

Long-Term Impact of a Chef on School Lunch Consumption: Findings from a 2-Year Pilot Study in Boston Middle Schools

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ABSTRACT

School cafeterias can play an important role in providing healthy meals. Although schools participating in the National School Lunch Program are required to meet minimum program standards, advocates recommend that innovations be sought to enhance menu dietary quality. This study evaluated the Chef Initiative, a 2-year pilot study in two Boston middle schools, designed to increase the availability and consumption of healthier school foods. Between 2007 and 2009, a professional chef trained cafeteria staff to prepare healthier school lunches (ie, more whole grains, fresh/frozen fruits and vegetables, and less sugar, salt, saturated fats, and *trans* fats). Meal nutrient compositions were monitored from 2007 to 2009, and a plate waste study conducted in the spring of 2009 compared food selection and consumption patterns among students at Chef Initiative schools, with students receiving standard school lunches at two matched control schools. Paired *t* tests and descriptive statistics were used to examine differences in menus and mixed-model analysis of variance was used to analyze differences in students' food selection and consumption between Chef Initiative and control schools. Overall, the Chef Initiative schools provided healthier lunches and the percent of foods consumed at Chef Initiative and control schools were similar (61.6% vs 57.3%; $P=0.63$). Of the areas targeted, there was greater whole-grain selection and vegetable consumption; 51% more students selected whole grains ($P=0.02$) and students consumed 0.36 more vegetable servings/day ($P=0.01$) at Chef Initiative schools. The potential of chefs collaborating with cafeteria staff to improve the availability, selection, and consumption of healthier meals is promising.

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SCHOOLS CAN BE VIEWED AS A CAPTIVE ENVIRONMENT where public health interventions can reach the greatest number of students, especially to improve dietary patterns.¹ School meal participants consume up to 47% of their daily energy at school.² School meal programs can influence students' dietary habits and impact their diet quality; students who participate in the National School Lunch Program (NSLP) typically consume more protein and micronutrients at lunch compared with nonparticipants.^{2,3} Although school meals typically strive to meet the NSLP nutritional requirements, they often exceed the recommended 10% of energy from saturated fats.^{4,5} In addition, NSLP nutritional requirements do not address sodium, whole grains, or fiber, which often results in school meals being higher in sodium and lower in whole grains and fiber than the 2010 Dietary Guidelines for Americans recommendations.^{5,6} Diets rich in whole grains, unsaturated fats, fruits, and vegetables, and low in sugar, sodium, saturated fats, and *trans* fats can have several health benefits, including decreased risk of overweight and diabetes and lower blood pressure.⁷⁻¹⁵ However, foodservice directors are often concerned that offering

healthier options will decrease the palatability of the meal and reduce participation.¹⁶ The Chef Initiative was a quasi-experimental, 2-year pilot program in two Boston middle schools that hired a chef to train cafeteria staff to provide healthier, more palatable school meals. A chef-based model was selected based on key informant interviews with school cafeteria staff and administration in low-income communities in Massachusetts. These interviews suggested that, despite schools' offering meals that met NSLP standards, there was a need for innovations to enhance the menu's dietary quality and palatability. The literature also suggested that an additional barrier to providing healthier options is that cafeteria staff often believe that they lack sufficient skills to prepare healthier options; this could potentially be addressed by having them work with a chef.¹⁶ Because a chef could collaborate with staff to enhance multiple aspects of the cafeteria foods (eg, increasing whole grains, fiber, fresh/frozen fruits and vegetables, and reducing saturated and *trans* fats, sodium, and sugar), the menu changes could be broader than previous studies that, for example, targeted only fruits and vegetables and/or a reduction in fats.¹⁷⁻²⁰ Lastly, research concluded that

although introducing more fruits, vegetables, and whole grains on school menus is important, changes to the school food environment alone will not guarantee consumption; the foods' palatability must also be improved.²¹ This might partly explain why previous studies with cafeteria changes, including larger interventions with classroom and/or parent components, have experienced mixed success.^{19,20,22-28} It was therefore believed that a chef-based model could provide cafeteria staff with inventive recipes to further improve the dietary quality of school meals and teach staff additional food preparation techniques to improve the palatability of the foods. The goal of the Chef Initiative was to pilot test the effectiveness of a chef-based model on student's selection and consumption of school lunches. The objectives were to further improve the nutrient profiles of school meals and maintain students' selection and consumption of the school lunch components (ie, entrées, grain-based sides, fruits, vegetables, and milk), and this was measured using a plate waste study at the end of the 2-year program. It was hypothesized that the chef could successfully work with the existing cafeteria staff to improve the quality of the school meals and, with repeated exposure to healthier, more palatable lunches, students would select and consume the foods at rates similar to those of students at control schools.

METHODS

Description of the Intervention Program

The Chef Initiative was a nutrition pilot program developed by the nonprofit anti-hunger organization Project Bread, Boston Public Schools, the Boston Public Health Commission, and Harvard School of Public Health. Project Bread hired a chef to develop recipes, plan menus, and train existing cafeteria staff to create healthier, more flavorful lunches in two middle schools in Boston, MA. Boston Public Schools selected schools based on the ability to cook foods on site and the staff's willingness to implement new menus. The chef worked with the staff 2 to 3 days per week at each school during the 2007-2009 school years; trainings included food-preparation techniques and recommendations on how to achieve the nutrition goals (eg, ways to incorporate more whole grains).

The Chef Initiative schools were matched with two control public middle schools in Boston based on race and ethnicity and percent eligible for free or reduced-price meals. Control schools received standard Boston Public Schools meals. At Chef Initiative schools, 88% of the students (n=1,609) were eligible for free or reduced-price meals (roughly 78% participated in school lunch daily), and 86% of control school students (n=1,440) were eligible (approximately 70% participated daily). These eligibility rates did not change substantially during the course of the initiative.

This unique collaboration between a community group, public schools, local government, and a university was achieved by including members of each group at regular meetings to create the program and establish realistic goals (eg, determine reasonable aims for menu changes). Once the program was under way, the chef was included at the meetings and the group monitored the progress of the initiative and addressed challenges (eg, acceptance from cafeteria staff).

Study Design

The chef created new menus that resembled the standard Boston Public Schools menus, but were modified to improve the healthiness and palatability of all meal components (meals included entrées, grain-based sides, fruits, vegetables, and milk; Figure). The goals of the Chef Initiative were to replace *trans* and saturated fats with unsaturated fats, reduce added sugar and salt, and increase whole grains and fiber. These goals were operationalized with the following guidelines: eliminate *trans* fats, use low-fat cheese when available, eliminate whole and reduced-fat milk, cook with oils instead of butter, remove pastries, limit chocolate milk to two times per week, replace fruits canned in syrup with fresh or frozen fruit, serve fresh or frozen vegetables instead of canned, substitute refined grains with whole grains products when available (eg, seasoned brown rice instead of white rice), remove added salt from recipes, and serve lunches with at least 5 g fiber. To help achieve the goals and further improve the palatability of the foods, scratch cooking was emphasized (eg, sauces and salad dressings). A toolkit can be accessed at http://www.projectbread.org/site/PageServer?pagename=end_bettermeals.

Adherence to the Chef Initiative goals was assessed in the fall, winter, and spring of 2007-2009 by monitoring planned menus and randomly analyzing 6 weeks of production records and food labels. The study aimed for 100% compliance with the initiative's guidelines. Nutrients were determined using Nutrition Facts labels and nutrient information reported by Boston Public Schools. Boston Public Schools also provided planned menus and Nutrition Facts labels for analyzing the standard lunches. Total energy, total fats (and total fats as a percent of energy), *trans* fats, saturated fats (and saturated fats as a percent of energy), fiber, and sodium were estimated using Nutrikids software (version 7.0, 2005, Lunch-Byte Systems). Study staff collaborated with the chef after meal analyses, typically discussing ways to further reduce sodium and saturated fats and increase whole grains and unsaturated fats.

To assess the quantity of food discarded, a plate waste study was conducted using methods adapted from previous studies.²⁹⁻³¹ Passive consent procedures were followed for all students, and students were eligible to participate in the study if they attended a lunch period on a study day. Students were excluded if they did not take a school lunch or ate outside the cafeteria; schools had closed campuses so students left the cafeteria only to attend detention or visit the nurse. Students were also excluded if they refused to participate (n=12). Each school was visited on 2 consecutive weekdays in the spring of 2009, and all lunch periods were included. Dates were randomly selected after the menus were planned.

Before each lunch period began, trays were numbered and 10 random samples of each portioned food served that day were weighed in grams on a food scale to estimate the average prelunch weight of the meal components (OXO 1130800, OXO Company). Staff had been trained in portion control and many foods were in preportioned containers. During the lunch period, research assistants stood by the cash registers and recorded the tray numbers, foods items, and sex of the students purchasing the foods. When students completed their meals, the assistants collected the trays, recorded the tray numbers, and weighed the remaining foods and beverages (including

Menu items	
Chef Initiative Schools	Boston Public Schools
Entrées Whole-wheat pasta and meatballs with homemade lower-sodium sauce Low-fat grilled cheese on whole-wheat bread Baked, seasoned chicken Tuna salad on whole wheat-bread with lettuce, tomato, and onion	Entrées Meatball sandwich on refined-wheat roll Prepackaged grilled cheese with refined wheat Chicken nuggets Tuna salad on white bread
Milk Nonfat and 1% milk (flavored milk served twice per week)	Milk Milk variety offered daily (eg, whole milk, chocolate milk, 1% plain)
Vegetables Salad with homemade dressing Homemade soup with fresh and frozen vegetables Seasoned frozen broccoli sautéed in oil and garlic Corn (canned) and black bean salsa	Vegetables Canned peas and carrots Canned green beans Frozen broccoli (plain) Canned corn
Fruit Fresh apples Fresh oranges	Fruit Canned applesauce Canned mixed fruit in syrup
Sides Seasoned brown rice Whole-wheat rolls	Sides White rice Refined-wheat rolls

Figure. Examples of menu items served at lunch in Chef Initiative schools and Boston Public Schools. Examples taken from 6 weeks (n=30 days) of planned menus in the fall, winter, and spring of the 2007–2009 school years from the two Chef Initiative Schools and from the standard menu planned for all other Boston Public Schools with middle school students and with on-site cooking (n=19). The nutritional goals of the Chef Initiative: Fats: eliminate *trans* fats and reduce saturated fat. Milk: eliminate whole and reduced-fat (2%) milk, use low-fat cheese (when available), substitute butter with oils (eg, olive, canola) in recipes. Sugar: eliminate fruit or vegetables canned in syrup, limit chocolate milk to <3 days per week, eliminate “sweet food products” (ie, cookies, cakes, or doughnuts). Sodium: reduce or eliminate added salt in recipes and substitute salt with other seasoning (eg, spices, garlic), and rinse canned vegetables. Produce: serve a fresh/frozen fruit and vegetable offering, 2 servings per day or 10 servings per week. Whole grains: substitute refined grains with whole grains for entrées and sides (when available). Fiber: at least 5 g (guidelines are in addition to the nutrition requirements for the National School Lunch Program).

vending machine and à la carte purchases) on each tray. Each component (eg, vegetables, fruits) was weighed separately and scales were checked to ensure zero baseline weights. The Committee on Human Subjects at the Harvard School of Public Health approved this study.

The number of students receiving a school lunch and selecting entrées, grain-based sides, vegetables, fruit, and milk (recorded by the research assistants standing at the cash registers) was used to calculate the percent of students selecting each meal component (grain-based entrées and sides were combined to estimate overall whole-grain selection). When a student was only able to select one option when given a choice for a menu component (eg, students had to choose between pasta or a sandwich for an entrée), percent consumption was calculated for the menu component using the following equation: (average pre-lunch weight of the food/beverage [based on the 10 samples]–weight of the food or beverage remaining at the end of the lunch period)/average pre-lunch weight of the food or beverage×100. For items where students could select two (eg, students could select a salad and vegetable soup), the fraction consumed was calculating using the equation and summed for each food type to

calculate the number of servings. Foods that were served in quantities less than an NSLP standard serving size (eg, onion on a sandwich) were excluded from the estimates. The weights of empty containers (eg, milk cartons) were subtracted from the pre-lunch and post-lunch weights.

Statistical Analysis

Paired *t* tests were used to examine differences in the total energy, total fat, saturated fat, fiber, and sodium of the school lunches served in Chef Initiative schools and Boston Public Schools. Mixed-model analysis of variance, with school as a random effect nested within conditions, was used to examine differences in overall selection and consumption of lunch, as well as for the entrées, side dishes, milk, and servings of fruits, vegetables, and whole grains between Chef Initiative and control schools. The analysis of variance models included the following a priori covariates: sex, number of meal items taken, number of à la carte or vending machine snacks taken with the lunch, and a variable controlling for day 1 and day 2. The analyses were performed using SAS statistical software (version 9.1, 2003, SAS Institute).

Table 1. Comparison of nutrients in school lunches served in Chef Initiative schools and Boston Public Schools during fall 2007 through spring 2009^a

	Chef Initiative schools	Boston Public schools	P value	Federal requirements ^b
	←————— <i>mean ± standard deviation</i> —————→			
Food energy (kcal)	661 ± 99	658 ± 141	0.92	785
Total fat (g)	19.3 ± 4.8	17.7 ± 6.5	0.33	—
% of Energy	26.3 ± 5.5	24.3 ± 7.1	0.19	<30
Saturated fat (g)	5.7 ± 1.3	6.8 ± 2.6	0.04	—
% of Energy	7.8 ± 1.8	9.4 ± 3.1	0.03	<10
Fiber (g)	11.2 ± 2.8	7.6 ± 1.7	<0.0001	—
Sodium (mg)	927 ± 267	1,211 ± 255	<0.0001	—

^aAnalyses based on the average of 6 weeks (n=30 days) of planned menus in the fall, winter, and spring of the 2007-2009 school years from the two Chef Initiative Schools and from the standard menu planned for all other Boston Public Schools with middle school students and with on-site cooking (n=19) using Nutrikids software (version 7.0, 2005, LunchByte Systems). Comparisons are for statistically significant differences in nutrients between Chef Initiative schools and Boston Public Schools using paired *t* tests.

^bCurrent federal nutrition requirements for school meals (using traditional menu planning for grades 4 through 12) are based on the 1995 Dietary Guidelines for Americans.³⁶

RESULTS AND DISCUSSION

Six weeks of planned menus were analyzed for Chef Initiative school lunches and standard lunches for the other Boston Public Schools, with middle school students and with on-site cooking (n=19 schools), and nutrients were determined using Nutrition Facts labels and nutrient information reported by Boston Public Schools (Table 1). Because meals adhered to federal guidelines, they provided roughly the same number of calories as control school meals.³² Consistent with the goals of the Chef Initiative, total fats were not reduced, instead unsaturated fats replaced saturated and *trans* fats. Fiber was 3.6 g higher in Chef Initiative schools ($P<0.0001$) and meals had, on average, 284 mg less sodium ($P<0.0001$). Although reducing added sugar was a goal, this could not be accurately calculated because Nutrition Facts labels combine naturally occurring and added sugars.

Whole grains and fresh/frozen produce were an important component of the Chef Initiative. Of the carbohydrate-based entrées, 77% were whole grain at Chef Initiative schools and only 38% contained whole grains at control schools. At Chef Initiative schools, 66% of the side dishes served to complement protein-based entrées (eg, rolls and rice) were whole grain compared with 33% at control school. All of the vegetables were either fresh or frozen at Chef Initiative schools, compared with 20% at control schools (80% were canned). At Chef Initiative schools, 71% of the fruits were fresh and none were canned. At control schools, no fresh fruits were served and 60% of the fruit options were canned in syrup.

During the plate waste study, a total of 1,609 students at Chef Initiative schools and 1,440 students at control schools participated. On average, students at Chef Initiative schools ate similar quantities of food compared with students in control schools (61.6% vs 57.3%; $P=0.63$), not including milk (Table 2). At Chef Initiative schools, 85.7% of students took at least one serving of whole grains from the entrées and/or sides, and at control schools only 34.7% took a whole grain ($P<0.02$). Students in Chef Initiative schools consumed similar amounts of their entrées compared with students in control schools (79.6% vs 84.4%; $P=0.26$). Students at Chef Initiative schools ate, on average, 45% more of their side dishes than control

school students ($P<0.0001$), resulting in greater whole-grain consumption among Chef Initiative students.

Although there were no differences in the percent of students selecting vegetables (59.1% at Chef Initiative schools and 61.6% at control schools; $P=0.91$), Chef Initiative students ate, on average, 0.36 more servings of vegetables per day (0.54 servings at Chef Initiative schools and 0.18 servings at control schools; $P=0.01$), which translates to about two additional servings of vegetables per week. A similar percentage of students took fruit at Chef Initiative and control schools (35.2% vs 39.1%; $P=0.17$) and there was not a significant difference in consumption (0.47 vs 0.62 servings of fruit; $P=0.49$).

Despite limited access to chocolate milk at Chef Initiative schools, selection and consumption of milk remained high. A similar percentage of students took milk at Chef Initiative schools and control schools (62.2% vs 67.8%; $P=0.56$). Consumption did not decrease among students at Chef Initiative schools, including days in which skim milk was the only option at Chef Initiative schools (77.2% vs 73.5%; $P=0.38$).

Results from this study suggest that a chef-based model can be used to collaborate with cafeteria staff to enhance school menu dietary quality and palatability. In contrast to the belief that students will eat less if they are offered healthier meals, students consumed similar quantities of their lunches at Chef Initiative schools compared with control schools, and drank similar amounts of plain milk (nonfat and reduced-fat [1%]) when chocolate milk was limited. The present study also found that students ate whole grains when they were available, corroborating the findings from a pilot study in Minneapolis, MN.²⁷ Although students often benefit more from multicomponent interventions,^{19,20,22-24,27} this pilot study's results suggest that by training cafeteria staff to provide healthier, more palatable choices, changes to the cafeteria food alone have the potential to improve the food habits of the students. Interventions such as the Chef Initiative can also improve the health of the students: The reduction of sodium in the Chef Initiative was similar to that of the Exeter-Andover Project, which reduced sodium in school meals and found students' blood pressure decreased.³³ Additional studies should examine ways to further reduce sodium levels in school

Table 2. Middle school students' average daily selection and consumption of foods and beverages at lunch in Chef Initiative (n=2) and control schools (n=2) in Boston (spring 2009)

	Percent of Students Selecting Foods and Beverages			Percent of Foods and Beverages Consumed ^a		
	Chef Initiative	Control	<i>P</i> value ^b	Chef Initiative	Control	<i>P</i> value ^b
Overall ^c	(reference) ^d	(reference)	—	61.6	57.3	0.63
Entrée	99.5	99.3	0.50	79.6	84.4	0.26
Side ^e	21.5	30.4	0.68	74.6	29.2	<0.0001
Milk	62.2	67.8	0.56	77.2	73.5	0.38
				No. of servings consumed ^a		
Vegetable	59.1	61.6	0.91	0.54	0.18	0.01
Fruit	35.2	39.1	0.17	0.47	0.62	0.49
Whole grains ^f	85.7	34.7	0.02	1.51	1.43	0.81

^aCalculated using least-squares means regression. For individual food items and milk, amount consumed was calculated using only those students who took the food or beverage.

^bResults based on mixed-model analysis of variance, with school as a random effect nested within conditions. Estimates are adjusted for sex, number of food items taken, number of à la carte snacks consumed, and study day (day 1 vs day 2).

^cExcludes milk.

^dReference category is n=1,609 for Chef Initiative schools and n=1,440 for control schools.

^eSides are carbohydrate based (ie, rolls and rice) and complement protein-based entrées. Sides do not include fruits and vegetables.

^fSources of whole grains are entrées and sides.

meals, such as a formal cafeteria staff education program to help them identify lower-sodium products. Although few school-based nutrition interventions have examined the impact on students' weight, results are promising.^{22,34,35} Future research should assess the impact on health outcomes of these menu modifications and changes in consumption.

This study has several limitations. Because the Chef Initiative was already established by the nonprofit organization, Project Bread, before the evaluation was planned, schools were not randomly selected and preintervention consumption data could not be assessed. However, the selection criteria (the ability to cook foods on site and the willingness of the staff to implement new menus) were unlikely to have a major effect on students' selection and consumption of healthier foods. Control schools were matched on intervention school characteristics without knowledge of students' consumption patterns to reduce potential confounding by ethnic or neighborhood characteristics. Only urban, low-income middle schools in Boston were examined; future work should examine whether findings are similar in schools with other demographics and/or whether a chef-based model can substantially impact school meal participations rates in schools where fewer students are eligible for free and reduced-price meals.

Planned menus were evaluated for the nutrition content of the meals. Although detailed compliance measures were beyond the scope of this study, a research assistant frequently examined Chef Initiative school production records and the foods proposed were almost always the foods served. Meals were analyzed during the course of the 2-year period, and nutrients were typically calculated using the recipes provided by the chef and directly from the Nutrition Facts labels of products used at the schools; thus the nutrient analysis reflects what students at Chef Initiative schools were served on average during the entire initiative. Caution is also warranted

when interpreting the results of the menu analysis because multiple components of the diet were tested for differences and some could be significant by chance.

Consumption was evaluated on only 2 days at each school. However, there is no reason to suspect that consumption on study days was different from other days. Although students were aware of tray collections, they did not know the study aims; any changes in intake were likely small and nondifferential between intervention and control schools. Many students who took a school lunch on the first study day also took a lunch on the second day, but these repeated measures could not be directly addressed. However, the analysis included a variable for study day; tray-to-tray variability caused by serving different foods each day was likely a larger source of variability than within-child variability. Although Boston Public Schools frequently conduct student satisfaction surveys, none were collected during the 2 study years, so student's acceptance of the meals was not directly assessed.

Although schools are often concerned about the potentially higher cost of healthier foods, this could not be accurately calculated for the pilot study. Only two schools provided healthier meals in this study, and prices are often impacted by the volume of foods purchased. Therefore, the amount spent would not accurately reflect the cost of purchasing for an entire school district. Future research should investigate the cost of meals like those of the Chef Initiative, but with the foods ordered on a larger scale.

CONCLUSIONS

This pilot study provides evidence that enhancements in school menu dietary quality and palatability can be achieved using a chef-based model. Overall, the selection and consumption of foods at Chef Initiative schools were similar to those of students in control schools. Students at Chef Initiative

schools ate more vegetables and took more whole grains. Despite limited availability of chocolate milk, milk consumption remained high. Because providing healthier school meals can improve students' diet quality and possibly overall dietary habits, this can have important health implications for children. These results highlight the need for larger, long-term randomized studies to corroborate these findings, assess the fiscal implications of the menu changes, and evaluate the impact of similar dietary changes on health outcomes. Although an aim of the study was to maintain consumption levels after enhancing the nutrient dietary quality of the meals, future intervention studies should also examine ways to increase the consumption of nutrient-dense vegetables, whole grains, and fruit without added sugars. Additional research is needed to evaluate if the consumption of healthier school meals impacts food choices outside of school.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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