



The Impact of 1 Year of Healthier School Food Policies on Students' Diets During and Outside of the School Day



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ABSTRACT

Background In 2012, Massachusetts implemented both the updated national school meal standards and comprehensive competitive food/beverage standards that closely align with current national requirements for school snacks.

Objectives This study examines the impact of these combined standards on school meal and snack food selections, as well as food choices outside of school. In addition, this study examines the impact of these standards on nutrients consumed.

Design The NOURISH (Nutrition Opportunities to Understand Reforms Involving Student Health) Study was an observational cohort study conducted among students from spring 2012 to spring 2013.

Participants/setting One hundred sixty students in 12 middle schools and high schools in Massachusetts completed two 24-hour recalls before (spring 2012) and after implementation (spring 2013) of the updated standards.

Main outcome measures Changes in school meals, competitive food, and after-school snack selection, as well as nutrients consumed outside of school were examined.

Statistical analyses performed Logistic regression and mixed-model analysis of variance were used to examine food selection and consumption.

Results After implementation, 13.6% more students chose a school meal (70.1% vs 56.5%; $P=0.02$). There were no differences in competitive food purchases but a significant decrease in the number of after-school unhealthy snacks consumed (0.69 [standard error=0.08] vs 1.02 [standard error=0.10]; $P=0.009$). During the entire day, students consumed, on average, 22 fewer grams of sugar daily after implementation compared with before implementation (86 g vs 108 g; $P=0.002$).

Conclusions With the reduction in the number of unhealthy school snacks, significantly more students selected school meals. Students did not compensate for lack of unhealthy snacks in school by increased consumption of unhealthy snacks outside of school. This provides important new evidence that both national school meal and snack policies may improve daily diet quality and should remain strong.
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IN THE UNITED STATES, APPROXIMATELY 95% OF PUBLIC schools participate in the national school lunch program, and 82% to 97% of middle and high school students have access to competitive foods in schools (ie, snacks and beverages sold in vending machines, à la carte, and in school

stores).^{1,2} In the absence of national standards promoting healthy competitive foods, the snacks purchased by students were typically nutrient-poor foods, with the most common selections being desserts, sugar-sweetened beverages, salty snacks, and candy.^{3,4} Recognizing the potential of school food policies to have meaningful effects on the diets and overall health of children nationwide, Congress authorized the United States Department of Agriculture (USDA) to update the science-based nutrition standards through the Healthy Hunger Free Kids Act of 2010.⁵ The USDA standards first went into effect in the fall of 2012 with improvements to the school meals. Although there were concerns that the policy would lead to reductions in students' meal selection and consumption, preliminary studies revealed that students were still consuming the school meals.^{6,7} However, these studies

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were not conducted in the presence of healthier competitive food policies and were evaluated in low-income school districts where the majority of students received free meals, and therefore the policy would be less likely to affect school meal selection. The 2014 Smart Snacks in School (“Smart Snacks”) national standards were implemented to improve the competitive foods in schools. These updated school meal and competitive food standards improved students’ access to whole grains, fruits, and vegetables; emphasized low-fat dairy; created calorie limits; reduced sodium levels; and eliminated *trans* fats in the foods available in schools (and additionally reduced sugar levels in competitive foods).^{8,9} However, until the 2016–2017 school year, competitive foods did not need to meet the updated standards if they contained at least 10% of the daily value for “nutrients of concern” (ie, calcium, potassium, vitamin D, or dietary fiber).

Before implementing the Smart Snack standards, Massachusetts passed a competitive food law in 2010 (105 CMR 225.000) that was nearly identical to the fully implemented Smart Snack standards. These standards went into effect in the fall of 2012, simultaneously with the updated national school meal standards. Implementation of the Massachusetts competitive food standards was previously evaluated, and high rates of compliance with the standards were observed.^{10,11} Although previous studies have examined the impact of the updated school meal standards on school lunch consumption in the absence of healthier competitive food standards,^{6,7} it is currently unknown how the combined school meal and competitive food standards affect students’ food selections in school (ie, school meals and/or competitive foods) or outside of the school day.

The NOURISH (Nutrition Opportunities to Understand Reforms Involving Student Health) Study was developed to learn more about the impact of the Massachusetts competitive food law on school compliance,^{10,11} barriers and strategies for successful implementation,¹² revenues,¹³ and students’ diets. This observational cohort study was a collaboration among the Harvard T. H. Chan School of Public Health, Northeastern University, Brandeis University, and the Massachusetts Department of Public Health. The present preliminary assessment examines the impact of the updated Massachusetts competitive food standards and USDA school meal standards on students’ food choices while at school and outside of the school day, as well as nutrients consumed.

METHODS

Participants and Setting

School districts in Massachusetts were recruited to participate in the NOURISH Study in the spring of 2012 before implementation of the updated school food standards. Eligibility requirements for districts included having a middle and a high school. Districts that had schools that included only kindergarten through eighth grade or that were combined with other districts at the high school level were excluded. A total of 37 Massachusetts school districts agreed to participate (with one middle and one high school randomly selected to participate per district; n=74 schools total). Recruitment procedures for the schools have been published previously.¹⁰ In general, the participating schools had fewer minority students and fewer students eligible for free or reduced priced lunch compared with the state overall. All

RESEARCH SNAPSHOT

Research Question: What is the impact of the updated national school meal standards and comprehensive competitive food/beverage standards on school meal and snack food selections and food choices outside of school? In addition, what is the impact of these standards on nutrients consumed?

Key Findings: In this preliminary observational cohort study, conducted with 160 students from 12 middle schools and high schools in Massachusetts, 13.6% more students chose a school meal after implementation of the standards ($P=0.02$). There were no differences in competitive food purchases but a significant decrease in the number of after-school unhealthy snacks consumed. Students consumed, on average, 22 fewer grams of sugar daily after implementation compared with before implementation ($P=0.002$).

participating schools had site visits to assess the competitive foods available before and after implementation of the Massachusetts competitive food law and updated USDA school meal standards, with additional study details published previously.¹⁰ The institutional review board at Harvard T. H. Chan School of Public Health approved this study.

Among the participating school districts, a subsample of schools (n=7 middle schools and n=5 high schools) agreed to participate in a dietary assessment component with their students. These schools were similar in demographics to those participating in the larger NOURISH Study, although the average age of the student body was slightly younger as a result of more middle schools participating in the dietary analyses. Students were recruited using active consent (parental consent and student assent) and informed that this was a study to learn more about students’ diets. Parents completed a survey with student demographic information, including their child’s sex, age, grade, race/ethnicity, and eligibility for free/reduced priced meals. Each student received a \$10 gift card for participating in the study. A total of 243 students agreed to participate (9.5% of the total eligible school population), and 160 students completed assessments in both the spring of 2012 (before implementation) and the spring of 2013 (after implementation). Among the participating students, approximately 75% attended middle school and 25% attended high school.

24-Hour Recalls

Consumption of foods and beverages during the school day and outside of school was assessed by means of two 24-hour phone recalls per student. This method has been previously validated among this age group.¹⁴ The scripts were based on the National Health and Nutrition Examination Survey (NHANES) recall questions with additional prompts specific to school foods.¹⁵ Trained research assistants called students on school nights after dinner (Tuesday through Thursday evenings at a time specified by the parent). Evenings were selected for the recalls because of the feasibility of data collection among this population. Research assistants then used the script with prompts to systematically ask the students to recall all foods/ and beverages consumed earlier that

Table 1. Baseline (spring 2012) characteristics of 160 Massachusetts students participating in the NOURISH^a Study

Characteristics	
	<i>n (%)</i>
Female	90 (56.3)
Race/ethnicity	
Hispanic	6 (3.8)
Non-Hispanic	
Asian	3 (1.9)
Black	15 (9.4)
White	101 (63.1)
Other/Mixed Race	35 (21.8)
Eligible for free/reduced price meals	28 (18)
	<i>mean (range)</i>
Age, y	13.3 (9-17)
Grade at baseline	7.4 (6-11)

^aNOURISH=Nutrition Opportunities to Understand Reforms Involving Student Health.

day and the evening before, food and beverage sources, the location where the food or beverage was consumed, and the time of day each item was consumed. Research assistants manually recorded the recall information and then entered the data into ASA24, an open-access software tool developed by the National Institutes of Health,¹⁶ which is used to record diet and calculate daily nutrient consumption. For this analysis, we included energy, total fat, saturated fat, total sugar, fiber, and sodium. After-school snack foods (defined as foods eaten after the end of the school day and before dinner) were also coded as “healthy” or “unhealthy” based on whether they were in alignment with the competitive food standards.

The food sources for after-school snacks varied and included home, school, restaurant/convenience store, after-school programs, a friend’s or relative’s house, and sports/entertainment venue. The daily nutrients consumed were assessed based on the full 24-hour recall.

Statistical Analyses

Within-child differences in food selection, consumption, and nutrients consumed were examined before and after implementation. Logistic regression with multilevel modeling was used to examine differences in school lunch and competitive food selection before and after implementation, accounting for the repeated measures of students nested within schools (SAS PROC GENMOD¹⁷). To examine changes in the number of healthy and unhealthy after-school snacks selected and nutrients consumed before implementation vs after implementation, mixed-model analysis of variance was used to examine students who selected a school meal and/or a competitive food at school both before and after implementation, accounting for the repeated measures of students and school as a random effect (students nested within schools), using SAS PROC MIXED. The analyses examining the selection of competitive foods, number of after-school snacks, and the daily nutrients consumed were adjusted for school lunch source (eg, school meal or meal brought from home).

RESULTS

The characteristics of the students participating in the dietary recall as part of the NOURISH Study are presented in Table 1. Slightly over half of the participants were female, and the majority were white. Students were, on average, 13 years old (range, 9 to 17 years); the average grade level was 7 (range, 6 to 11); and 18% of students were eligible for free or reduced priced meals. Approximately half of the students received a school meal, and roughly a quarter of the students purchased competitive foods. Similar competitive food purchasing rates were seen among participants receiving a school meal and those bringing food from home. A small percentage (3%)

Table 2. Selection of foods during or after school among students in Massachusetts participating in the NOURISH^a Study comparing baseline (2012) with 1 year after implementation (2013) of the Massachusetts competitive food standards and the US Department of Agriculture school meal standards

	Baseline (Reference)	After Implementation		
	Mean ^b	Mean ^b	Difference ^c	P value
School lunch (%)	56.5	70.1	13.6	0.02 ^d
Competitive foods (%)	26.2	27.0	0.8	0.90 ^d
Number of healthy snacks after school, ^e mean (SE ^g)	0.36 (0.06)	0.41 (0.07)	0.05	0.83 ^f
Number of unhealthy snacks after school, ^e mean (SE)	1.02 (0.10)	0.69 (0.08)	−0.33	0.009 ^f

^aNOURISH=Nutrition Opportunities to Understand Reforms Involving Student Health.

^bResults are unadjusted.

^cDifference was calculated by subtracting results after implementation from baseline (reference group).

^dCalculated using logistic regression, with school as a random effect and repeated measures among students, and adjusting for lunch source (school meal or meal brought from home) for analysis of competitive food selection.

^eAfter-school snacks were defined as foods eaten after the end of the school day and before dinner. The food sources for after-school snacks included home, school, restaurant/convenience store, after-school program, friend’s or relative’s house, and sports/entertainment venue.

^fCalculated using mixed-model analysis of variance, with school as a random effect and repeated measures among students, adjusting for students’ sex, race/ethnicity, eligibility for free/reduced priced meals, and middle vs high school status and lunch source (school meal or meal brought from home).

^gSE=standard error.

purchased only a competitive food to consume as lunch. In addition, approximately 5% of students purchased a lunch off campus, and among those students, a third also purchased a competitive food from the school.

Participants' selection of school lunches, competitive foods, and healthy and unhealthy after-school snacks are presented in Table 2. After the updated school meal and competitive food standards were implemented, 13.6% more students chose a school meal vs no school meal (eg, lunch from home, a competitive food as lunch, or no lunch consumed at school) compared with before implementation. Overall, only 5% of students selected more than one competitive food during the school day, and there were no statistically significant differences in the overall purchases of competitive foods before implementation- compared with after implementation. There were also no significant differences in the number of healthy after-school snacks consumed, although there were significant reductions in the selection of unhealthy after-school snacks after implementation compared with before implementation.

The daily nutrients consumed, as well as nutrients consumed after school, were also determined from the 24-hour recalls (Table 3). Overall, there were no statistically significant differences in energy, total fat, saturated fat, fiber, or sodium consumed throughout the day before implementation vs after implementation. However, students consumed, on average, 22 fewer grams of sugar daily after implementation compared with before implementation. Similar results were observed when the nutrients consumed from after-school snacks only were analyzed. No significant differences in energy, total fat, saturated fat, fiber, or sodium were observed; but students consumed 10 fewer grams of sugar after school, on average, after implementation compared with before implementation. Throughout the study, the primary sources of daily added sugar and after-school were ice cream, candy, baked goods, and sugar-sweetened beverages; a reduction, rather than replacement, of these items was seen over the study period.

DISCUSSION

To our knowledge, this is the first study to examine the impact of both the updated USDA school meal guidelines and competitive food standards on students' diets during and outside of the school day. After the updated standards were implemented, significant increases in the selection of school meals and no changes in the selection of competitive foods were observed. It was particularly noteworthy that students did not compensate for the healthier school food environment by selecting unhealthy foods and beverages after school. In fact, students consumed significantly fewer unhealthy snacks and less total sugar after school after implementation of the healthier school food and competitive food standards as compared with before implementation. The results provide initial support that these standards may improve students' diet quality.

Similar to our study, an analysis examining nationally representative data from the School Nutrition Dietary Assessment showed that improvements to the school food environment can lead to meaningful changes in student's diets, although investigators found a stronger reduction in total calories compared with our study.¹⁸ In another study, Woodward and colleagues¹⁹ asked students about specific

Table 3. Nutrients consumed after school and daily among students in Massachusetts participating in the NOURISH^a Study comparing baseline (2012) with 1 year after implementation (2013) of the Massachusetts competitive food standards and the US Department of Agriculture school meal standards

	Baseline	After Implementation		
	Mean (SE) ^{b,c}	Mean (SE) ^c	Difference ^d	P value ^e
After school^f				
Energy, kcal	429 (58)	337 (71)	-92	0.07
Total fat, g	9.3 (5.5)	4.9 (5.9)	-4.4	0.12
Saturated fat, g	4.1 (1.0)	2.7 (1.1)	-1.4	0.10
Total sugar, g	31 (5)	21 (5)	-10	0.01
Fiber, g	3.7 (0.5)	3.3 (0.6)	-0.4	0.28
Sodium, mg	434 (78)	364 (85)	-70	0.30
Daily				
Energy, kcal	1,977 (132)	1,852 (134)	-125	0.14
Total fat, g	73.5 (6.1)	70.5 (6.2)	-3.0	0.54
Saturated fat, g	26.2 (2.6)	23.8 (2.6)	-2.4	0.22
Total sugar, g	108 (11)	86 (11)	-22	0.002
Fiber, g	16.0 (1.5)	15.7 (1.5)	-0.3	0.66
Sodium, mg	3,379 (225)	3,394 (229)	15	0.97

^aNOURISH=Nutrition Opportunities to Understand Reforms Involving Student Health.

^bSE=standard error.

^cCalculated using least-squares mean regression.

^dDifference calculated by subtracting results after implementation from baseline (reference group).

^eCalculated using mixed-model analysis of variance, with school as a random effect and repeated measures among students, adjusting for lunch source (school meal or meal brought from home) for analyses of overall nutrient consumption.

^fAfterschool snacks were defined as foods eaten after the end of the school day and before dinner. The food sources for after-school snacks included home, school, restaurant/convenience store, after-school program, friend's or relative's house, and sports/entertainment venue. Data were analyzed among students who selected a school meal and/or a competitive food at school both before and after implementation.

food items consumed at school and at home before and after implementation of a healthier competitive food law in California. They also found that students did not compensate for the healthier school food environment with less healthy food choices at home. Results of this research suggest that students are accepting of healthier school foods.

The improvements in diet seen with the healthier school meal and competitive food policies have important health implications for students. More students selected the school meals, which have greater quantities of whole grains and vegetables because of the updated school meal standards.^{5,6} In addition, students decreased their sugar intake; students consumed, on average, 22 fewer grams of sugar per day after implementation of the healthier food standards, which is equivalent to removing about one 8-oz sugar-sweetened beverage from their daily diet. This cumulative impact on diet can have important implications because greater sugar consumption is associated with increased risk of obesity, cardiovascular disease, and type 2 diabetes.²⁰⁻²² Previous

research by Fox and colleagues²³ revealed a positive association between less healthy food options in schools nationwide (especially products high in sugar) and body mass index z-scores among students. Overall, research suggests that national school food policies can have a major impact on students' diets, weight, and health.

This study had several limitations. Only middle and high school students in Massachusetts were included in the study. However, there was variability in race/ethnicity and geographic location (urban, suburban, and rural). Although a relatively small percentage of students (18%) were eligible for free/reduced priced meals, these results are likely generalizable to other middle and high school students who have similar socioeconomic status and/or consume a school meal. Future studies should be designed to examine the impact of the healthier school food policies in elementary schools and other school settings. Although this was an observational study without a control population, previous research has demonstrated that Massachusetts' competitive food policy resulted in improvements to school snacks, although no significant changes were observed in a control state without a competitive food policy; therefore the results of this study were not likely due to secular trends.^{10,11} In addition, because the dietary software used to calculate the nutrients consumed (ASA24) would not have been updated to reflect reformulated healthier school meals or competitive foods, the nutrients consumed at lunch were not calculated. Future research should examine the impact of the combined standards on nutrients consumed while students are in school.²⁴ Although the sample size was a relatively small, more detailed dietary information was collected. Future larger studies should also examine associations with student diet and assess the long-term impact of healthy school food policies. An additional strength of this study was the ability to track students over time, both before and after the updated school food policies were implemented, as well as the ability to examine dietary intake after school and for the entire day.

CONCLUSIONS

This was the first study to evaluate students' overall diets before and after implementation of the updated USDA school meal standards and fully implemented competitive food standards. With the reduction in the number of unhealthy school snacks, significantly more students selected school meals. Notably, students did not compensate for the lack of unhealthy snacks and beverages by selecting and consuming less healthy foods after school, and in fact, consumed fewer unhealthy after-school snacks and significantly less sugar throughout the day. This study provides important preliminary evidence that both national school meal and snack policies may improve students' diet quality.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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J. F. W. Cohen, L. Rosenfeld, L. Smith, E. B. Rimm, and J. A. Hoffman conceived the study. J. F. W. Cohen and M. T. Gorski Findling supervised the study. J. F. W. Cohen completed the analyses and led the writing. M. T. Gorski Findling, L. Rosenfeld, L. Smith, E. B. Rimm, and J. A. Hoffman provided critical feedback on the manuscript.