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Quantitative Evaluation of HHFKA Nutrition Standards for School Lunch Servings and Patterns of Consumption

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Please note that this study was published before the SY2014-15 implementation of the Smart Snacks Nutrition Standards for Competitive Food in Schools, as required by the Healthy, Hunger-Free Kids Acts of 2010. As such, certain research relating to food in schools may not be relevant today.

ABSTRACT

Purpose/Objectives

The purpose of this paper is to provide baseline data and characteristics of food served and consumed prior to the recently mandated nutrition standards as authorized by the Healthy, Hunger-Free Kids Act of 2010 (HHFKA).

Methods

Over 600,000 school lunch menus with associated food production records from 61 elementary schools nested in 39 districts across five states were collected during the school years 2010-2011 and 2011-2012 (baseline). Data were analyzed using school food image analysis system to provide quantitative assessment of National School Lunch Program (NSLP) meal patterns and nutrient compositions. Subsequently, these values were compared to the new standards to determine the level of adjustments needed to meet these requirements.

Results

The national daily averages for fruit, vegetable, grain, meat, and milk servings for the school years at baseline were as follows: 0.42 cup, 0.22 cup, 1.07 oz, 1.70 oz, and 0.82 cup, respectively. The average calorie content of these serving trays was 484.73 ±163.70 kcal with 802.93±468.60 mg of sodium and 5.37±4.27 mg or 11.08% saturated fat. In comparison to the HHFKA requirements, these values suggest that, of the 644,070 meals analyzed, 57%, 84%, 61%, 45%, and 19% did not include the recommended daily minimum servings of fruits, vegetables, grain, meat, and milk respectively, and only 47% of these meals contained the proper calories.

Application to Child Nutrition Professionals

The applications of procedures presented in this paper are important to schools for policy implementation and certifications for reimbursements. However, the data are also of significant interest to state health officials and policy makers in promoting and monitoring healthy school nutrition in accordance with the new nutritional guidelines.

Keywords: school, nutrition, standards, HHFKA, NSLP, SFIA

INTRODUCTION

The Healthy, Hunger-Free Kids Act (HHFKA) of 2010 is an expansion of several policies governing child nutrition (i.e. National School Lunch Act of 1946, Child Nutrition Act of 1966, Child Nutrition Reauthorization Act of 1998, and Child Nutrition and WIC Reauthorization Act of 2004). The overarching aim of HHFKA is to improve school nutrition in alignment with public health goals (Kraak, Story, & Wartella, 2012). HHFKA required the U.S. Department of Agriculture (USDA) to establish new nutrition standards for the National School Lunch Program (NSLP) and School Breakfast Program (SBP) (USDA, 2012). These new nutritional standards were implemented at the beginning of the 2012 school year for both the NSLP and SBP. Poor nutrition, heart disease, and

childhood obesity are the leading health issues addressed by these nutritional standards (Larson & Story, 2011; Ogden, Carrol, Kit, & Flegal, 2012).

HHKFA nutritional standards are health preventive measures under the umbrella of social capital change. Social capital change measures the ability of social networks to find solutions to social problems. Social capital change follows the traditional five step policy cycle of agenda setting, formulation, adoption, implementation, and evaluation (Andersen, 2011; Putnam, 1995). A key to understanding this complex public policy is to understand the interplay among four independent inter-related factors: organizational, financial, social, and political.

Organizational factors pertain to school district leadership decisions often made by school food administrators influencing or directing organizational food service practices led by cafeteria managers. This interaction is defined by organizational working culture, policy, and environment (Quinn & Rohrbaugh, 1983; Schein, 1992). The quality of HHFKA policy for implementation and the degree of compliance are directly dependent upon this organizational interplay.

Financial factors deal with economic forces associated with NSLP's food and beverage products (Gundersen, Kreider, & Pepper, 2011). Consequently, this new mandate creates challenges for school and school districts to offset the higher cost of fresh produce, whole-grains, and low-fat, sodium food items. Secondly, the operational cost associated with training and certifying school staff (i.e. HHFKA compliance in food and recipe preparation) is an added expense. Lastly, financial decisions also include the accounting process for policy compliance on reimbursable meals and student (family) qualification for free and reduced lunch meal eligibility.

Social factors deal with students' decisions, preferences, participation, change in behaviors and environmental correlates of healthy nutrition (Bandura, 1986). Therefore, healthy nutrition pertains to change in decisions and behaviors made by individual (students) and moderated by social factors (school, role of peers) in terms of food composition and the quality of meals selected and consumed (nutrition) (Bandura, 1986; Mendoza, Watson, & Cullen, 2010).

Political factors deal with policy implementation, evaluation, and monitoring of the HHFKA in meeting health and nutritional objectives. The health outcome (dependent variable) of this complex policy is distal to the nutritional standards (independent variables). Therefore, the success and effectiveness of HHFKA is significant to a wide spectrum of governmental agencies, food industries, and interest groups (Hearn, 2008).

Undoubtedly, childhood obesity, type-2 diabetes, cardiovascular diseases, some form of cancers, food insufficiency, and malnutrition are significant health concerns (Fram, et al., 2011; Hoenselar, 2012; Larson & Story, 2011; Lee & Lee, 2011; Ogden, et al., 2012). A number of research studies strongly suggest that with proper nutrition these health issues are preventable conditions (Ogden, et al., 2012). With these expectations, therefore, HHFKA nutritional policy enforces key nutritional changes and additions impacting the purchasing, preparation, cooking, and serving of foods for the NSLP.

Food Based Menu Planning

The new regulation requires schools to increase the availability of fruits, vegetables, whole grains, and fat-free or low-fat fluid milk in school lunch meals (USDA, 2012). Using these new guidelines lunch meals are to be served under a standardized food-based menu planning (FBMP) approach (Wechsler, Brenner, Kuesler, & Miller, 2001). The implementation of this change took effect during the school year 2012-2013 (USDA, 2012). This approach specifies the minimum serving amount (portion size) of key food groups by grade levels. The FMBP approach is recommended to meet daily nutrient requirements and minimize the opportunity to offer unhealthy foods (National Research Council, 2011). For example, the following weekly minimum amounts for lunch meal patterns for K-5 grades are as follows: 2.5 cups of fruits, 3.75 cups of vegetables, 8-9 ounces of grains, 8-10 ounces of meat or meat alternatives, and 5 cups of milk. The daily minimum amounts are 0.5 cup fruit, 0.75 cup vegetables, 1 ounce of grains, 1 ounce of meat or meat alternatives, and 1 cup of milk.

Calorie Requirements

To support the FBMP approach for a well-balanced meal, the new standard establishes a range of calorie requirements per grade level. The primary rationale behind this minimum and maximum calorie requirement is anchored on the severity of childhood obesity and the importance of nutritious meals (Fram, et al., 2011; Ogden, et al., 2012). For instance, the calorie requirement for grades K–5 is a range of 550–650 kcal per lunch averaged for a 5-day week. This change was scheduled for implementation at the beginning of school year 2013-2014.

Sodium, Saturated Fat and Trans Fat Limits

The new standard further emphasizes the importance of healthy diet with accompanying dietary specifications for cafeteria food preparation and servings (Wootan, 2011). These supplementary rulings are added to focus on the use of sodium, saturated fat, and transfat in food preparation and cooking. Because sodium, saturated fat, and transfat are risk factors for cardiovascular diseases, limits are set on these nutritional components (Hoenselar, 2012). For sodium, limits are enforced with three targeted timelines. For example, in grade levels K-5, the sodium content per lunch meal (FBMP serving) must be $\leq$ 1,230 mg by school year 2014–2015, $\leq$ 935 mg by school year 2017–2018; and $\leq$640 mg by school year 2022–2023. Moreover, the amount of saturated fat in school lunches must be less than 10% of the total calories averaged per week. A more rigorous ruling has been introduced on the use of trans fats with less than 0.5 grams per unit of food serving allowable under this guideline which took effect July 1, 2012.

The intricacies and complexities of this policy have placed a tremendous burden on school systems for implementation (Hearn, 2008). Although this new regulation is not without criticism, it further requires schools to track and conduct a bi-weekly evaluation of school menus. Consequently, state officials are required under this new guideline to perform a three-year evaluation cycle or administrative scheduled reviews for policy compliance with each school nutrition program. In essence the state agencies are empowered with fiscal responsibilities to enforce corrective actions for non-compliance and repeat violators (USDA, 2012).

Consequently, federal subsidies and meal reimbursements are anchored on compliance to the new nutritional standards. Therefore, the primary purpose of this paper is to: 1) provide baseline data and characteristic of the amounts of food served and consumed prior to the recently mandated nutrition standards; and 2) provide a measure of relative change and or adjustments that schools will need to make to comply with these new nutrition standards for the NSLP.

METHODOLOGY

Participant Recruitment

School districts across the nation with greater than 70% of their student population receiving free and reduced lunch meals were invited to participate in the study. Thirty nine school districts responded to the request and extended the invitation to their respective elementary schools (n=61). These school districts were public school systems serving the states of Arkansas, Iowa, New York, Texas, and Washington.

Data Collection

School production records and menus were collected from all participating schools for the two academic years (2010–2011 and 2011–2012) prior to implementation of the HHFKA new nutritional standards. Data collections were scheduled twice each year, once in the fall semester and another during the spring semester. In addition, pertinent school demographics and information were collected from each state's department of education public information system.

School Food Image Analysis (SFIA)

Nutrient compositions were analyzed using the SFIA system (Echon, 2012). This innovative technology was developed through a USDA- sponsored research project designed to improve three critical areas in nutritional analysis for school aged children. SFIA features improvements in data collection methodologies, nutrient database query, and estimation of dietary intake (Echon, 2013).

SFIA has been discussed in detail elsewhere (Echon, 2012; Echon,2013). Briefly, the data collection system used cameras to photograph the food trays or IP cameras (stationary) or mobile devices for video and image capture capability with web-based IT framework for rapid and real-time data collection. IP cameras (static IP address) were placed in selected elementary school

cafeterias. One set was positioned above the cash register to represent NSLP meal serving (before meal pictures), and another set was placed above the disposal window to represent food consumption (after meal pictures). The primary advantage of using the IP cameras (non-intrusive) was that it eliminated unnecessary disruption of school for interviews or questionnaires (Echon, 2013). For participating schools using hand-held cameras, a minimum of 3 days of data collections was scheduled to minimize school disruption. However, for schools equipped with stationary Internet Protocol (IP) cameras a maximum of 20 days of data collections was scheduled (passive data collection).

Recipe Generator and Food Production Analysis

The recipe generator and food production analysis systems were composed of automated food identification protocols and adaptive database query systems. These systems were devised to analyze school food production records, use of ingredients, and preparation patterns. The customized IT architecture had linkage to the USDA’s Child Nutrition and referential (sR) databases. In addition, the food identification protocol was designed to minimize random selection errors with electronic readers used with various types of bar codes (Echon, 2013).

Food Volume Analysis

The principal analytical strength of the SFIA was its image analysis module that was composed of edge detector, geometric and pattern recognition, image threshold capability, surface area, and volume (3D) calculation. Collectively, these innovative features greatly improved (from 15-70% to 94-99 % accuracy) the limitations of questionnaire-based nutrient analysis (i.e. food frequency questionnaires and 24-hour dietary recalls) by accurately converting image measurements into food volumes for nutrient analysis (Echon, 2013).

Nutrient Analysis

SFIA was designed to provide either specific (i.e. per meal, per day, per week) or multi-level weighted average nutrient analysis (i.e. per student, per school, per district). The SFIA system incorporates adaptive corrections for the following factors: (a) nutritional change due to moisture and fat gain or loss; (b) auto selection of NDB or CN index for raw to cooked yield method; (c) auto indexing of NDB or CN codes for separable food items to provide true nutrient values; and (d) multipliers for multiple servings.

RESULTS AND DISCUSSION

School Participants

A total of 42,938 grade K-5 students with parental consents from 61 elementary schools nested in 39 school districts across the nation participated in the study. The total enrollment for these school districts for the school year 2010-2011 was 1,005,452, and for the school year 2011-2012 it was 1,007,017. The combined racial/ethnic composition for this study population averaged over the 2 year period was 38% White, 33% Hispanic, 19% African-American, 8% Asian and <2% other ethnicity.

Patterns of NSLP Servings prior to HHFKA Implementation

Table 1 provides a summary of the average amounts of key food groups served for school lunches during 2010-2011 and 2011-2012. In this study, the average number of food items served on a typical NSLP tray at baseline was four items. These four items represented 1 carton of milk (250 ml), a side serving of vegetable (54.78 ± 48.73 grams), a serving of fruit (150 ± 85.15 grams), and an entrée (i.e. sandwich, chicken nuggets). The entrée represented a serving of grain, meat, meat alternatives (i.e. beans) and additional servings of cooked vegetables. To compare these results with the new nutrition standards, these values were categorized to reflect the new FBMP guidelines. Therefore, at baseline, the daily average servings of fruits, vegetables, grain, meat or meat alternatives, and milk were 0.42 cup, 0.22 cup, 1.07 ounce, 1.7 ounce, and 0.82 cup, respectively. These amounts were then compared to the minimum daily NSLP requirements for K-5 grade levels under the new nutrition standards: 0.5 cup of fruit, 0.75 cup of vegetable, 1 ounce of grain, 1 ounce of meat or meat alternative, and 1 cup of milk. In terms of meeting the HHFKA requirements, the aforementioned values suggest that, of the 644,070 meals analyzed from 42,938 students 57%, 84%, 61%, 45%, and 19% were not receiving the recommended amounts of fruits, vegetables, grain, meat, and milk servings, respectively.

Table 1. *Summary of National School Lunch Program Servings per Tray per State for Grades K-5 during 2010-2012*

State	School	Fruit Serving (g)			Vegetable Serving (g)			Grain Serving (g)			Meat/Meat Alt Serving (g)		
	N	*M* ±*SD*	Cup	%P[a]	*M* ±*SD*	Cup	%P[a]	*M* ±*SD*	Oz	%P[a]	*M* ±*SD*	Oz	%Pa
AK	10	149± 95	0.60	56	110± 73	0.44	42	33 ±39	0.99	34	80 ±59	2.40	78
IA	17	89 ±89	0.36	33	72 ±70	0.29	19	36 ±59	1.07	39	55 ±46	1.66	55
NY	15	95 ±72	0.38	40	41 ±38	0.17	6	39 ±63	1.17	39	45 ±61	1.34	51
TX	12	87 ±75	0.35	35	25 ± 34	0.10	6	32 ±45	0.96	43	66 ±94	1.97	49
WA	7	107± 95	0.43	49	25 ±29	0.10	5	38 ±48	1.14	41	37 ±44	1.11	42
Average		106± 85	0.42	43	55 ±49	0.22	16	36 ±51	1.10	39	57 ±61	1.10	55
Weekly Total		2.11 cups			1.10 cups			5.34 oz			8.48 oz		

[a]%P = Percentage of the total NSLP meals analyzed that meet the HHFKA nutrient requirements.
Note: the daily minimum amounts of fruit, vegetable, grain, meat/meat alternative, and milk servings for the NSLP under the new nutrient standards are: 0.5 cup, 0.75 cup, 1 oz, 1 oz, and 1 cup respectively. The required minimum weekly average amounts for fruit, vegetable, grain, meat/meat alternative, and milk are: 2.5 cups, 3.75 cups, 8-9 oz, 8-10 oz, and 5 cups respectively.

Table 2. *Summary of Mean Calorie and Nutrient Content of National School Lunch Program Serving Tray per State for during 2010-2012*

State	School	No. Items	Energy Served[a] (kcal)				Sodium (mg)				Saturated F
	N	*M* ± *SD*	*M* ± *SD*	%P[b]	Min	Max	*M* ± *SD*	%14[c]	%17[c]	%22[c]	*M* ± *SD*
AK	10	5.0 ± 0.9	614 ±177	73	271	1,064	1,014 ± 617	met	85	64	6.9 ± 3.8
IA	17	5.0 ± 0.5	500 ± 123	50	264	790	870 ± 373	85	76	69	4.3 ± 3.6
NY	14	4.5 ± 0.6	437 ± 156	40	193	825	777 ± 477	met	86	75	5.8 ± 5.0
TX	12	4.0 ± 0.9	434 ± 192	32	103	1,048	724 ± 474	met	met	84	4.1 ± 5.3
WA	7	4.0 ± 0.9	439 ± 169	41	81	969	630 ± 402	met	met	89	5.7 ± 3.7
Average		4.5 ± 0.8	485 ± 164	47	182	939	803 ± 469	met	82	76	5.4 ± 4.2

[a]The daily minimum and maximum calorie standard per NSLP for grades K-5 is 550 – 650 kcal.
[b]%P = Percentage of the total NSLP meals analyzed that meet the HHFKA nutrient requirements.
[c]%14, %17, %22 = Sodium limit by school years: 2013-2014 is ≤ 1,230 mg; 2017-1018 is ≤ 935 mg; 2022-2023 is ≤ 640 mg.
[d]%E = % Saturated Fat per total Energy (kcal).

Calorie and Nutrient Requirements

In accordance with HHFKA nutrition standards, the daily NSLP calorie requirement for K-5 grades

should be between 550 to 650 kcal. Table 2 highlights the average calories, sodium, and saturated fat contained in foods on NSLP food trays served prior to HHFKA implementation. On average these NSLP trays contained 484.73±163.70 kcal with a range of 182 - 939 kcal. The sodium limits for grade levels K-5 were set at ≤ 1,230 mg by the school year 2014–2015, ≤ 935 mg by the school year 2017-2018, and the final target of ≤ 640 mg by the school year 2022–2023. The average sodium content of NSLP food served was 802.93±468.60 mg. The saturated fat limit for grade levels K-5 was set at less than 10% of the total calories averaged per week. However, the average saturated fat content of NSLP food served was 5.37±4.27 g or 11.08% of total calories.

Pattern of NSLP Consumptions per FBMP Key Food Groups

The Figure below displays a composite representation of FBMP food consumption per state. The average consumption rate (Consumption/Serving) per food group was as follows: 51±10%, 58±20%, 78±32%, 75±15%, and 88±6% of fruits, vegetables, grains, meat/meat alternatives, and milk, respectively.

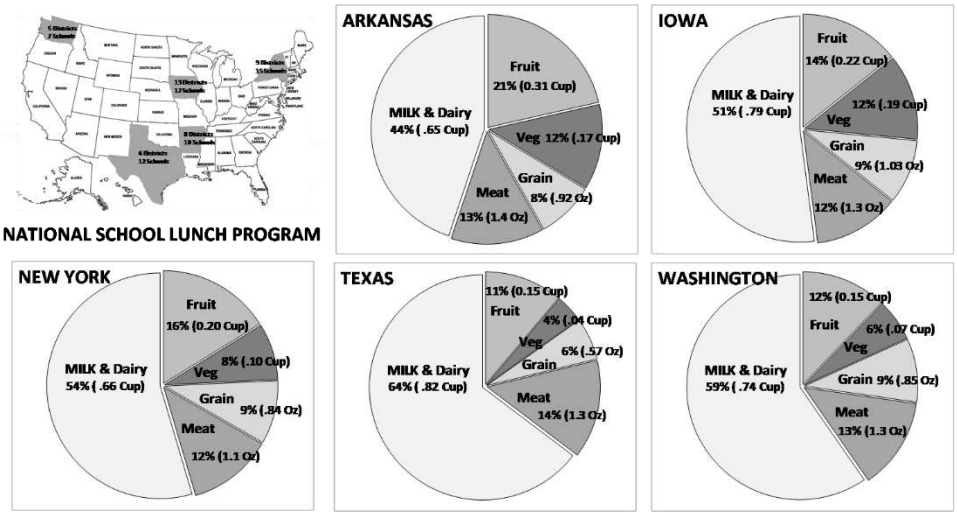

Figure. *Average Consumption of National School Lunch Program's Food Based Menu Planning Distribution per Key Food Groups per State for Grades K-5 during 2010-2012*

Of the average 0.42 cup of fruit served to students with an average 51% consumption rate, Arkansas had the highest consumption per serving at 0.31 cup, followed by Iowa at 0.22 and New York at 0.20. The states of Texas and Washington had the lowest fruit consumption, both consuming 0.15 cup each. Coincidentally, these two states also had the lowest consumption rates of vegetables at 0.07 and 0.04 cup, respectively. Also the average vegetable serving for these two states was 0.10 cup which was far below any of the menu planning standards prior to the new meal planning standard. Consequently, this small serving (0.10 cup) was reflected with low amounts of consumption. Of the average 1.07 ounce of grains served to students, the average consumption per state was as follows: 0.92, 1.03, 0.84, 0.92, and 0.85 ounce, respectively for Arkansas, Iowa, New York, Texas, and Washington.

Table 3. *Summary of Most Frequently Served Food Items (Top 5) per Key Food Groups and Their Consumption Patterns for K-5 National School Lunch Program during 2010-2012*

		Serving Parameters			% Consumption			
NBD/CN	**Food Item**	**N**	Frequency	% School	*M* ±*SD*	Skewness [b]	% Dist M_1 [c]	%Dist M_2 [c]
Fruit								

Table 3. *Summary of Most Frequently Served Food Items (Top 5) per Key Food Groups and Their Consumption Patterns for K-5 National School Lunch Program during 2010-2012*

9003	Apple, fresh	109,492	Weekly	100	6 ± 21	3.72	0 (86)	0 (7)
9200	Oranges, fresh	56,034	Weekly	100	63 ±45	-0.57	0 (51)	100 (35)
9237[a]	Peaches, pack	32,304	Weekly	100	39 ±46	0.48	100 (58)	0 (32)
9267[a]	Pineapple, pack	27,763	Biweekly	90	82 ±35	-1.73	100 (77)	0 (13)
9040	Banana, fresh	17,390	Biweekly	80	94 ±20	-3.91	100 (87)	0 (4)
Vegetable								
11090	Broccoli, raw	27,244	Weekly	100	32 ±45	0.79	0 (60)	100 (27)
11124	Carrots, raw	27,051	Weekly	100	34 ±45	0.67	0 (57)	100 (29)
11579[a]	Mixed Vegetables, canned	19,322	Weekly	90	6 ±28	2.68	0 (69)	50 (13)
11726[a]	Green Beans, canned	12,881	Monthly	80	11 ±18	4.62	0 (67)	0 (24)
11143	Celery, raw	7,149	Monthly	70	15 ±30	1.86	0 (59)	80 (10)
Grain								
18069	Bread, white	251,187	Biweekly	92	71 ±18	-0.87	100 (59)	0 (33)

Table 3. *Summary of Most Frequently Served Food Items (Top 5) per Key Food Groups and Their Consumption Patterns for K-5 National School Lunch Program during 2010-2012*

18342	Dinner roll	193,221	Weekly	85	54 ±32	0.44	100 (50)	0 (38)
18009	Biscuit, plain	148,136	Weekly	80	47 ±44	0.48	100 (46)	0 (41)
20045[a]	Rice	70,848	Weekly	74	92 ±13	-4.86	100 (90)	0 (3)
18022	Cornbread	6,441	Monthly	35	4 ±33	3.60	0 (91)	50 (3)
Entrée (Meat/Meat Alternative + Grain)								
5321	Chicken Nuggets	193,221	Biweekly	100	97 ±12	-7.41	100 (96)	0 (1,4)
21089[a]	Cheeseburger	20,610	Monthly	70	87 ±27	-2.60	100 (75)	80 (12.9)
21302[a]	Pepperoni Pizza	11,593	Monthly	45	97 ±15	-5.60	100 (93)	80 (3.9)
21118[a]	Hot Dog in Bun	9,017	Monthly	62	96 ±16	-5.27	100 (93)	0 (2.2)
22401[a]	Spaghetti w/Meat Sauce	7,085	Monthly	73	63 ±36	-0.48	100 (8)	0 (12.6)
Milk/Dairy								
1085	Chocolate Milk (fat free)	424,147	Daily	100	52 ±48	-0.09	100 (49)	0 (42)
1085	Strawberry Milk (fat free)	131,426	Daily	100	57 ±47	-0.29	100 (54)	0 (36)

Table 3. *Summary of Most Frequently Served Food Items (Top 5) per Key Food Groups and Their Consumption Patterns for K-5 National School Lunch Program during 2010-2012*

1082	Low Fat Milk	41,817	Daily	100	44 ±47	0.24	0 (46)	100 (39)
42187[a]	Yogurt	10,820	Biweekly	85	97 ±14	-5.99	72 (20)	30 (18)
43597[a]	Mozzarella Cheese Sticks	6,763	Biweekly	80	51 ±29	0.01	56 (16)	73 (14)
Non-Key Food								
19411	Potato Chips	13.590	Biweekly	50	97 ±13	-6.53	100 (95)	80 (3)
19183	Chocolate Pudding	12,946	Biweekly	65	62 ±32	-0.28	100 (28)	33 (10)
21030[a]	Chocolate Chip Cookies	12,888	Biweekly	100	71 ±35	-0.70	100 (46)	25 (8)
25028[a]	Tortilla Chips	7,085	Monthly	30	75 ±31	-0.91	100 (54)	70 (7)
21029[a]	Cookies (Animal Crackers)	6,447	Monthly	80	65 ±39	-0.59	100 (46)	0 (15)

[a]USDA's Child Nutrition (CN) Database Codes or Nutrient Databank (NDB) codes. These codes were used for nutrient analysis.
[b]Skewness is a measure of dispersion.
[c]M_1 and M_2 are the two modes of bi-modal distribution.

The recommended servings (average 1.70 ounce) and consumption of meat or meat alternatives served to students were met by each of the states in this study. Thus, the average consumption per state of meat or meat alternatives was 1.4, 1.3, 1.1, 1.3, and 1.3 ounce, respectively for Arkansas, Iowa, New York, Texas, and Washington. Lastly, of the average 0.82 cup of milk served to students, average consumption per state was as follows: 0.65, 0.79, 0.66, 0.82, and 0.74 cups, respectively for Arkansas, Iowa, New York, Texas, and Washington. Therefore the milk serving constitutes a significant amount (49-54%) of the daily caloric requirement (Figure).

Pattern of NSLP Consumption per Food Types

Table 3 is a summary of the most frequently served NSLP food items (top 5) per key food groups and their respective consumption patterns. Bananas (94%) and oranges (63%) were the most commonly consumed fresh fruit items. Although fresh apples were the most commonly served fruit

(109,492), they were rarely consumed (6%) by students in this study (K-5). In addition, prepackaged peaches (39%) and pineapple (82%) were the most commonly consumed non-fresh fruits. Vegetables were minimally consumed regardless of form (cooked, canned, or raw). In addition, for separable food items (i.e. salads and sandwiches) vegetables were often left or picked out. White bread served alone or in sandwiches (i.e. Cheeseburger) or in Entrée (i.e. Pizza) was the largest source of grains. White bread was highly consumed, regardless of serving type: alone (71%), in sandwiches (87%), or in entrée (97 %).
Of the 597,390 milk servings analyzed (found on 93% of NSLP serving trays), chocolate milk represented 70.6%, followed by low fat milk (unflavored) at 21.6%, and strawberry flavored milk at 7.7%. Subsequently, the average milk consumption was 0.52 ± 0.26% of the one cup serving, with a bivariate frequency distribution (Modes at 0 and 100%). Lastly, non-key food items that were commonly served in NSLP trays that were highly consumed by students were potato chips (97%), tortilla chips (75%), and chocolate chip cookies (71%).

CONCLUSIONS AND APPLICATION

This paper is a baseline evaluation of the National School Lunch (NSLP) aimed at studying the impact of the new nutritional standards as authorized by the HHFKA (USDA, 2012). The implementation phase of this complex public policy took effect at the beginning of the school year 2012-2013 with the evaluation phase scheduled to begin in the school year 2015.

Food Based Menu Planning
The SFIA is a novel method used in this study to evaluate the FBMP for NSLP. FBMP is the HHFKA nutritional guideline for the amount of key food groups served to students per grade level. The present study showed that at baseline the servings of fruit, vegetables, grain, meat or meat alternate, and milk are as follows: 0.42 cup, 0.22 cup, 1.07 ounce, 1.7 ounce, and 0.82 cup, respectively. Under the FBMP guideline, the servings of fruits and vegetables did not meet the new nutrition standards. This gap is partly explained that prior to 2012, some schools were using Nutrient Standard Menu Planning that allowed flexibility with foods served as long as they met nutrition standards. Consequently, these results strongly suggest that collectively schools must focus their attention on fruits and vegetable servings within the upcoming years to meet the new FBMP guidelines.

This study has shown that during 2010-2012, an NSLP tray generally offered 484.73 ± 163.70 kcal of energy, of which 11% was derived from saturated fats (5.37 ± 4.27 grams) with an average sodium content of 802.93 ± 468.60 mg. These ranges strongly suggest that on a daily basis $\geq$20 % of the school children are either undernourished or served in excess. Nonetheless, in terms of meeting the HHFKA calorie requirements, of the 644,070 meals analyzed from 42,938 students, 47% met this requirement.

All schools evaluated in this study met the HHFKA sodium limit requirement for the school year 2014-2015. However, for future school years 2017–2018 and beyond (2022–2023 limits), significant changes will need to occur to meet these requirements.

Nutrient Analysis
HHKFA nutritional standards are health preventive measures under social capital change theory that follow the traditional five step policy cycle. Because of these health objectives, specific changes in HHFKA nutritional standards require reliable and efficient nutrient analysis tools to determine the caloric and nutrient components of food items served.

Commonly used nutrient analysis tools are questionnaire or interview-based systems. The primary limitations of questionnaire based nutritional data are the reliability of these questionnaires when adapted for small children. Reading comprehension, playfulness, memory recall, and immaturities are just a few factors that affect the reliability of questionnaire based nutritional data (Garcia, et al., 2012). In addition, transcribing responses from questionnaires for nutrient analysis often results in random and system errors. Random errors are operator errors due to selection and system errors are computational error (Echon, 2013). Collectively these errors lead to either over or

underestimation of nutrient values (Costello, Loria, Lau,J, Sacks, & Yetley, 2011; Echon, 2013; Zelmann, 2011).

One unique benefit of this study was the successful use of SFIA, an innovative form of technology. SFIA is an efficient and cost effective system with unparalleled speed and measurement precision for nutrient analysis. The application of SFIA in this study was passive and provided an individual level specificity to determine the caloric and nutrient composition of NSLP lunch trays.

Pattern of NSLP Meal Consumption

In this study, the evaluation of school food production records and menus is linked to consumption (nutrition). This analysis was performed because under the HHFKA guidelines all schools are required to develop and follow standardized recipes. As presented in Table 3, with the exception of spaghetti with meat sauce and pepperoni pizza, the bulk of school meals at baseline were pre-prepared or canned. However, the preparation of spaghetti with meat sauce using food production recipes varied significantly. In addition, the local brand names of canned products are not in the USDA's Child Nutrition database. Therefore, standardized recipes and entry of local brands into nutrient databases is one aspect of HHFKA that requires further coordination between schools and the USDA.

Linking consumption (nutrition) parameters with standard recipe or customized nutrient parameters is important to schools. Moving forward with HHFKA implementation, the use and preparation of standard recipes will improve the ability to evaluate food consumption patterns (See Table 3) to provide a true measure of variance and usefulness (Wilk';s Theorem)(Ree & Earles, 1998). This is important because at lowest (student) level nutrition is a decision or choice (probability) made from two (YES or NO) possible options (Gold & Shadlen, 2007). For example, a decision of YES for milk consumption (nutrition) may be viewed as an affirmation of HHFKA effect (Social Cognitive Theory). On the contrary, a decision of NO triggers a number of possible outcomes (Antonakis, Bendahan, Jacquart, & Lalive, 2010). For example, dental status of children in this age group may partly explain the non-consumption of apples (Table 3). Thus, schools may find it useful to use alternatives (i.e. applesauce, pineapple pack) to raw apples for this age group.

Nevertheless, the selection of "NO" becomes random (the "What If") event, as the number of possible outcomes increases, and the level of options (gray area) also increases in complexity (conditional probability). Consequently, this gray area becomes less discrete ("Contingent Upon";). Explaining "NO" is composed of overlapping and conflicting social and environmental factors (i.e. product placement of chocolate milk in cooler) that can make the causal interpretation of the health benefits of HHFKA complex (Gold & Shadlen, 2007). Social and environmental factors are composites of organizational (school) decisions (Bandura, 1986; Schein, 1992). Organizational decision is a cumulative process involving four components: composition, context, communication, and control. Composition addresses the individual's behaviors, knowledge, and skills about the choice. Context deals with the type of environment where the decision takes place. Communication deals with the quality of dialogue among participants; and control deals with the process of regulating the content and outcome of the decision (Hastie & Dawes, 2007). Henceforth, patterns of consumption (nutrition) are critical to HHFKA policy effectiveness. The pattern of consumption must be shared among organizational channels for financial, social, and political measures to determine the usefulness of each recipe or food product offered to students in order to establish its net effect on health objectives.

HHFKA Policy Implementation and Evaluation

Another important benefit of SFIA is the ease and simplicity for data collection regardless of location. This is important because the HHFKA evaluation covers the entire United States regardless of school location (i.e. remote or rural areas). The use of Internet Protocol (IP) cameras with web-based connectivity or Smartphones is ideal to monitor remote areas from a central location. Moreover, SFIA is a transparent approach to policy evaluation. The data (just the food trays) being collected and analyzed can be viewed securely in real time by appropriate officials anywhere. This approach is optimal in this age of fiscal responsibility and accountability.

More importantly, SFIA can minimize the amount of workload needed regardless of the number of students (sample size) being evaluated. This technology can offer significant savings to both large and small districts. Obviously, for large school districts with large student population (i.e. serving over 900,000 students) the cost of evaluation can be minimized by eliminating the need for data collectors (human resources) and disruption of school schedules.
The nutritional information presented in this study was analyzed using SFIA. SFIA is a technology based nutrient and recipe analysis system with a high degree of precision. This technology is specifically designed to evaluate HHFKA nutritional standards and help schools with policy compliance. Therefore, the data and procedures presented in this paper are beneficial to state health officials and policy makers in promoting, monitoring, and evaluating healthy school nutrition.

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BIOGRAPHY

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