Impact of Connecticut Legislation Incentivizing Elimination of Unhealthy Competitive Foods on National School Lunch Program Participation

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Objectives. We analyzed the impact of Connecticut legislation incentivizing voluntary school district–level elimination of unhealthy competitive foods on National School Lunch Program (NSLP) participation.

Methods. We analyzed data on free, reduced, and paid participation in the NSLP from 904 schools within 154 Connecticut school districts from the 2004–2005 to the 2009–2010 school year, resulting in 5064 observations of annual school-level meal participation. We used multilevel regression modeling techniques to estimate the impact of the state competitive food legislation on the count of NSLP lunches served per student in each school.

Results. Overall, the state statute was associated with an increase in school lunch participation. We observed increases between 7% and 23% for middle- and high-school meal programs, and a slight decrease of 2.5% for the elementary school free meal eligibility category, leading to an estimated revenue increase of roughly $30 000 for an average school district per school year.

Conclusions. This study provides support for national implementation of proposed rigorous competitive food standards that can improve the health of students while supporting local school district finances. (*Am J Public Health*. Published online ahead of print May 16, 2013: e1–e8. doi:10.2105/AJPH.2013.301331)

Federal meal programs in the United States serve more than 30 million students every day, providing an unparalleled opportunity to improve the diet of the nation's youths.[1] Recent changes to school meal program regulations will substantially improve the nutritional quality of meals that have already succeeded at preventing childhood nutritional deficiencies in the United States.[2–4] Public health efforts to reduce childhood obesity rates and improve diet quality in the United States have increasingly focused on improving the food environment in schools.[5–7]

The sale of foods in schools outside the school meal programs, known as competitive foods, has been consistently linked with unhealthy diet and, in some but not all studies,[8] with increased risk of obesity.[9] Energy-dense, nutrient-poor competitive foods and beverages are widely available in US schools and are regularly consumed by children.[10–13] A number of local school district and statewide policy changes reducing or eliminating the sale of unhealthy competitive food and beverages at school have been shown to improve dietary outcomes, including reduced sugar-sweetened beverage consumption and increased consumption of fruits and vegetables.[14–16] Sanchez-Vaznaugh et al. reported that removing unhealthy competitive foods may be linked to a lower incidence of overweight in children in California.[17] Taber et al. reported findings based on the Early Childhood Longitudinal Study–Kindergarten showing that adolescents in states with strong competitive food standards from 2003 to 2006 gained 0.44 body mass index (BMI; defined as weight in kilograms divided by the square of height in meters) units less than adolescents in states without such standards.[18]

Despite the success of some state and local policies, national policy efforts have so far failed to sufficiently address the negative impact of the sale of unhealthy competitive foods on children's health. The Child Nutrition and WIC Reauthorization Act of 2004 required all school districts participating in the National School Lunch Program (NSLP) to develop wellness policies that include nutrition guidelines for all foods available at schools by the 2006–2007 school year.[19] However, the legislation did not require districts to implement specific competitive food policies.[5] A review of a nationally representative sample of wellness policies and related regulations from 2006–2007 up to 2008–2009 found that, although some districts have implemented strong policies, in general, rules governing competitive food sales were weak or nonexistent.[20]

In response to concerns about the role of both the school meal programs and competitive foods in addressing the obesity epidemic, Congress passed The Healthy, Hunger-Free Kids Act of 2010.[21] The act required the US Department of Agriculture (USDA) to update the nutrition standards for the NSLP and the School Breakfast Program while providing a performance-based increase in reimbursement rate for lunches. The bill also for the first time gave the USDA authority to set nutrition standards for competitive foods sold throughout the school day.[21] Congress instructed the USDA to develop nutrition standards for competitive foods that align with the current Dietary Guidelines for Americans[22] while giving consideration to practical application of the standards. The USDA is currently developing competitive food standards with the goal of releasing final regulations in 2013.

Reactions to the USDA's revised nutrition standards for the school meal program suggest that the USDA may face strong opposition to nutritionally rigorous competitive food standards.[23,24] In addition to objections raised by food industry associations, the School Nutrition

Association, which represents school food service professionals, commented to the USDA that improving the health quality of the school meals may reduce participation in the program if students instead purchase competitive foods or bring food from outside school.[25]

However, creating rigorous new competitive food nutrition standards could support simultaneous implementation of improved meal program standards by removing unhealthy yet attractive alternatives to the meal program from school environments. A number of studies have found that reducing availability of unhealthy competitive foods results in increased meal program participation and limited impact on overall food service revenue.[26,27] On the basis of a systematic review that identified 7 studies that assessed the relationship between nutrition standards and school revenue, Wharton et al. concluded that fears of net negative financial impacts of improved nutrition standards are unfounded and that increased participation in NSLP may compensate for lost revenue from lower competitive food sales.[27] However, because there is a relatively limited evidence base, additional evidence showing that implementing stronger competitive food standards across a broad range of schools can increase school meal participation would support ongoing USDA efforts to implement rigorous national competitive food and school meal nutrition standards.

Since 2006, Connecticut's Healthy Food Certification (HFC) has offered school districts in the state a monetary incentive to comply with stringent competitive food nutrition standards that are updated annually.[28] The standards, which are based on the Dietary Guidelines for Americans, apply to all foods sold at school at all times. Exceptions can be granted by local school boards for food sold during events held outside the regular school day. Districts must annually file compliance forms with the Connecticut State Department of Education (CSDE), which reviews nutrition information for all foods sold in each district and conducts site visits in selected participating districts to ensure compliance. Districts that choose to comply with the voluntary standards are paid an additional 10 cents per lunch by the state, based on the total number of reimbursable lunches (paid, free, and reduced) served in the district in the previous school year. Previous research based on the program's first year of implementation found that districts participating in HFC substantially reduced the availability of unhealthy competitive food and increased paid school meal participation in middle schools.[29]

This study extends the initial evaluation of the program, and analyzes the impact of district participation in HFC on student participation in free, reduced, and paid lunches by using statewide school meal participation data from the 2004–2005 to 2009–2010 school years. It was hypothesized that district participation in HFC is positively related to student participation in the NSLP.

METHODS

We included all public school sponsors in Connecticut that represent school districts or single schools participating in the NSLP or other federal meal programs in the analysis. We excluded private schools, vocational or magnet schools, and Residential Child Care Institution sponsors because of lack of demographic information and geographic representation (n = 30). After we excluded 92 schools because of missing outcome or covariate data, the analysis included 904 schools within 154 school districts with an average of 5.6 observation years from the 2004–2005 to the 2009–2010 school year, resulting in 5064 observations of annual school-level meal participation (Table 1).

Data

We obtained data on the total number of students per school enrolled in school and eligible for free, reduced, and paid meals, as well as the total number of lunches sold (lunch counts) in each category during each school year in the sample period, from the CSDE.[30] The CSDE also provided data on the number of school days for each school each year and annual district-level participation in HFC.

We used a composite district-level demographic variable created by the CSDE to adjust multivariable models for sociodemographic factors that may influence district participation in HFC and NSLP participation rates. The CSDE classifies districts into 9 district reference groups (DRGs) from low-need (A) to high-need (I) districts. The DRG classification incorporates a broad range of data inputs, including median family income, parental educational attainment and occupation, percentage of children in single-parent households, percentage of children whose parents speak a language other than English at home, percentage of children eligible for free and reduced-price meals, and district size.[31] The CSDE provided school-level data on the percentage of students eligible for free and reduced-price meals. We obtained valid data for 904 out of 1026 Connecticut schools. Missing schools did not differ with respect to DRG (the proportion of missing schools was slightly higher in A, C, and I districts compared with the remaining DRG categories).

Analysis

We used multilevel regression modeling techniques to estimate the impact of HFC participation on the count of NSLP lunches served per student in each school. We used separate generalized linear mixed models (GLMM) from the Poisson family with a logarithmic link function to model annual lunch counts for each meal-eligibility category (i.e., free, reduced-price, and paid), with the number of potential lunches sold per year (number of students multiplied by number of school days) used as an offset. We used a multilevel approach to account for clustering of observations within schools over the study period and for the clustering of schools within school districts. Moreover, within-subjects as well as between-subjects effects are directly modeled when one is using a multilevel modeling framework. We included school grade level (i.e., elementary, middle, high school) and year dummies as fixed effects. We allowed intercepts and the HFC participation effect to vary across both schools and districts. In addition, models included a grade level by HFC cross-level interaction term to estimate separate effects for each grade level. The full model with a description of each term is available in the Technical Appendix, Equation 1 (available as a supplement to the online version of http://www.ajph.org). In a second model, we included district-level DRG and school-level free and reduced-price lunch eligibility to account for potential confounding by sociodemographic factors. However, including these

TABLE 1—Characteristics of Schools and School Districts Included in Analysis of Connecticut National School Lunch Program Participation: 2004–2005 to 2009–2010 School Years

Schools (n = 904)	No. (%) or Mean ±SD (Range)
Panel information	
School observed for 5 or 6 y	711 (90.5)
School observed for ≤ 4 y	193 (9.5)
HFC participation	
2004	0/779 (0)
2005	0/854 (0)
2006	429/855 (50.2)
2007	506/853 (59.3)
2008	569/859 (66.2)
2009	568/864 (65.7)
School level	
Elementary school	619 (68.5)
Middle school	141 (15.6)
High school	144 (15.9)
School size (no. students, first y of observation)	564 ±378 (20-3162)
% of students eligible for free or reduced-price meals (first y of observation)	29 ±28 (0-100)
School districts (n = 154): district reference groups[a]	
A, B	28 (18.2)
C, D	47 (30.5)
E, F	47 (30.5)
G, H	25 (16.2)
I	7 (4.6)

Note. HFC = Healthy Food Certification. School level sample sizes result from counting each school in the sample once though schools may provide data across multiple years.
Source. Authors' calculations based on data from the Connecticut State Department of Education (2004–2005 to 2009–2010 school years).[30]
[a]The Connecticut State Department of Education classifies districts into 9 district reference groups from low-need (A) to high-need (I) districts, on the basis of on a broad range of factors described in greater detail in the Methods section.

variables did not affect our main effects of interest—HFC-related changes in meal counts—thus, the more parsimonious model is presented here.

We fitted the Poisson GLMMs by using the GLMER function from the LME4 package version 0.999375–42[32] in R version 2.14.1 (R Foundation for Statistical Computing, Vienna, Austria). We computed marginal effects of HFC participation on lunch counts by using Monte Carlo simulations to average over the random effects included in the model. Details on the regression modeling, prediction approach, and comparison of alternative estimation methods are included in the Technical Appendix.

We calculated the effect of HFC participation on school-level food service annual meal program revenue by multiplying predicted marginal lunch counts by total per-lunch federal revenue reported by the USDA for the 2011–2012 school year and estimates of average revenue from student payments for reduced-price and paid lunches. Estimates were derived as follows. In 2011–2012, schools received federal cash reimbursement of $2.77 for each free lunch served, $2.37 for each reduced-price lunch, and $0.26 for each paid lunch sold. In addition, schools received 22.25 cents per lunch served in commodity food products.[1] Schools may charge a maximum of 40 cents per reduced-price lunch served. Data on what Connecticut schools charged for reimbursable lunches were not available; therefore, we used national data instead. According to a national sample of schools in the School Nutrition Dietary Assessment-III, during the 2004–2005 school year, the mean price charged for paid school lunches was $1.55 in elementary schools, $1.70 in middle schools, and $1.66 in high schools.[33] On average, schools collected a maximum of 40 cents per reduced-price lunch.

School meal reimbursement rates are increased annually based on May-to-May changes in the Consumer Price Index US city average food away from home item.[34] On the basis of the observed constant relative price of paid meal payments to free meal reimbursement rates from 1991 to 2004, we inflated national average paid lunch payments observed in the School Nutrition Dietary Assessment-III 2004–2005 sample to 2011–2012 dollars by using the 23.5% increase in the Consumer Price Index food away from home item from May 2004 to May 2011.[34] We inflated the mean price charged for paid lunches in 2004–2005 as reported in a sample of approximately 350 schools surveyed in the School Nutrition Dietary Assessment-III to $1.91 for elementary schools, $2.10 for middle schools, and $2.05 for high schools for the 2011–2012 school year. Predicted changes in school lunch revenue as a result of HFC participation are reported by meal eligibility category and school level.

RESULTS

District participation in HFC increased throughout the study period, resulting in an increase in school-level participation from 429 out of 855 (50%) schools during the 2006–2007 school year to 568 out of 864 (66%) schools during the 2009–2010 school year (Table 1). Although Connecticut is a relatively wealthy state on average, schools and districts included in the sample represent a wide range of sociodemographic experiences, with the percentage of students eligible for free or reduced-price meals ranging from 0% to 100% at the school level.

Based on the GLMM model results, HFC participation was significantly associated with decreased free lunch participation rates (incidence rate ratio [IRR] = 0.976; $P < .05$) in elementary school, increased middle-school paid lunch participation (IRR = 1.115; $P < .001$), and increased high-school free

(IRR = 1.072; $P < .001$), reduced-price (IRR = 1.120; $P < .001$), and paid (IRR = 1.228; $P < .001$) lunch participation (Tables 2 and 3). Predicted participation rates for each eligibility category show that HFC participation was associated with a 1.9 percentage-point reduction (81.5% vs 83.4%) in elementary-school free meal participation, a 5 percentage-point increase in middle-school paid meal participation (48.3% vs 43.3%), and 4.3 to 6.0 percentage point increases in high-school meal programs, including increased free (64.3% vs 60.0%), reduced-price (55.8% vs 49.8%), and paid meal participation (30.7% vs 25.0%; Table 3).

Overall, HFC participation was associated with increased meal program revenue because of significantly higher participation across all meal eligibility categories in high school and more limited changes in middle school and elementary school (Tables 3 and 4). For the average high school, HFC was associated with an approximately $21 000 increase in revenue for paid lunches, an approximately $1700 increase for reduced-price lunches, and an approximately $4000 increase for free lunches. For middle schools, we observed a significant increase in revenue for paid lunches with an expected average revenue gain of approximately $12 000 per school year. For elementary schools, the negative effect on free lunch participation corresponded to a small expected loss in revenue of approximately $1300 per school year on average. These results do not incorporate the additional 10 cents per lunch paid by the state to incentivize participation in HFC.

Assuming an average district with 4 elementary schools, 1 middle school, and 1 high school with average meal counts across the 3 meal eligibility categories as shown in Table 3, operating 180 days, HFC participation would lead to a total expected revenue increase of around $30 000 for this district per year based on the difference in the 2009–2010 predicted annual lunch counts between schools participating in HFC and those not participating in HFC (Tables 3 and 4).

DISCUSSION

On the basis of 6 years of statewide data from more than 900 schools and 150 school districts, we found that incentivizing school districts to implement rigorous competitive food standards resulted in widespread district-level program adoption and increased student school lunch participation. This analysis builds on previous reports showing that Connecticut's efforts to improve the school food environment have resulted in reduced availability of unhealthy food in schools and improved dietary outcomes for children.[15,29] Confirming these findings, a recent report analyzing data from the Centers for Disease Control and Prevention's School Health

TABLE 2—Multilevel Overdispersed Poisson Models for Annual National School Lunch Program Counts: Connecticut, 2004–2005 to 2009–2010 School Years

	Paid		Reduced-Price		Free	
Fixed effects	IRR (95% CI) or SD	*P* or Corr	IRR (95% CI) or SD	*P* or Corr	IRR (95% CI) or SD	*P* or Corr
HFC participation, yes	0.985 (0.946, 1.025)	.461	0.975 (0.944, 1.007)	.112	0.976 (0.957, 0.996)	.015
Year (Ref: 2004)						
2005	1.038 (1.020, 1.058)	< .001	1.007 (0.984, 1.029)	.559	0.997 (0.983, 1.012)	.681
2006	1.067 (1.046, 1.089)	< .001	1.060 (1.033, 1.086)	< .001	1.020 (1.004, 1.037)	.013
2007	1.084 (1.062, 1.105)	< .001	1.063 (1.035, 1.091)	< .001	1.013 (0.996, 1.030)	.129
2008	1.042 (1.021, 1.063)	< .001	1.039 (1.011, 1.067)	.004	1.009 (0.991, 1.026)	.313
2009	1.018 (0.998, 1.039)	.084	1.037 (1.010, 1.065)	.006	0.996 (0.979, 1.014)	.671
School level (Ref: elementary)						
Middle school	0.816 (0.766, 0.868)	< .001	0.897 (0.857, 0.938)	< .001	0.941 (0.919, 0.964)	< .001
High school	0.454 (0.425, 0.485)	< .001	0.623 (0.595, 0.652)	< .001	0.717 (0.700, 0.735)	< .001
HFC × middle school	1.132 (1.070, 1.197)	< .001	1.064 (1.015, 1.115)	.009	1.031 (1.002, 1.061)	.035
HFC × high school	1.247 (1.179, 1.319)	< .001	1.149 (1.096, 1.203)	< .001	1.098 (1.067, 1.130)	< .001
Constant	0.467 (0.441, 0.494)	< .001	0.733 (0.710, 0.756)	< .001	0.823 (0.808, 0.839)	< .001
Random effects						
Observation level	0.171		0.218		0.143	
School level: intercept	0.337		0.206		0.095	
School level: HFC	0.198	–0.452	0.112	–0.767	0.066	–0.821
District level: intercept	0.264		0.109		0.066	
District level: HFC	0.141	–0.547	0.087	–0.543	0.049	–0.369

Note. CI = confidence interval; Corr = correlation; HFC = Healthy Food Certification; IRR = incidence rate ratio. Results are from separate models predicting annual counts for the free, reduced-price, and paid lunch eligibility categories, with 95% CIs shown based on (exp(β+/- 2*SE)). Models are based on 5064 observations from 904 schools in 154 districts.
Source. Authors' calculations based on data from the Connecticut State Department of Education (2004–2005 to 2009–2010 school years).[30]

TABLE 3—Impact of Healthy Food Certification on Lunch Counts and Meal Program Participation Rates by School Level: Connecticut, 2004–2005 to 2009–2010 School Years

	Effect of HFC on Lunch Counts				Predicted Lunch Counts per Year, 2009–2010[b]		Predicted Meal Program Participation	
Meal Program	IRR (95% CI)	*P*[a]	Observed Counts, No.	Potential Lunches, No.	No HFC, No.	HFC, No.	No HFC, Rate[c]	HFC, Rate[c]
Paid lunch								
Elementary school	0.985 (0.946, 1.025)	.461	22 883	48 546	25 673	25 288	0.529	0.521
Middle school	1.115 (1.049, 1.184)	< .001	37 114	91 249	39 530	44 061	0.433	0.483
High school	1.228 (1.157, 1.303)	< .001	40 081	148 548	37 107	45 569	0.250	0.307
Reduced-price lunch								
Elementary school	0.975 (0.944, 1.007)	.112	3783	4850	3879	3781	0.800	0.780
Middle school	1.037 (0.987, 1.089)	.139	5423	7730	5551	5756	0.718	0.745
High school	1.120 (1.067, 1.175)	< .001	4974	9567	4768	5339	0.498	0.558
Free lunch								
Elementary school	0.976 (0.957, 0.996)	.015	19 109	21 519	17 956	17 528	0.834	0.815
Middle school	1.007 (0.976, 1.037)	.669	19 713	23 930	18 800	18 922	0.786	0.791
High school	1.072 (1.040, 1.104)	< .001	20 888	33 010	19 794	21 215	0.600	0.643

Note. CI = confidence interval; HFC = Healthy Food Certification; IRR = incidence rate ratio.
Source. Authors' calculations based on data from the Connecticut State Department of Education (2004–2005 to 2009–2010 school years),[30] the US Department of Agriculture,[1,33] and the US Bureau of Labor Statistics[34] from separate models for free, reduced-price, and paid lunch eligibility categories.
[a]*P* value from the corresponding significance test from multilevel model (Table 2) predicting annual lunch counts.
[b]Marginal lunch counts predicted.
[c]Participation rates are calculated as predicted lunch counts over potential annual lunches (number of a school's enrolled students in a given eligibility category multiplied by the school's number of school days per year).

Profiles Surveys on changes in availability of competitive foods by state found that schools in Connecticut substantially reduced availability of unhealthy competitive foods from 2006 to 2010.[35] Connecticut now ranks in the top-5 states nationally for limiting access to unhealthy competitive foods in schools.

Critical Opportunity for Adolescent Health

The transition to middle and high school represents a critical window for improving population diet quality and preventing obesity. Overweight and obesity during adolescence are much stronger predictors of future adult obesity and related comorbidities than overweight and obesity during childhood.[36] However, at the same time that the stakes for maintaining a healthy weight increase, schools and other organizations charged with supporting a healthy transition from adolescence to adulthood frequently increase access to and promotion of obesogenic foods.[37,38]

National data and results from this study show a precipitous decline in participation in school meal programs beginning during middle school and accelerating in high school. In part, students choose not to participate in the meal program because schools are offering unhealthy snack alternatives high in fat, added sugars, and sodium.[39] The effect of Connecticut's HFC highlights the potential to bring middle- and high-school students back to the meal program by removing unhealthy alternatives from the school environment. This study's finding that HFC was associated with a slight decrease in elementary-school meal participation rates cannot easily be explained with the available data. One possibility that would need to be investigated further is that elementary schools have increased availability and sales of competitive foods that are now more likely to be viewed as healthy snack options under the new nutrition standards, although elementary schools generally have far fewer competitive food choices than do middle and high schools.

The significant overall increase in participation in the reduced-price and free-meal eligibility categories observed in this study deserves particular attention. Low-income families struggling to maintain food security received additional benefits for which their children were eligible but were not previously utilizing. Researchers have hypothesized that stigmatization of students participating in the meal program may reduce program participation.[40–42] By increasing participation in the paid meal program, Connecticut's HFC may have contributed to reduction of this stigma.

Impact on Local School District Finances

This study adds to a growing body of research showing that reducing the availability of unhealthy competitive foods in schools results in either positive or neutral effects on food service finances, in part by increasing revenue from the school meal programs.[26,27,43] One major limitation to the current study is that it does not incorporate reported changes in competitive food sales into the calculation of the impact of HFC on school revenues. However, it is likely that the results presented here underestimate the positive impact of removing unhealthy competitive foods on school finances.

In a USDA report based on a national sample of school districts surveyed during the 2005–2006 school year, researchers found that

TABLE 4—Predicted Impact of Healthy Food Certification on Lunch Counts and Meal Program Revenue by School Level: Connecticut, 2011–2012 School Year

Meal Program	Marginal Effects (Lunch Counts),[a] HFC – No HFC	Revenue per Meal, $[b]	Predicted Annual Lunch Program Revenue[c]		
			No HFC, $	HFC, $	Difference, HFC – No HFC, $
Paid lunch					
Elementary school	–385	2.39	61 423	60 502	–921
Middle school	4531	2.58	102 086	113 788	11 701
High school	8462	2.53	93 973	115 403	21 430
Reduced-price lunch					
Elementary school	–98	2.99	11 608	11 315	–293
Middle school	205	2.99	16 611	17 225	613
High school	571	2.99	14 268	15 977	1709
Free lunch					
Elementary school	–428	2.99	53 733	52 453	–1281
Middle school	122	2.99	56 259	56 624	365
High school	1421	2.99	59 234	63 486	4252

Note. HFC = Healthy Food Certification.
Source. Authors' calculations based on data from the Connecticut State Department of Education (2004–2005 to 2009–2010 school years),[30] the US Department of Agriculture,[1,33] and the US Bureau of Labor Statistics.[34]
[a]Marginal effects calculated from marginal predictions (Table 3).
[b]Predicted revenue per meal for 2011–2012 school year based on the sum of cash reimbursement, commodity support, and student payments (see "Methods" section for additional detail).
[c]Predicted revenue calculated on the basis of multiplication of revenue per meal and the marginal predicted lunch counts per year for each meal eligibility category and school level reported in Table 3.

revenue from competitive food sales fell short of the reported cost of competitive food production by 29%.[44] By contrast, revenue from reimbursable meal sales exceeded reported costs by 15%. The USDA reported that many schools do not properly attribute overhead and labor costs to competitive food sales as should be done in accordance with generally accepted accounting principles. When these costs are allocated correctly, the USDA found that on average schools were selling competitive foods at a loss. Because of this widespread but rarely recognized practice, school districts have been subsidizing the sale of unhealthy competitive foods with money intended for students participating in school meal programs.

Implications for National School Food Policy

Although further improvements should be made, the positive impact of changes to USDA school meal regulations following the Healthy Hunger-Free Kids Act should not be understated. Beginning in the 2012–2013 school year, school meals included a greater quantity and variety of fruits and vegetables and more whole grains, and for the first time specified minimum and maximum calorie ranges for each meal appropriate for each age group.[45] In compliance with the Consolidated and Further Continuing Appropriations Act, 2012,[24] substantial reductions in sodium levels will be phased in slowly over a period of 10 years.

However, food service professionals have correctly warned that students may reduce participation in healthier meal programs in favor of unhealthy competitive food offerings.[25] Results of the current study suggest that a new rigorous national competitive food policy could support continued participation in the meal programs. In addition, the USDA recently released an interim rule requiring districts to stop subsidizing competitive food sales with revenue from the meal programs, which will cause districts to increase competitive food prices.[46] As a result, the USDA estimated that in the 2012–2013 school year, 871 000 children will join meal programs.

The combined effect of the changes to competitive food regulations will create a broader constituency for school meal programs as children in higher-income families begin to participate in the paid meal program. The overall increase in participation, and especially from children in higher-income families, may create new political pressure to continue to improve the quality of school meal programs. Given the success of Connecticut's minimal monetary incentive at achieving voluntary participation in HFC, legislators and regulators should consider whether implementation of rigorous national competitive food standards could follow a similar model.

Methodological Considerations

Although the current study is limited by the lack of data on competitive food sales and evaluation of HFC's impact on students' actual diet quality, the study provides timely input to deliberation over the implementation of the first national competitive food standards.

One of the study's core strengths is its use of appropriate statistical techniques and existing administrative data to conduct a natural experiment of innovative state legislation for nutrition standards. Because we used data before and after implementation of state nutrition standards and because implementation

was staggered over time across districts, we were able to rigorously estimate the independent effect of state nutrition standards on district-level NSLP participation.

Conclusions

In Connecticut, district-level implementation of state nutrition standards reducing the availability of unhealthy competitive foods over a period of 4 years was associated with increased participation in the NSLP. Rigorous national competitive food standards would support implementation of improved school meal nutrition standards while protecting local school district finances. ■

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Contributors

M. W. Long and K. E. Henderson were responsible for the study design. J. Luedicke performed the statistical analysis with assistance from M. Dorsey. All authors interpreted the study data. M. W. Long was responsible for drafting the article with substantive revisions from all authors.

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Human Participant Protection

This study was approved by the Yale institutional review board.

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