrease ED and increase MAR of the entrées. Additionally, this school district reduced some entrée portion sizes to adhere to policy requirements, which lowered the total calorie and total fat content of these entrée items. These factors collectively contributed to the significant increase in nutritional quality (MAR, ED and ES) found.

The lack of significant change in ED for HS could be attributed to the high variability in student selected entrees within each category. HS also had 50% more entrée choices available daily. Students selecting more entrées with high ED (i.e., high fat, low vegetable) in a category would have created more variability and reduced the likelihood of a significant result.

While studies have shown an increase in nutrient dense foods (e.g., fruit, vegetables, whole grain[21, 24, 26, 31, 32, 36, 37], to our knowledge no study has specifically addressed changes in the variety of entrees served. Our study shows that the variety of entrees offered to students decreased after implementation for all but one Category (i.e., HS Cold Sandwiches). A contributing factor included consolidation of entrée items. To help the district conform to the new meal standards[5], the school district food manager standardized entrée items across schools to reduce variations of similar items and help with menu development and compliance. This made it easier to ensure that the new standards were being met, eliminated repetition, but consequently decreased the variety of entrees within the district. Adherence to the new standards also required recipe changes to pre-policy products supplied by the Food Industry. While some food processors could make necessary changes, others were unable or unwilling to produce items that complied with the new standards, thus further eliminating entrees that did not meet requirements.

The popularity of food items determines the overall nutritional impact of these changes. For example, Hot Sandwiches had the largest variety decrease for both MS and HS, potentially due to higher saturated fat, total fat and energy content of some pre-implementation items, which were eliminated under the new standards. However, despite the decrease, Hot Sandwiches was still the highest selected category post-policy in MS and second highest in HS. Pizza also remained high in both MS and HS post-implementation, which is consistent with other research[25]. This is an important consideration because those foods then drive total nutrition quality more than other categories. Other studies showed entrée consumption significantly increased post-implementation[24, 31] and that entrees were the principal source of calories in school lunch[23, 25], demonstrating their importance. Research also shows that one of the biggest

drivers of food choice for children and adolescents is preference[42] and that plate waste decreases as preferred foods are paired[29]. Therefore, when menus are updated to adhere to NSLP policy requirements, focus should be on improving student preferred entrees. These may have the highest impact on improved nutrient consumption because they are more commonly consumed.

There were many strengths to this study. Assessment of the nutritional quality of categories was enhanced by using three nutritional indices (MAR, ED and ES). This study also was able to assess student entrée selections (1.7 million) over a 31-month period pre- and post-implementation. The longitudinal nature of the study accounted for influences of seasonal variability, initial student uncertainty regarding new menu items, featured lunch items, and school closures (scheduled and unscheduled). The results also illustrate changes made to lunch entrees in high schools, a population not often studied in prior HHFKA research.

The study was limited by data collection from a single urban school district in Washington State, reducing the generalizability of the findings. There were also fewer days (n=22) captured post-implementation, resulting in fewer entrees captured. The schools included in analysis also initially had discretion over lunch menus, making menu items prior to implementation non-standardized. Small changes in ingredients or presentation of entrees could have changed the nutritional profile or perceived palatability of the entrees. Potato servings were also non-standardized pre-implementation, and portions were at the discretion of foodservice employees at point of service. Therefore, the potato nutrient totals included in analysis were based solely on the manufacture's standard serving sizes and nutritional information. Potatoes were also automatically included in the post-implementation recipes nutrient content by the district, making a comparison of entrees without potatoes unachievable. Finally, our study did

not account for plate waste. Therefore, the students in this study could have been consuming more lunch items post-implementation, increasing their nutrient consumption.

While this study helped to complete existing descriptions of the full impact of HHFKA, many studies, including this one, were conducted within the first two years of implementation. Food acceptance increases with continued exposure[43] so further studies should be done to determine current consumption and plate waste levels.

CONCLUSION

While other studies have confirmed the positive effect of increased fruit and vegetable choices, this study provides evidence that entrée meal components also helped to increase MAR and decrease ED of school lunches post-implementation. Increases in nutritional quality of entrees were mainly due to smaller portion sizes, adjustments to ingredients and changes to products purchased in response to the new standards. Altering menu items meant elimination, reduction or revision of pre-implementation lunch items, as seen in this study. Therefore, school lunch policy changes influence the entire food system. Finally, future modifications to NSLP foods should take into consideration student preferred entrees. These may have the highest impact on improved nutrient consumption and drive total nutrition quality more than other foods.

Appendix A

Healthy Hunger Free Kids Act 2010 Standards: Meal Requirements For Lunches[5]		
	Grades 6-8 (Ages 11-13)	**Grades 9-12 (Ages 14-18)**
Min-Max Calories	600-700 kcal	750-850 kcal
Saturated Fat*	Provide less than 10% of total calories.	
Sodium*	≤ 1,360 [by July 1, 2014] ≤ 1,035 [by July 1, 2017] ≤ 710 [by July 1, 2022]	≤ 1,420 [by July 1, 2014] ≤ 1,080 [by July 1, 2017] ≤ 740 [by July 1, 2022]
Trans fat	0 grams of trans fat (less than 0.5 grams) per serving	
Meat/ Meat Alternative*	9-10 oz.	10-12 oz.
Fruit†	Offered Daily: fresh, frozen without added sugar, canned in light syrup, water or fruit juice, and/or dried. All juice must be 100% full-strength.	
	Serving: 2.5 cups	**Serving:** 5 cups
Vegetables†	Offered Daily: fresh, frozen, or canned vegetables and dry beans and peas (legumes). Offered Over the Course of the Week: Dark green vegetables, red-orange vegetables, beans and legumes, starchy vegetables, and other.	
	Serving: 3.75 cups	**Serving:** 5 cups
Grains	Enriched and whole grains. ▪ Half must be whole grain-rich products (50% whole grains, remainder enriched flour) [by July 1, 2012] ▪ All grains must be whole grain-rich [by July 1, 2014]	
	Serving: 8-10 oz.	**Serving:** 10-12 oz.

* On average over the school week

† Note: NSLP students are required to select a fruit or a vegetable as part of the reimbursable meal

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

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