Is Scratch-Cooking a Cost-Effective Way to Prepare Healthy School Meals with US Department of Agriculture Foods?

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ABSTRACT

Background Despite the resurgence of interest in scratch-cooking as a way to increase the quality and appeal of school meals, many school districts are concerned about the cost implications of switching to scratch-cooking. US Department of Agriculture (USDA) Foods are the single largest source of ingredients for school meals, and about half of USDA Foods are diverted for processing before being sent to the school district.

Objective We aimed to determine whether school lunch entrées made in a district from basic or raw USDA Foods ingredients can be healthier and less expensive to prepare than those sent to external processors.

Design/setting This cross-sectional study examined the relationship between the extent of scratch-cooking and the nutritional content and cost to prepare entrées. Information was gathered by interview with school foodservice personnel and from school foodservice records from a convenience sample of 10 school districts in California that employed varying degrees of scratch-cooking and is diverse in terms of geographic location and the sociodemographics of the student body. The sample included all elementary school lunch entrées that contain USDA Foods offered during October 2010 for a total sample of 146 entrées.

Statistical analyses Ordinary least squares regressions were used to test for statistically significant differences in cost and nutrient content of entrées according to the level of scratch-cooking.

Results There was no significant relationship between total costs and level of scratch-cooking. Entrées with the highest scratch-cooking scores had significantly lower food costs, higher labor costs, and not significantly different total costs compared with entrées with no scratch-cooking. Nutrient content was not consistently associated with scratch-cooking, but scratch-cooked entrées did include a larger variety of non–fast-food-type entrées.

Conclusions The findings suggest that scratch-cooking can be a cost-effective way to expand the variety of healthy school lunches prepared with USDA Foods.
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IN CALIFORNIA AND MANY OTHER STATES, SCHOOL meals are supported by both federal and state funds that reimburse schools for each student meal served. In addition to cash reimbursement, the federal government supplies foods to schools through the Child Nutrition US Department of Agriculture (USDA) Foods Program (formerly known as the Child Nutrition Commodities Program). USDA Foods are estimated to represent about one fifth of the food served in school lunches[1] and are the largest single source of ingredients for school meals.[2] Given the scope of their contribution to the school meal program, USDA Foods play an important role in the quality of school meals.

Although the USDA Foods Program offers many nutritious options, federal and state analyses of the content of school meals continue to show that many school meals are not meeting the nutrient targets recommended by the Dietary Guidelines for Americans.[3]

One aspect of the USDA Foods Program that may affect the quality of the school meal is USDA Foods processing. School districts can choose to divert the USDA Foods they order to commercial food processors where these foods are converted from raw bulk commodities (referred to as brown box) into more convenient, ready-to-use products.[4] Although this processing enables school districts to serve foods they lack sufficient capacity to prepare in-house, the processing may also increase the content levels of fat, sugar, and sodium. Nationally, about half of USDA Foods are diverted for processing before being sent to school districts.[1]

Previous research we conducted[5] found that more than 82% of the value of the USDA Foods ordered by school

districts was for meat and cheese items, both relatively high in fat and saturated fat. By comparison, fruit, fruit juices, vegetables, and legumes amounted to only 13%. The findings indicated that almost 70% of money for USDA Foods was spent on just four types of foods—raw beef, mozzarella cheese, cheddar cheese, and chicken—and these four types of food made up 88% of the USDA Foods sent for processing.[5] These four foods were primarily converted to three entrée items: hamburgers, pizza, and chicken nuggets.

Although many school districts rely on the processing of USDA Foods, a number of school districts across the country are cooking with USDA Foods onsite instead. There is some anecdotal evidence that scratch-cooking has resulted in food that is more appealing to students, and that districts using this method can more effectively manage costs and control nutritional quality.[6-9] However, other districts worry that they cannot afford the extra cost of cooking within the districts, and that the use of processed food helps guarantee that nutrition standards are met.[10]

Very little empirical research exists that examines the influence of scratch-cooking of USDA Foods on nutritional quality or cost. Several recent studies used a qualitative, case study approach to compare the use of commercially processed commodities to scratch-cooking with raw bulk commodities.[6-9] Peterson conducted a series of analyses comparing the costs of these processed commodities to the costs of purchasing comparable foods on the private market[11,12] and found that commercial foods were less expensive per food case than commodity products when procurement costs were included.[11] A more statistically robust evaluation of the Chef Initiative in Boston middle schools found that emphasizing scratch-cooking improved the nutritional content of meals, although it was difficult to identify which changes were a result of scratch-cooking and which were a less-direct result of schools collaborating with chefs.[13] A study of four New Jersey middle schools found no significant correlation between total fat content and if a food had been preprocessed or cooked from scratch.[14]

This study focused on the use of USDA Foods and was designed to determine whether entrées made in the district, from basic or raw ingredients, could be healthier and/or less expensive than preprocessed, heat-and-serve entrées. This study builds on the largely anecdotal evidence currently available by providing sufficient statistical power to analyze detailed data from a diverse, albeit not representative, set of districts in California.

A better understanding of the costs and nutritional quality of school meals prepared using processed foods vs scratch-cooking with USDA Foods can help schools use these ingredients more effectively, particularly as they make the transition needed to comply with requirements under the Healthy, Hunger-Free Kids Act of 2010.

METHODS

Sample Selection

A convenience sample of 10 districts in California was selected to participate in this study. An initial list of 35 districts known to employ varying amounts of scratch-cooking was compiled from among districts recommended by the authors or their colleagues. Seventeen districts met the study criteria (ie, had elementary schools, agreed to be interviewed, and had access to the necessary cost and nutrient information). Lunch entrées served at these districts during a random sample of 5 days during October 2010 were scored with regard to extent of scratch-cooking (see the Figure) and averaged to create an average scratch-cooking score for each of the 17 districts. Ten districts were then selected based on their ability to provide the needed documentation and to ensure diversity in terms of total enrollment, number of

Convenience Prep (0 points)

- Product is fully processed and only requires heating and serving (may require portioning)
- Examples: Heat-n-serve macaroni and cheese and premade bean and cheese burrito

Minimal Prep (1 points)

- Food preparation involves assembly and main component is highly processed
- Examples: Meatloaf and mashers made with premade meatloaf and rehydrated mashed potatoes, chili dogs made with hot dogs and house-made chili (canned beans, tomatoes) and bun

Almost Scratch (2 points)

- Some components raw; some mixing, cooking, and preparation involved
- Example: Chicken teriyaki made from presauced cooked chicken, fresh rice, and fresh vegetables

Made from Scratch (at the district) (3 points)

- Ingredients are in raw or close-to-raw states, including brown box[a] precooked meat with or without light seasoning that is not otherwise processed or presauced
- Example: Chicken fajitas made with chicken fajita strips, tortillas, sautéed peppers, and cheese

Figure. Scratch-cooking scoring system used in a study examining the relationship between the extent of scratch-cooking and the nutritional content and cost to prepare entrées in schools in California participating in the US Department of Agriculture Foods Program.

students eligible for free or reduced-price meals, urban/rural classification, location in the state, and extent of scratch-cooking. Five districts that do mostly scratch-cooking (ie, >50% of entrées made from scratch), three districts that do a moderate amount (ie, one third of entrées scratch-cooked), and two districts that do a minimal amount of scratch-cooking were selected for the final sample. The district level scratch-cooking score was only used as a basis for selecting districts for inclusion in the study. All analyses were conducted at the entrée level using a scratch-cooking score assigned to each entrée. All distinct elementary school lunch entrées (that included at least one USDA Foods ingredient) offered during October 2010 at the 10 study districts were included in the sample. October was selected because it is commonly used as a base month by the California Basic Educational Data System and has no major holidays or school-wide testing that might influence meal offerings.

Scratch-Cooking Score

The scratch-cooking score (see the Figure) was designed primarily to distinguish entrées that were prepared in the district with USDA Foods vs those that were prepared with USDA Foods that were diverted offsite for processing; but also distinguishes those prepared onsite based on the extent to which the various ingredients were processed (before arrival at the district). The score is based on detailed, objective criteria developed by the research team and was pilot tested on 46 entrées from four districts. Each entrée was assessed independently by two experienced nutrition researchers, one of whom is a registered dietitian nutritionist. Whenever the two ratings were not in agreement the source of the discordance was identified and the rating criteria were adjusted or clarified as needed. Face validity was assessed by examining the scores for each of the 46 entrées to determine whether they appeared, at face value, to accurately distinguish more-processed from less-processed entrées, and adjustments to the criteria were made accordingly. One researcher rated all 146 entrées that were included in the final study sample, so interrater reliability was not an issue.

Data Collection

Nutrient and cost data were collected for each distinct elementary school lunch entrée offered during October that included at least one USDA Foods ingredient for an average of 14.6 distinct entrées per district. Within each district all elementary schools offered the same menu options and most offered 1 to 2 choices each day. Entrées were defined as the "center of the plate" item in a meal and always included a meat or meat alternate (eg, cheese or legume) component. If the entrée was "packaged" with sides (such as a serving of grain, vegetable, or fruit) or condiments, the entire package was considered to be the "entrée." Information was primarily gathered in person during site visits to the schools and was supplemented by data gathered remotely by mail, telephone, or e-mail. Whenever possible, data were entered and reported through the districts' NutriKids Menu Planning and Nutritional Analysis software (versions varied by district, Lunchbyte Systems Inc, Heartland School Solutions).

Data and documentation requested included:

- recipes* to determine the type and amount of ingredients or prepared items included in a finished entrée;
- nutrient analysis† information to determine the amount of calories, fiber, sodium, total fat, saturated fat, and *trans* fat per entrée served;
- invoices or bid lists to calculate the cost of each ingredient or item in a single entrée serving;
- the number of staff, type of staff, and time required to prepare each entrée containing USDA Foods;
- salary and benefit rates for each foodservice employee involved in food preparation of the selected entrées;
- production records and meal counts to determine the number of each entrée prepared and served per day at each district; and
- free and reduced-price meal eligibility and average daily lunch participation.

Self-reporting of the labor time involved in preparing each USDA Foods-containing entrée was obtained via interview by the same trained interviewer. Prompts were used to ensure that foodservice staff recounted all the time and steps involved in preparing only the entrée in question, including all preparation and cleanup that might happen well before or after the entrée was served. Foodservice directors and staff reviewed the final summary of steps and time taken and adjustments were made as needed.

Demographic data for each district were obtained from the California Department of Education.

Data Analysis

Based on the information collected, a scratch-cooking score (4-point scale) was assigned for each of the lunch entrées. Entrées that were 100% scratch-cooked received 3 points and entrées that involved no scratch-cooking received 0 points (Figure).

Labor costs per entrée were calculated based on reported time to prepare the particular entrée, number of entrées prepared, and salary and benefit information. Labor costs included all staff time involved in preparing, serving, and cleaning up after meals. Labor costs did not include administrative or other staff time for those not directly involved in meal preparation. Food costs included actual dollars paid for the food, including processed items and any associated fees, but not the fair market value of the commodity ingredients. Costs not assessed included: district level administrative personnel, overhead, equipment, and supplies.

Ordinary least squares regressions were used to test for statistically significant differences in the cost and nutrient content of the entrées according to the level of scratch-cooking. Of 158 entrées that met the selection criteria, complete data were available for 146 entrées. Nutrient

**Primarily used recipes entered in NutriKids, but also accepted approximated written recipes for those not entered in NutriKids.*

†Primarily used nutrient analysis reports generated by NutriKids or product specification sheets; when neither of these was available, nutrients were analyzed using Nutritionist Pro Diet Analysis software (version 4.1, 2008, Axxya Systems, LLC).

composition outcome variables included: calories, sodium (milligrams), dietary fiber (grams), total fat (grams), saturated fat (grams), and *trans* fat (grams) per entrée. Cost-related outcome variables included food costs, labor costs, and total paid cost (ie, food costs plus labor costs) per entrée. Only specifications with calorie-adjusted outcome variables are reported here, but specifications without calorie adjustment were also conducted. The primary variable of interest—the scratch-cooking score—was coded as an indicator variable in the reported regressions, allowing comparisons of entrées at each level of scratch-cooking to entrées that were not scratch-cooked (base case). The reported analysis also controlled for socioeconomic differences across districts that could potentially affect the results by including district-level fixed effects‡; potential differences due to whether or not an entrée included grains, fruit, or vegetables; the average daily number of students served each distinct entrée (for each day the entrée was served during October 2010); and the number of USDA Foods used as ingredients. Heteroscedasticity-corrected standard errors are reported and the results are robust to a number of alternative regression specifications not reported here. For instance, a single indicator for scratch-cooking that aggregated all levels of scratch-cooking was created due to the limited number of entrées for some of the categories, and the regressions were estimated using the categorical variable for scratch-cooking and restricting the effects across levels to be linear. In addition, basic regressions that only included the scratch-cooking score with and without district fixed effects, regressions that included interaction terms with the scratch-cooking score and different types of entrées, and regressions that clustered standard errors by school district to account for potential unobserved differences and measurement errors across districts were conducted for all those alternative functional forms of the primary variable of interest.

The study was reviewed and approved by exempt review procedures by the University of California, Berkeley, Institutional Review Board.

RESULTS

Summary Statistics: School Districts

Three of the districts were located in Southern California, five in Northern California, and two in the Central Valley. The study districts varied in terms of district size (number of elementary schools and number of students), socioeconomic status (eligibility for free and reduced price lunch), ethnic diversity, and urban or rural classification (Table 1). The district average scratch-cooking score for those entrées included in the final sample varied from 0.4 to 2.3 (on a scale of 0 to 3, with 3 representing the highest level of scratch-cooking). The number of entrées in the final sample ranged from 10 to 23 per district for a total of 146 entrées.

Summary Statistics: Entrées

Average paid food costs per entrée were $0.43, average labor costs were $0.20, with an average total cost of $0.62 per entrée (Table 2). Unadjusted food costs were lowest for Level 3 and labor costs were considerably higher for Levels 1 through 3 compared with Level 0. All entrées included USDA Foods (an average of 1.7 per entrée) and the fair market value of these foods was not included. The labor costs per entrée included costs directly related to meal preparation, service, and cleanup and did not include administrative personnel, overhead, or other district-wide costs. Therefore, the total cost per entrée reported here is less than the actual total cost incurred per entrée. Furthermore, the total meal cost is considerably higher because the entrée was always served with additional meal components.§

On average an entrée had 350 kcal, 815 mg sodium, 3.4 g fiber, 13 g total fat, 4.5 g saturated fat, and 0.10 g *trans* fat. Compared with no scratch-cooking, Levels 1 through 3 tended to have less *trans* fat, more fiber, and more calories; no clear pattern emerges for the other nutrients. Scratch-cooked entrées were more likely to include a vegetable and/or fruit; however, fruit was rarely a part of any entrée. On average 4,558 of each type of entrée was served, with scratched-cooked entrées served in slightly lower numbers on average. Additional regressions not reported here failed to detect a statistically significant effect of scratch-cooking on the number of meals served.

Summary Statistics: Scratch-Cooking and Types of Entrées Served

Many more of the entrées with higher scratch-cooking scores were Asian-style, soup/stew/chili, or traditional (eg, barbecued chicken and roast turkey) compared to those with lower scores (Table 3). All of the entrée salads received a scratch-cooking score of 3 and half of Mexican dishes did. More of the entrées with a scratch-cooking score of 0 or 1 were burgers, cheese-based (eg, grilled cheese, macaroni-and-cheese), hotdogs/corn dogs, chicken/meat nuggets, and pizza. Nearly 50% of entrées with scratch-cooking score of 0 were chicken/meat nuggets or pizza. Most chicken/meat pasta dishes and sandwiches had a score of 1.

Regression Results: Scratch-Cooking and Nutrient Content

Entrées with scratch-cooking score of two had significantly less total fat, saturated fat, and *trans* fat per 100 kcal than did those not scratch-cooked (Level 0) (Table 4). Level 2 entrées on average had 1.35 fewer grams of total fat, 0.61 fewer grams of saturated fat, and 0.05 g *trans* fat per 100 kcal. Entrées with a scratch-cooking score of one also had less *trans* fat. Differences in calories (data not shown), sodium, and fiber by scratch-cooking score were not statistically significant. Not adjusting for calories (data not shown), did not alter these results.

‡*District-level characteristics do not vary by entrée or the time period analyzed such that fixed effects absorb any potential cost and nutritional differences due to differences in size and composition of school districts.*

§*These excluded costs do not tend to vary by entrée within districts or with the use of USDA Foods and, therefore, their exclusion was not likely to influence the results of these analyses.*

Table 1. Demographic and basic characteristics of the 10 study school districts in California during school year 2010-2011, in a study examining the relationship between the extent of scratch-cooking and the nutritional content and cost to prepare entrées

Characteristic	Mean±standard deviation	Range
Total district enrollment[a]	15,860.0±10,965.2	3,900-38,300
Percent of students eligible for free/reduced-price meals	56.9±24.9	18.7-98.6
Number of elementary schools in district[b]	16.6±13.0	3-42
Average daily lunch participation (%)	51.3±22.8	24.8-96.0
Percent of students in district, by race/ethnicity[c]		
African American	6.9±5.8	0.6-16.6
Asian	11.9±13.7	0.0-41.4
Latino	49.9±22.0	12.0-93.8
White	24.9±21.1	0.2-56.7
Other (including 2 or more races/ethnicities)	6.9±5.0	2.4-21.0
Percent of elementary schools in each urban/rural classification		
City, large territory	13.4±27.5	0-80.5
City, midsize territory	18.6±37.2	0-94.1
City, small territory	17.5±35.4	0-100
Suburb, large territory	45.5±44.5	0-100
Rural, fringe census	4.2±9.2	0-30.8
Rural, distant census	0.8±2.3	0-7.7
Number of entrées in analysis	14.6±3.6	10-23
Average scratch-cooking score	1.5±0.5	0.4-2.3

[a]District enrollments rounded to the nearest 100 to mask district identity.
[b]In one district, all elementary schools are kindergarten through grade 8.
[c]All race/ethnicity categories are mutually exclusive.

Regression Results: Scratch-Cooking and Costs

The highest level of scratch-cooking had significantly lower food and higher labor costs, with no significant difference in total costs compared with no scratch-cooking (Table 5). Food costs per 100 kcal for Level 3 entrées were $0.043 less and labor costs were $0.017 higher on average compared with Level 0 entrées. Although the other two scratch-cooking levels display a similar pattern (higher labor and low food costs compared with Level 0), the differences were not statistically significant.

The inclusion of fruit in an entrée was associated with significantly higher food costs of about 11 cents per 100 kcal, whereas the inclusion of more USDA Foods was significantly associated with lower food and total costs, although the savings was <$0.1/100 kcal. The inclusion of grain products or vegetables and the number of servings prepared of a given entrée was not significantly associated with food, labor, or total costs.

Summary statistics also indicated that some types of entrées were more expensive than others (data not shown). Entrée salads were one of the most expensive entrée options and were always scratch-cooked (Level 3). Pizzas were the least expensive entrée offered, and were even less expensive when prepared from scratch. Pasta and rice dishes were more expensive overall but also less expensive when prepared from scratch than when processed.

DISCUSSION

Among the entrées examined for this study, scratch-cooking did not significantly alter fiber, sodium, or calorie content. With regard to total and saturated fat, only Level 2 scratch-cooking was significantly different from Level 0, and only Levels 1 and 2 had significantly lower *trans* fat. These differences in fat content could be due to differences in the types of entrées at each scratch-cooking level that were not controlled for by the inclusion of additional variables. For example, entrées with a score of 2 were much more likely to be Asian-style rice or noodles entrées (see Table 3), which may account for the lower average fat content. Scratch-cooking alone, therefore, might not automatically improve nutrient content; other factors such as the type of entrée may also need to be considered.

Overall, scratch-cooking provided for a greater variety of options in categories other than fast food. Schools did not just offer scratch-cooked remakes of familiar fast-food favorites, such as pizza, but also added new scratched-cooked options such as Asian-style rice and noodle dishes, soups and stews, BBQ chicken, roast turkey, and meat loaf. This change in product mix may provide the added benefit of exposing children to a wider variety of healthy meal options. The finding that scratch-cooking did not significantly affect the number of meals served suggests that scratch-cooked entrées were accepted by students in this study.

Table 2. Characteristics of 146 elementary school lunch entrées containing US Department of Agriculture (USDA) Foods served during October 2010 at 10 California study district schools, by scratch-cooking score

Characteristic	Scratch-Cooking Score 0	1	2	3	Overall
Number of entrées in analysis	51	33	16	46	146
	←mean±standard deviation→				
Scratch-cooking score	—	—	—	—	1.39±1.25
Paid food cost per entrée serving ($)	0.47±0.20	0.43±0.29	0.47±0.20	0.35±0.26	0.43±0.25
Labor cost per entrée serving ($)	0.14±0.09	0.21±0.22	0.28±0.55	0.22±0.21	0.20±0.25
Total costs per entrée serving ($)	0.61±0.21	0.64±0.35	0.75±0.54	0.57±0.40	0.62±0.36
Calories per entrée serving (kcal)	327.3±71.7	397.6±109.6	321.7±91.5	350.3±118.2	349.8±103.0
Sodium per entrée serving (mg)	736.7±252.2	1014.0±450.8	654.7±360.7	814.6±650.6	814.9±479.2
Fiber per entrée serving (g)	2.32±1.43	4.61±4.37	3.02±3.08	3.78±3.11	3.38±3.15
Total fat per entrée serving (g)	13.05±4.49	15.21±7.02	8.17±4.60	13.20±5.75	13.05±5.88
Saturated fat per entrée serving (g)	4.62±1.99	5.61±3.86	2.53±1.82	4.16±2.03	4.47±2.68
***Trans* fat per entrée serving (g)**[a]	0.18±0.48	0.02±0.19	0±0	0.09±0.37	0.10±0.36
No. served (for a given entrée)	5,449.7±3,890.9	3,532.2±3,153.0	3,754.4±2,906.6	5,169.5±4,886.3	4,557.5±4,148.3
No. of USDA Foods ingredients used per entrée	1.2±0.5	2.2±2.5	1.4±0.7	2.0±1.3	1.7±1.5
	←n (%)→				
Entrées that include a grain serving[b]	48 (94)	33 (100)	12 (75)	40 (87)	133 (91)
Entrées that include a fruit serving[c]	0 (0)	0 (0)	0 (0)	3 (7)	3 (2)
Entrées that include a vegetable serving[d]	7 (14)	8 (24)	5 (31)	20 (43)	40 (27)
Entrées that include vegetables by subgroup[e]					
Vegetables	1 (2)	7 (21)	2 (13)	15 (33)	25 (17)
Fried potatoes	6 (12)	1 (3)	0 (0)	0 (0)	7 (5)
Other potatoes	1 (2)	0 (0)	2 (13)	0 (0)	3 (2)
Legumes[f]	0 (0)	3 (9)	1 (6)	4 (9)	8 (5)

[a]For *trans* fat only, n=44, 28, 13, 35, and 120 (from left to right).
[b]Where a serving equals 1 oz.
[c]Where a serving equals a $^1/_2$-cup equivalent ($^1/_4$ cup dried fruit=$^1/_2$ cup).
[d]Where a serving equals a $^1/_2$-cup equivalent (1 cup leafy greens, 2 Tbsp tomato paste=$^1/_2$ cup).
[e]Entrées may contain more than 1 vegetable subgroup.
[f]Legumes were counted as a vegetable only when there is already a protein serving.

Scratch-cooking (at Level 3) was associated with higher labor and lower food costs on average, with no significant differences in overall costs. Some of the cost savings incurred with scratch-cooking were due to the lower costs of scratch-cooked versions of items that are often processed offsite, such as pizza. Because the product mix for entrées varied with scratch-cooking score and the limited number of entrées per scratch-cooking level, factors other than scratch-cooking may be contributing to these cost differentials. An increase in calorie content, for instance, significantly increased costs on average, and many of the entrées approached or exceeded the average daily maximum per-meal calorie limit of 550 kcal recently established by the UDSA. Incorporation of more USDA Foods was also significantly associated with lower food costs and total costs. These results indicate that scratch-cooked entrées do not cost more on average and that by carefully choosing entrées that are more cost-effectively prepared from scratch, maximizing the use of USDA Foods, and keeping calories more in line with USDA guidelines, school districts may increase their ability to cost-effectively introduce scratch-cooking.

The differences in the average cost of entrées per district (range=$0.33 to $1.22) (data not shown) suggest that additional factors such as local labor costs, efficiency in the use of labor, and purchasing volume and practices may be at play. Because these differences are mainly district specific, they could not be directly addressed in this study. Some districts may experience larger savings from scratch-cooking than reported here if their labor costs are fixed and sufficient to

Table 3. Types of elementary school lunch entrées (n=146) containing US Department of Agriculture Foods during October 2010 in the 10 California study school districts, by scratch-cooking score

	Scratch-Cooking Score								
	0		1		2		3		
Entrée type	n	%	n	%	n	%	n	%	Total
Asian-style (chow mein, teriyaki chicken, or beef with rice)	1	8	1	8	7	54	4	31	13
Burgers (hamburgers, cheeseburgers, chicken burgers, sloppy joes)	4	25	10	63	0	0	2	13	16
Cheese-based (grilled cheese, macaroni and cheese, fruit and cheese plate, yogurt, and string cheese)	7	50	1	7	0	0	6	43	14
Chicken/meat nuggets (breaded, fried pieces of chicken, fish, meat)	15	100	0	0	0	0	0	0	15
Chicken/meat with pasta	0	0	4	57	1	14	2	29	7
Entrée salad	0	0	0	0	0	0	7	100	7
Hot dogs/corn dogs	3	75	0	0	1	25	0	0	4
Mexican-style (burritos, nachos, quesadillas, tacos, fajitas)	9	35	3	12	1	4	13	50	26
Pizza	10	67	2	13	0	0	3	20	15
Sandwich	1	7	11	73	2	13	1	7	15
Soup/stew/chili	0	0	0	0	1	33	2	67	3
Traditional (barbecued or fried chicken, roast turkey or chicken, meatloaf)	1	10	0	0	3	30	6	60	10
Other	0	0	1	100	0	0	0	0	1
Total	51	35	33	23	16	11	46	32	146

support scratch-cooking, whereas others may need to hire additional staff to accommodate the additional time required to prepare meals from scratch. Furthermore, schools may require substantial investment in kitchen equipment and staff training to make the transition to scratch-cooking. Time series studies that examine the transition to scratch-cooking are needed.

In contrast to this study, some studies have found that healthier meals cost more to prepare.[11,12,15] Differences in study design may account for the different conclusions. This study specifically focused on scratch-cooking (rather than nutrient content) as the independent variable. Furthermore, to our knowledge no other studies have assessed the labor and food costs of individual types of entrées, but rather they looked at average meal costs and, therefore, were unable to distinguish between different entrées in the same district. At least one other study[16] also found that cost was not associated with nutritional quality. Our results are also consistent with other studies that have shown that lowering requirements for certain meal components, such as fruits and vegetables, calories, and starch, also lowered costs,[15,17] and variations in meal costs were explained by the mix of meals served as well as other factors such as wage and benefit rates.[18] These additional considerations might explain why studies of the influence of scratch-cooking on nutritional content have reported mixed results.[13,14]

The National School Breakfast and Lunch Study found that in 2008-2009 school lunches cost on average $2.92 to prepare.[19] This is understandably considerably higher and cannot be compared with the findings of this study of $0.62 per entrée. The costs in this study did not include all meal components, did not include the fair market value of USDA Foods, and only included the labor of those directly involved with meal preparation. Given that the aim of this study was to examine cost differences rather than absolute costs, the limited examination of costs does not limit the validity or implications of the results.

The main limitation of this study is the relatively small convenience sample of school districts. Although the sample was designed to have significant variation in the variables of interest, the sample is not representative of school districts in California or nationwide. The decision to scratch-cook is endogenous and could be correlated with other unobserved factors that also potentially influence nutrient content and costs. Some of these differences might not be captured in the district fixed effects model. Furthermore, because it is difficult to determine which side dishes are selected with a given entrée this study only examined the costs associated with entrées. To ensure entrées were comparable, the analysis controlled for the inclusion of other meal components.

Finally, it is challenging to assess labor associated with a particular entrée, and self-report of time spent by foodservice staff may be subject to error. Because we only included labor involved directly with food preparation and cleanup, there may have been other hidden costs that were not declared. Assuming that these potential errors affect all entrées equally and are not more likely to occur when assessing labor costs of scratch-cooked items compared with processed items, they will be partly accounted for by the inclusion of district-level fixed effects; however, clustering of standard errors and the results reported here are robust to these alternative specifications.

Table 4. Estimation of the association between scratch-cooking and nutrient content of elementary school lunch entrées containing US Department of Agriculture (USDA) Foods served during October 2010 in 10 California study districts[a]

	Sodium (mg) per 100 kcal		Fiber (g) per 100 kcal		Total fat (g) per 100 kcal		Saturated fat (g) per 100 kcal		*Trans* fat (g) per 100 kcal	
Variable	**Coef±SE[b]**	***P* value**	**Coef±SE**	***P* value**	**Coef±SE**	***P* value**	**Coef±SE**	***P* value**	**Coef±SE**	***P* value**
Scratch cooking score group	—	0.713	—	0.960	—	0.006	—	0.023	—	0.135
Score 0 (reference)	—	—	—	—	—	—	—	—	—	—
Score 1	−30.1±37.1	0.420	0.10±0.18	0.601	−0.30±0.29	0.310	−0.15±0.14	0.298	−0.06±0.03	0.036
Score 2	−28.4±32.6	0.385	$4.4x10^{-3}$± 0.21	0.984	−1.35±0.37	<0.001	−0.61±0.20	0.003	−0.05±0.02	0.024
Score 3	−6.9±32.3	0.831	0.03±0.10	0.795	−0.28±0.28	0.321	−0.22±0.13	0.093	−0.05±0.03	0.118
Number served (for a given entrée)	$6.0x10^{-4}$±$6.3x10^{-3}$	0.924	$-7.4x10^{-5}$±$3.6x10^{-5}$	0.043	$-7.5x10^{-5}$±$5.5x10^{-5}$	0.176	$-4.3x10^{-5}$±$2.2x10^{-5}$	0.047	$3.4x10^{-7}$±$4.1x10^{-6}$	0.934
Number of USDA Foods ingredients used	5.4±13.7	0.691	0.07±0.04	0.065	0.03±0.07	0.685	0.08±0.04	0.036	$3.1x10^{-3}$±$5.0x10^{-3}$	0.526
Includes serving of grain	21.6±50.5	0.669	$-2.7x10^{-3}$±0.23	0.991	−0.66±0.42	0.114	−0.54±0.19	0.007	0.02±0.02	0.254
Includes serving of fruit	−86.5±40.5	0.035	0.49±0.23	0.032	−0.62±0.59	0.295	−0.22±0.16	0.162	$-2.9x10^{-4}$±0.04	0.993
Includes serving of vegetable	−8.0±37.7	0.833	0.09±0.17	0.596	−0.30±0.27	0.283	−0.35±0.13	0.011	−0.02±0.03	0.457
Constant	218.5±66.3	0.001	0.68±0.28	0.018	3.76±0.45	<0.001	1.66±0.25	<0.001	0.03±0.03	0.249
Observations	146		146		146		146		120	
R^2	0.119		0.220		0.255		0.254		0.121	

[a]Models are adjusted for district-level differences through the inclusion of district fixed effects.
[b]Coef±SE=regression coefficient±robust standard error.

Table 5. Estimation of the association between scratch-cooking and production costs of elementary school lunch entrées containing US Department of Agriculture (USDA) Foods served during October 2010 in 10 California study school districts[a]

	Food Costs ($) per 100 kcal		Labor Costs ($) per 100 kcal		Total Costs ($) per 100 kcal	
Variable	**Coef±SE[b]**	***P* value**	**Coef±SE**	***P* value**	**Coef±SE**	***P* value**
Scratch-cooking score group	—	0.099	—	0.146	—	0.358
Score 0 (reference)	—	—	—	—	—	—
Score 1	−0.021±0.018	0.257	0.010±0.009	0.258	−0.011±0.020	0.593
Score 2	−0.004±0.020	0.857	0.054±0.048	0.264	0.051±0.049	0.306
Score 3	−0.043±0.018	0.022	0.017±0.008	0.035	−0.026±0.022	0.236
Number served (for a given entrée)	$-5.0\times10^{-7}\pm3.2\times10^{-6}$	0.877	$-1.8\times10^{-6}\pm1.8\times10^{-6}$	0.321	$-2.3\times10^{-6}\pm3.6\times10^{-6}$	0.521
Number of USDA Foods ingredients used	−0.008±0.004	0.033	−0.001±0.002	0.752	−0.008±0.004	0.036
Includes serving of grain	0.001±0.021	0.979	−0.018±0.023	0.448	−0.017±0.033	0.601
Includes serving of fruit	0.113±0.048	0.020	0.002±0.021	0.939	0.114±0.061	0.064
Includes serving of vegetable	0.002±0.017	0.898	0.002±0.013	0.853	0.005±0.023	0.839
Constant	0.168±0.025	<0.001	0.102±0.042	0.015	0.271±0.046	<0.001
Observations	146		146		146	
R^2	0.217		0.257		0.264	

[a]Models are adjusted for district-level differences through the inclusion of district fixed effects.
[b]Coef±SE=regression coefficient±robust standard error.

CONCLUSIONS

Despite a resurgence of interest in scratch-cooking as a way to increase the quality and appeal of school meals, many school districts are concerned about the cost implications of switching to scratch-cooking. This study demonstrated in an examination of 146 entrées from 10 districts that scratch-cooking can be a cost-effective way to expand the variety of healthy school lunches prepared with USDA Foods. Although labor costs were shown to increase at the highest scratch-cooking level, lower food costs compensated for the increased labor costs.

References

1. Food Research and Action Center. Commodity foods and the nutritional quality of the school lunch program: Historical role, current operations, and future potential. 2008. http://frac.org/wp-content/uploads/2009/09/commodities08.pdf. Accessed April 14, 2014.
2. US Department of Agriculture, Food and Nutrition Service. White paper: USDA Foods in the National School Lunch Program. Updated May 2010. http://www.fns.usda.gov/sites/default/files/WhitePaper.pdf. Accessed April 14, 2014.
3. Gordon AR, Crepinsek MK, Nogales R, Condon E. *School Nutrition Dietary Assessment Study-III. Vol. I: School Foodservice, School Food Environment, and Meals Offered and Served. Final Report*. Princeton, NJ: Mathematica Policy Research, Inc; 2007.
4. US Department of Agriculture, Food and Nutrition Service. Food distribution fact sheet. June 2007. http://www.fns.usda.gov/fdd/processing/pfs-processing.pdf. Accessed April 11, 2014.
5. Hecht K, Samuels S, Boyle M, et al. *The Federal Child Nutrition Commodity Program: A Report on Nutritional Quality*. Princeton, NJ: Robert Wood Johnson Foundation; 2008.
6. Godfrey JR. The renegade lunch lady, Ann Cooper, implements her lunch lessons from Berkeley, California to Boulder, Colorado. *Child Obes*. 2011;7(3):247-251.
7. Collins B. Can schools save kids' palates? Cooking from scratch in schools—The greatest food service challenge of our times. *Child Obes*. 2012;8(4):323-326.
8. Stanley L, Colasanti KJA, Conner DS. A "real chicken" revolution: How two large districts are shifting the school poultry paradigm with scratch cooking. *Child Obes*. 2012;8(4):384-387.
9. Godfrey JR. Fulfilling the highest nutrition standards in Burke County district schools. *Child Obes*. 2012;8(4):400-403.
10. Poppendieck J. *Free for All: Fixing School Food in America*. Berkeley, CA: University of California Press; 2010.
11. Peterson C. A comparative cost analysis of commodity foods from the U.S. Department of Agriculture in the National School Lunch Program. *J Policy Anal Manage*. 2009;28(4):626-654.
12. Peterson C. A rotten deal for schools? An assessment of states' success with the National School Lunch Program's in-kind food benefit. *Food Pol*. 2011;36:588-596.
13. Cohen JF, Smit LA, Parker E, et al. Long-term impact of a chef on school lunch consumption: Findings from a 2-year pilot study in Boston middle schools. *J Acad Nutr Diet*. 2012;112(6):927-933.
14. Feldman C, Briceno-Pinar EA, Konas DW, Ruskin M, Toney J, Wunderlich S. A laboratory analysis of total fat content and an examination of portion size of foods served in four New Jersey public middle-school foodservice operations. *J Food Serv*. 2009;20:264-274.
15. Newman C. The food costs of healthier school lunches. *Agric Resource Econ Rev*. 2012;41(1):12-28.
16. Wagner B, Senauer B, Runge CF. An empirical analysis of the policy recommendations to improve the nutritional quality of school meals. *Rev Agric Econ*. 2007;29(4):672-688.

17. Crawford P, Woodward-Lopez G, Gosliner W, Webb K. Lessons from Fresh Start can guide schools seeking to boost student fruit consumption. *Calif Agric*. 2013;67(1):21-29.

18. Ollinger M, Ralston K, Guthrie J. School food service costs: Location matters. May 2011. http://www.ers.usda.gov/publications/err-economic-research-report/err117.aspx#.U0wUsfldXZA. Accessed April 13, 2014.

19. Wild P, Kennedy M. The economics of a healthy school meal. http://www.choicesmagazine.org/magazine/article.php?article=86. Accessed April 13, 2014.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

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