



Implementation of Competitive Food and Beverage Standards in a Sample of Massachusetts Schools: The NOURISH Study (Nutrition Opportunities to Understand Reforms Involving Student Health)



Jessica A. Hoffman, PhD; Lindsay Rosenfeld, ScM, ScD; Nicole Schmidt, PhD; Juliana F. W. Cohen, ScM, ScD; Mary Gorski, MS; Ruth Chaffee, MEd; Lauren Smith, MD, MPH; Eric B. Rimm, ScD

ARTICLE INFORMATION

Article history:

Submitted 11 July 2014
Accepted 21 April 2015

Keywords:

Competitive
Food
Beverage
School
Lunch

Supplementary materials:

Table 1 is available online at www.andjrn.org.

2212-2672/Copyright © 2015 by the Academy of
Nutrition and Dietetics.
<http://dx.doi.org/10.1016/j.jand.2015.04.019>

ABSTRACT

Background During 2012, Massachusetts adopted comprehensive school competitive food and beverage standards that closely align with Institute of Medicine recommendations and Smart Snacks in School national standards.

Objective We examined the extent to which a sample of Massachusetts middle schools and high schools sold foods and beverages that were compliant with the state competitive food and beverage standards after the first year of implementation, and complied with four additional aspects of the regulations.

Design Observational cohort study with data collected before implementation (Spring 2012) and 1 year after implementation (Spring 2013).

Participants/setting School districts (N=37) with at least one middle school and one high school participated.

Main outcome measures Percent of competitive foods and beverages that were compliant with Massachusetts standards and compliance with four additional aspects of the regulations. Data were collected via school site visits and a foodservice director questionnaire.

Statistical analyses performed Multilevel models were used to examine change in food and beverage compliance over time.

Results More products were available in high schools than middle schools at both time points. The number of competitive beverages and several categories of competitive food products sold in the sample of Massachusetts schools decreased following the implementation of the standards. Multilevel models demonstrated a 47-percentage-point increase in food and 46-percentage-point increase in beverage compliance in Massachusetts schools from 2012 to 2013. Overall, total compliance was higher for beverages than foods.

Conclusions This study of a group of Massachusetts schools demonstrated the feasibility of schools making substantial changes in response to requirements for healthier competitive foods, even in the first year of implementation.

J Acad Nutr Diet. 2015;115:1299-1307.

COMPETITIVE FOODS ARE FOODS AND BEVERAGES sold in vending machines, à la carte cafeteria lines, school stores, and fundraisers that often “compete” with school meals and are widely available in most schools throughout the United States.¹ These foods are commonly nutrient poor, calorically dense, and high in saturated fat and added sugar.²⁻⁷ About 40% of US schoolchildren consume competitive foods, which accounts for approximately 200 additional calories per student daily.⁵ Students who eat competitive foods consume more saturated fat and added sugar daily and are less likely to consume healthier foods such as fruit, vegetables, and milk.^{8,9}

Changing the school food environment provides an important opportunity to improve children's diets and health. There is resistance to set nutrition standards due to fears that schools will lose money¹⁰ and students will simply consume unhealthy food elsewhere.¹¹ However, research indicates that schools implementing healthier competitive food policies generally do not experience financial losses,¹⁰ in part because students are more likely to purchase school meals,¹² and students do not compensate by consuming more energy-dense foods at home.¹¹

Whereas school meals must meet nutrition standards to receive federal subsidies,¹³ national standards for competitive

foods were not required until the start of the 2014-2015 school year (Table 1, available online at andjrn.org). States and local school districts have been setting competitive food policies independently for the past decade.^{11,14-23} A national analysis of competitive food policies found that while 39 states had enacted policies as of 2010, they were not well-aligned with the science-based recommendations of the Institute of Medicine (IOM), and no state policy met all of the IOM recommendations.²³

Massachusetts enacted a statewide school nutrition bill in 2010 (105 CMR 225.000) that required the Massachusetts Departments of Public Health and Elementary and Secondary Education to develop new nutrition standards for all competitive foods served in Massachusetts schools, effective August 1, 2012. There were no statewide competitive food and beverage standards in Massachusetts before the bill. The Massachusetts standards are closely aligned with IOM recommendations and the national standards (see Table 1, available online at www.andjrn.org).²³⁻²⁵ The Massachusetts law limits the calories, portion sizes, saturated and *trans* fats, sugar (including sugar-sweetened beverages), and sodium of competitive foods while emphasizing water without additives, nonfat and low-fat milk, fruits, vegetables, and whole grains. Massachusetts standards apply to all public elementary, middle, and high schools and to all competitive foods sold or made available to students.²⁶ The Massachusetts standards include four additional components: access to free drinking water throughout the day, access to nutrition information on non-prepackaged competitive foods and beverages sold in the cafeteria, the sale of fresh fruits and nonfried vegetables at locations where food is sold, and prohibiting the use of fryolators (an appliance used for deep frying).

Multiple methods were employed by the State to facilitate implementation of the standards, including development of a guidance document that was disseminated to all schools, presentations at professional state school associations and at a summer institute for school foodservice directors (FSDs), informative exhibits displayed at school conferences and professional associations, nutrition education classes for school foodservice personnel, and technical assistance for districts.

The Nutrition Opportunities to Understand Reforms Involving Student Health (NOURISH) study examined middle schools' and high schools' compliance with the Massachusetts standards, children's food consumption patterns throughout the day, effects of the standards on school food revenue, and strategies that foster successful implementation and prevent revenue loss. The purpose of this first NOURISH analysis was to understand the extent to which Massachusetts schools sell foods and beverages that are compliant with the state competitive food and beverage standards after the first year of implementation. It was hypothesized that Massachusetts schools would sell more competitive foods and beverages that were consistent with the standards after implementation (Spring 2013) relative to before implementation (Spring 2012). It was also hypothesized that Massachusetts schools would be more consistent in implementing the four additional components of the regulations (ie, availability of free water, fruits and vegetables, and nutrition information and eliminating the use of fryolators) after implementation relative to before implementation.

METHODS

Participants and Setting

During 2012, the sample included 74 middle schools (usually grades 6 through 8) and high schools (grades 9 through 12) across 37 school districts in Massachusetts. School districts were eligible for participation if they had at least one middle school and one high school in the district. Recruitment procedures are described in Figure 1. Briefly, randomly selected principals from one high school and one middle school at 136 eligible districts in Massachusetts received an introductory letter about the NOURISH study. A follow-up e-mail invitation to the study with an attached informed consent form was sent to middle and high school principals and the district FSD; if informed consent was provided, FSDs were e-mailed a link to the NOURISH Nutrition Services Survey and a site visit was scheduled. If there was no response, a research assistant followed-up with a telephone call to the FSD. Recruitment procedures yielded a 27% participation rate. FSDs were provided a \$50 incentive for participation. The main reasons for nonparticipation in 2012 were the timing of the contact with FSDs at the end of the school year and a lack of interest in the study. During 2013, 29 school districts (81%) continued participation. The main reason FSDs declined participation in 2013 was a lack of time.

Measures and Data Collection Procedures

School sociodemographic data were obtained electronically from the Massachusetts Department of Elementary and Secondary Education.²⁷ The variable called percent of racial/ethnic minority students included students who were African American, Asian, Hispanic, Native American, and multiracial. School site visits were conducted at baseline (Spring 2012) and 1-year after implementation (Spring 2013) to obtain detailed observational data regarding the competitive foods sold in all vending machines, à la carte lines, and school stores in the participating schools. Research assistants took digital photographs of every food and beverage product sold in each location. Only prepackaged products that were not part of the school meals and frozen cookies that were baked at the school were included in the study. Food and beverage items were photographed so that the entire product name and package size could be viewed clearly. The decision to only include prepackaged items and frozen cookies baked at the school was made so that it was possible to make accurate determinations regarding whether or not products were consistent with the standards. The product name, size, location, and price of each photographed item were entered into a database. Information about whether the item was included on the John Stalker Institute A-list²⁸ in 2012 and 2013 was also recorded. The A-list is a comprehensive list of food and beverage products that is updated weekly and is a living document including only those items that meet the Massachusetts nutrition standards.

The primary dependent variables were percent compliant foods and percent compliant beverages. A measure of compliance with state food and beverage guidelines was created: number compliant products/total number of products in the school. Compliance was calculated separately in 2012 and 2013, and separately for competitive foods (chips/salty snacks, sweet snacks, ice cream/frozen treats, and yogurt/cheese) and beverages. To assess reliability, a second research assistant

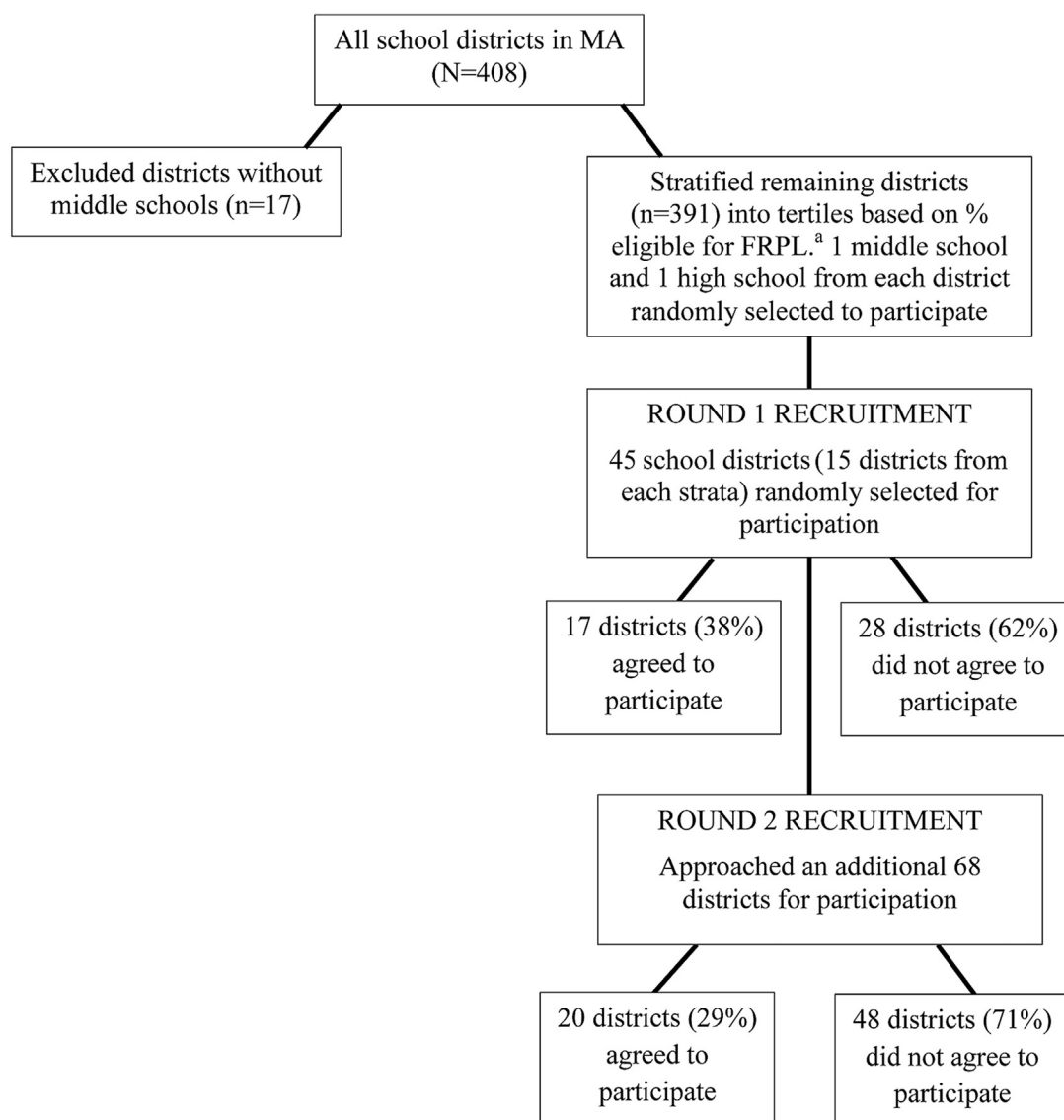


Figure 1. NOURISH (Nutrition Opportunities to Understand Reforms Involving Student Health) study Massachusetts school district recruitment procedures flow chart (N=37). ^aFRPL=free and reduced price lunch.

independently coded every 25th data point (360 observations) and kappa coefficients were computed to control for chance agreement. Interobserver agreement regarding the extent to which products were or were not compliant with the Massachusetts regulations in 2012 and 2013 was nearly perfect²⁹ (2012 and 2013 compliance: $\kappa = 0.96$; P values < 0.001).

The NOURISH Nutrition Services Survey is a 14-item questionnaire administered either electronically or in person to FSDs, which was modified from an FSD survey used in previous school food environment research.²² The survey was adapted to focus on competitive foods and beverages and to reflect specific aspects of the Massachusetts nutrition standards. In this study, schools' compliance with the four additional aspects of the nutrition regulations was used in the analyses: water available free of charge, sale of fresh fruit and nonfried vegetables, nutrition information available, and no fryolators (see Table 1, available online at www.andjrn.org). FSDs

indicated schools' compliance with the four additional aspects of the regulations by reporting "yes" or "no." FSDs completed a total of four surveys; they completed two surveys (one for the middle school and one for the high school) at each of the two study time points. To minimize social desirability, FSDs were told that their responses were confidential and researchers would not communicate information about individual school districts to the state. All study procedures were approved by the Institutional Review Board at Harvard University.

Study Design and Data Analysis

The NOURISH study employed a pretest/posttest design. Middle schools and high schools were nested within districts. To calculate average product availability across product categories, the number of unique products available in each product category was summed for each school and a mean

was calculated for each category. If the same product was sold in multiple locations in a school, it was only counted once in the analyses.

To examine whether compliance with competitive food and beverage guidelines changed after implementation of the new Massachusetts standards, first mean food and mean beverage compliance rates in 2012 to 2013 in Massachusetts middle schools and high schools were examined. Paired *t* tests were used for all comparisons except for beverage compliance in high schools, where the Wilcoxon signed rank test was used because of a suggested departure from normality. Next, to account for middle and high schools (level 1) being nested within districts (level 2), multilevel models were estimated using SAS Proc Mixed in SAS (version 9.3, 2011, SAS Institute, Inc). The model contained a random intercept for district and a fixed effect for year. The equation for the model is:

$$\text{Compliance}_{ij} = \gamma_{00} + \gamma_{10}\text{Year}_{ij} + \zeta_{0i} + \varepsilon_{ij} \quad (1)$$

where γ_{00} is the overall district intercept, γ_{10} is the overall rate of change (fixed effect of year), ζ_{0i} is the level 2 district random intercept variance, and ε_{ij} is the level 1 residual error. The parameter of interest is the fixed effect for year, which identifies the effect of changes in nutrition standards on changes in compliance, adjusting for the correlation between measurements within districts. Unadjusted models, as well as models adjusted for school level, percent of racial/ethnic minority students, and percent of students with free or reduced price lunch (FRPL) are presented in Tables 2 and 3. In addition, school size was controlled for, but this variable was not significant and did not change the effect of year, so it was omitted from final models. Multilevel model assumptions (functional form, normality, and homoscedasticity)³⁰ were tested and there was no evidence of a violation of such assumptions. Analyses were performed using complete case analysis for those middle and high schools retained in 2013 and reporting beverage compliance data (61 out of 74 schools; 82.4% response) and food compliance data (57 out of 74 schools; 77.0% response).

Finally, McNemar's test was used to examine changes in schools' practices with regard to the four additional aspects of the nutrition standards before and after the standards went into effect. McNemar's test was used because the data were paired and dichotomous. Missing data were handled using pairwise deletion.

RESULTS

Baseline data are displayed in Table 4. The schools that participated in this study had fewer minority students (19.2%) relative to the state as a whole (32.9%; $t=-7.18$; $P<0.001$) and fewer students eligible for FRPL (27.1%) relative to the percent eligible across the state (35.2%; $t=-4.25$; $P<0.001$). Competitive foods and beverages were widely available with middle schools selling competitive foods in fewer purchasing locations than high schools.

Product Availability

The average number of total competitive food and beverages sold in Massachusetts middle schools and high schools during 2012 (pre-implementation) and 2013 (post-implementation) is displayed in Figure 2. Fewer competitive food products

Table 2. Average percent compliant food and beverage products in middle schools and high schools participating in the NOURISH^a study before and after Massachusetts competitive food and beverage standards went into effect

School	Competitive Foods						Competitive Beverages					
	Pre mean (n)	Post mean (n)	Mean difference (n)	Standard error	Test statistic	P value	Pre mean (n)	Post mean (n)	Mean difference (n)	Standard error	Test statistic	P value
Middle schools	13.50% (29)	68.80% (21)	-0.51 (19)	0.07	-7.19	<0.0001 ^b	46.10% (34)	86.50% (24)	-0.38 (24)	0.09	-4.41	0.0002 ^b
High schools	12.50% (36)	54.10% (28)	-0.41 (28)	0.04	-9.89	<0.0001 ^b	28.00% (36)	80.10% (28)	—	—	-179.50	<0.0001 ^c

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

^bP values are from paired *t* tests comparing pre- to post-implementation means within middle schools and high schools separately.

^cThe P value for high school beverage compliance is from the Wilcoxon signed rank test comparing pre- to post-implementation means.

Table 3. Two-level random effects model^a testing change in Massachusetts school competitive food and beverage compliance rates, 2012 to 2013

	Model 1		Model 2	
	$\beta \pm \text{standard error}$	<i>P</i> value	$\beta \pm \text{standard error}$	<i>P</i> value
Food compliance (N=114)				
Fixed effects				
Year	.465±.032	<0.0001	.464±.033	<0.0001
Percent nonwhite	—	—	.004±.002	0.02
Percent FRPL ^b	—	—	−.004±.002	0.02
Covariance parameter estimates				
School district random intercept	.007±.004	0.03	.004±.004	0.11
Residual	.028±.004	<0.0001	.029±.005	<0.0001
Intraclass correlation coefficient	0.200		0.121	
Akaike information criterion	−49.9		−32.9	
Beverage compliance (N=122)				
Fixed effects				
Year	.458±.049	<0.0001	.455±.049	<0.0001
Percent nonwhite	—	—	.001±.002	0.69
Percent FRPL	—	—	.001±.002	0.58
Covariance parameter estimates				
School district random intercept	.012±.008	0.07	.013±.009	0.06
Residual	.070±.011	<0.0001	.070±.011	<0.0001
Intraclass correlation coefficient	0.146		0.157	
Akaike information criterion	49.5		69.1	

^aModel 1 is unadjusted for confounding and Model 2 adjusts for percent nonwhite and percent FRPL.^bFRPL=free and reduced-price lunch.

were sold in middle schools relative to high schools across all categories and the number of products sold decreased between 2012 and 2013 across all categories at both school levels. Most of the products for sale were beverages and sweet and salty snacks. Yogurts and cheeses were rarely sold at both time points. There was a sharp decrease in the number of frozen desserts for sale between pre- and post-implementation; this was likely the result of few products on the market that met the sugar guideline set forward in the

new standards. There was also a marked decrease in the number of beverages for sale, particularly at the high school level, where many of the sugar-sweetened beverages sold previously did not meet the state standards.

Food and Beverage Compliance

In Massachusetts during 2012, about 13% of competitive foods (both middle and high schools) and between 28% (high) and 46% (middle) of competitive beverages sold were

Table 4. Demographic characteristics of NOURISH^a study schools at baseline (Spring 2012)

Characteristic	Middle schools (n=37)	High schools (n=37)
	←—————mean \pm standard deviation (range)—————→	
School size by enrollment	636 \pm 239 (233-1,121)	1,019 \pm 502 (212-2,080)
Nonwhite students enrolled (%)	19.4 \pm 16.2 (4-78)	19.1 \pm 16.7 (3-87)
Students eligible for free or reduced price meals (%)	29.6 \pm 17.8 (4-67)	24.7 \pm 14.4 (5-58)
Number of purchasing locations*	5.6 \pm 2.9 (1-13)	11.4 \pm 5.2 (2-26)

^aNOURISH=Nutrition Opportunities to Understand Reforms Involving Student Health.**P*<0.05.

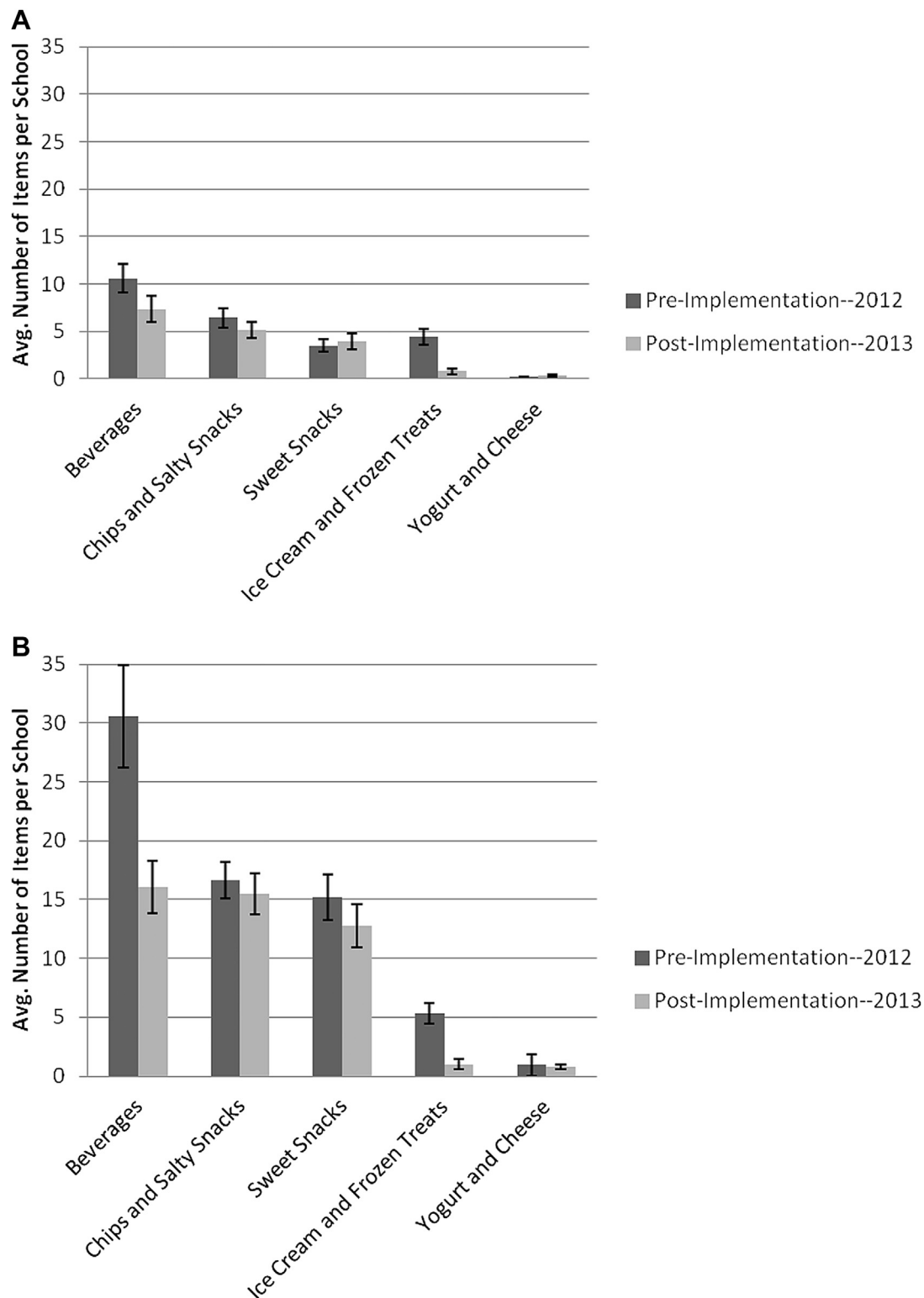


Figure 2. (A) Average number^a of unique competitive foods and beverage products for sale in NOURISH (Nutrition Opportunities to Understand Reforms Involving Student Health) study Massachusetts middle schools before (Spring 2012) and after (Spring 2013) state competitive food and beverage standards went into effect. (B) Average number^a of unique competitive foods and beverage products for sale in NOURISH study Massachusetts high schools before (Spring 2012) and after (Spring 2013) state competitive food and beverage standards went into effect. ^aError bars represent standard errors.

consistent with the proposed future nutrition standards (Table 2). In 2013 there was a dramatic increase in foods and beverages sold that were consistent with the Massachusetts standards. Compliant foods sold in middle and high schools had significant increases to 69% and 54%, respectively, whereas compliant beverages sold in middle and high schools significantly increased to 87% and 80%, respectively.

As noted above, we employed multilevel models to adjust for the clustering of schools within districts, as well as to adjust for district-level covariates. After adjusting for clustering, the effect of year on competitive food compliance was $\beta=0.465$ (Table 3), showing that a 1-year change amounted to a 46.5-percentage-point (95% CI 40.2% to 52.8%) increase in food compliance. There was also a significant random intercept for district, indicating that districts differed in their baseline compliance rates. Twenty percent of the variation in food compliance was due to differences between school districts (intraclass correlation coefficient=0.200). After adjusting for the percent of racial/ethnic minority students and percent of students receiving FRPL (at the district level), the random intercept for district was no longer significant but the effect of year was unchanged. Percent racial/ethnic minority students had a significant, positive effect on food compliance, whereas percent FRPL had a significant, negative effect on food compliance.

Similarly, the effect of year on competitive beverage compliance was $\beta=0.458$ (Table 3), indicating that a 1-year change amounted to a 45.8-percentage-point (95% CI 36.1% to 55.5%) increase in beverage compliance. Approximately 15% of the variation in beverage compliance was due to differences between school districts (intraclass correlation coefficient=0.146). Adjusting for percent of racial/ethnic minority students and percent FRPL did not change the effect of year, and these variables had nonsignificant effects on beverage compliance. The results from the *t* tests and multilevel models confirm statistically significant improvements in food and beverage compliance with the new Massachusetts standards 1 year after the implementation of new food guidelines.

The Four Additional Aspects of the Massachusetts Standards

The extent to which the four additional aspects of the MA standards were implemented in schools during the two study

time points is presented in Table 5. School FSDs reported nearly universal availability of free water and elimination of fryolators to prepare competitive foods at both time points. They reported increased availability of fresh fruit and non-fried vegetables for sale in locations where food is sold 1 year after the standards were in effect, but these changes were not statistically significant. The availability of nutrition information for non-prepackaged competitive foods and beverages sold in the cafeteria did increase significantly between the two time periods at both the middle and high school levels despite this standard not being required until the start of the following school year.

DISCUSSION

The NOURISH study, which is the first to examine competitive food standards that are similar to the IOM recommendations and the national Smart Snacks in School standards, found significant improvements to the competitive foods and beverages available in schools. Consistent with previous findings in California,²² competitive foods and beverages were widely available before and after the standards were implemented, with more unique products available in high schools relative to middle schools. Although product availability decreased from 2012 to 2013 in the Massachusetts schools in this study, particularly among beverages, there remained a wide variety of products for sale in the schools after implementation.

Consistent with the literature,^{17,20,31,32} increases in the percent of unique compliant food and beverage products for sale in both the NOURISH Massachusetts middle and high schools were observed following policy implementation. Competitive foods and beverages sold in the schools in this study that were consistent with Massachusetts standards increased by 47 percentage points and 46 percentage points, respectively, during the 1-year period. Consistent with findings in California,¹⁷ there were higher compliance rates at both pre- and post-implementation for beverages relative to foods in the NOURISH schools. Whereas 54% to 68% of foods sold in the high schools and middle schools, respectively, were consistent with the food standards at post-implementation, more than 80% of beverages were consistent with the beverage standards at post-implementation.

Table 5. Percent of NOURISH^a study Massachusetts middle schools and high schools reporting implementation of other aspects of the state school nutrition standards before (Spring 2012) and 1 year after (Spring 2013) the standards went into effect

Regulation	Middle Schools				High Schools			
	n	Pre (%)	Post (%)	P value	n	Pre (%)	Post (%)	P value
Free water ^b	21	100	100	NS ^c	22	96	96	NS
Fruit and vegetables sold ^d	18	61	83	0.29	19	68	95	0.06
Nutrition info ^e	19	26	82	0.03	19	32	68	0.02
No fryolators ^f	21	100	100	NS	22	96	100	NS

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

^bPlain, potable water is available to all students at no cost.

^cNS=not significant.

^dFresh fruit and nonfried vegetables are available for sale at any location where food is sold (not including nonrefrigerated vending machines and vending machines dispensing only beverages).

^eNutrition information for non-prepackaged competitive foods and beverages sold in the cafeteria is available (implementation of this standard was not required until August 2013).

^fFryolators are not used in the preparation of competitive foods.

This change was largely the result of noncompliant beverages no longer being sold in schools. Samuels and colleagues¹⁷ hypothesized that the higher compliance rate for beverages relative to foods may be related to easier interpretation and implementation of beverage standards relative to food standards. Of note, the Massachusetts schools in this study were able to achieve these high beverage compliance rates while implementing even stronger standards. Despite these impressive 1-year changes, there is still room for improvement, particularly for foods, and further follow-up is necessary to document the staying power for these changes.

With regard to the four additional aspects of the competitive food and beverage standards, most middle and high schools reported that free water was already available and that they eliminated the use of fryolators even before standards went into effect. The universal availability of free water during Spring 2012 was not surprising because this was a federal requirement for schools participating in the National School Lunch Program by the 2011-2012 school year.³³ We did observe increases in the sale of fruits and vegetables and the availability of nutrition information between pre- and post-implementation, but there was still room for improvement—particularly for the availability of nutrition information in high schools. Schools were not required to provide nutrition information for nonprepackaged products until Fall 2013, so it will be important to assess compliance in subsequent years, because supporting schools in providing nutrition information for non-prepackaged products may be an area where technical assistance is needed.

Compliance with competitive food and beverage standards is influenced by the individuals who make decisions about what will be available outside of the school meals programs, including FSDs, administrators, coaches, parent-teacher organizations, and students. Most of the competitive food and beverage products in the schools in this study were under the control of the FSDs. The majority of vending machines were run by either the FSD or by outside vendors. If they were run by outside vendors, they were overseen by and revenues were given to the FSD. There were a very small number of vending machines outside of the cafeteria and school stores that were run by other organizations. Securing cooperation from multiple stakeholder groups is critical when making changes that affect the entire school food environment, and this is particularly relevant for the issue of competitive foods and beverages that are available outside the cafeteria. When Massachusetts prepared for the implementation of the standards, they invited leaders from multiple stakeholder groups (eg, superintendents, principals, and school finance representatives) to a series of meetings to discuss the standards and presented on the standards at these groups' state conferences.

The primary study limitations were the participation rate and the study schools being different from the rest of the state on key demographic variables. Given these limitations, the sample may be biased toward districts that were particularly interested in improving the school food environment and caution should be taken when generalizing this study's findings to the state as a whole. A final limitation was that our study only examined competitive foods and beverages that were prepackaged products and that were not part of the school meals.

Despite these limitations, NOURISH builds on the competitive food and beverage literature in important ways.

Massachusetts standards are closely aligned with IOM recommendations and the national standards.²³⁻²⁵ There was little ongoing technical assistance to schools, yet there was evidence of promising changes to the school food environment during a 1-year period despite the potential for barriers in implementation. Also, the NOURISH study used direct observations of competitive foods and beverages to measure the primary dependent variables.

CONCLUSIONS

Future NOURISH analyses will explore the specific challenges and barriers to implementation, avenues for achieving better compliance, changes in students' consumption across 24-hour periods, and the effect of the Massachusetts standards on foodservice finances. Understanding best practices and measuring the association between the implementation of standards and changes in student diets and school food finances are important as we begin to explore the extent to which schools can implement these requirements with minimal resources and in the absence of financial incentives or penalties. Thus far, evidence suggests that a legislative requirement may reduce the availability of unhealthy foods in middle and high schools.

Future studies are important to assess how the Smart Snacks in School national standards are being implemented across the country. These studies should allow sufficient time to recruit school districts to ensure a representative sample; take steps to limit school district attrition, including oversampling; and recognize that a primary reason for declining study participation is due to FSDs' time constraints. Researchers can look at this first NOURISH study for preliminary descriptive data within one state and they can learn from this study to help design rigorous studies of competitive foods and beverages in schools.

References

1. *Foods Sold in Competition with USDA School Meal Programs: A Report to Congress*. Washington, DC: US Department of Agriculture; 2001.
2. Greves HM, Rivara FP. Report card on school snack food policies among the United States' largest school districts in 2004-2005: Room for improvement. *Int J Behav Nutr Phys Act*. 2006;3:1.
3. Brener N, O'Toole T, Kann L, Lowry R, Wechsler H. Availability of less nutritious snack foods and beverages in secondary schools—selected states, 2002-2008. *MMWR Morbid Mortal Wkly Rep*. 2009;58(early release):1-4.
4. Kann L, Grunbaum JA, McKenna ML, Wechsler H, Galuska DA. Competitive foods and beverages available for purchase in secondary schools—selected sites, United States, 2004. *MMWR Morbid Mortal Wkly Rep*. 2005;54(37):917-921.
5. Fox M, Gordon A, Nogales R, Wilson A. Availability and consumption of competitive foods in US public schools. *J Am Diet Assoc*. 2009;109(2 suppl):S57-S66.
6. Finkelstein DM, Hill EL, Whitaker RC. School food environments and policies in US public schools. *Pediatrics*. 2008;122(1):e251-259.
7. French S, Story M, Fulkerson JA, Gerlach AF. Food environment in secondary schools: À la carte, vending machines, and food policies and practices. *Am J Public Health*. 2003;93(7):1161-1167.
8. Kubik MY, Lytle LA, Hannan PJ, Perry CL, Story M. The association of the school food environment with dietary behaviors of young adolescents. *Am J Public Health*. 2003;93(7):1168-1173.
9. Cullen K, Eagan J, Baranowski T, Owens E, de Moor C. Effect of à la carte and snack bar foods at school on children's lunchtime intake of fruits and vegetables. *J Am Diet Assoc*. 2000;100(12):1482-1486.

10. Wharton CM, Long M, Schwartz MB. Changing nutrition standards in schools: The emerging impact on school revenue. *J Sch Health*. 2008;78(5):245-251.
11. Schwartz MB, Novak SA, Fiore SS. The impact of removing snacks of low nutritional value from middle schools. *Health Educ Behav*. 2009;36(6):999-1011.
12. Long MW, Luedicke J, Dorsey M, Fiore SS, Henderson KE. Impact of Connecticut legislation incentivizing elimination of unhealthy competitive foods on National School Lunch Program participation. *Am J Public Health*. 2013;103(7):e59-e66.
13. School Nutrition Association. Child nutrition programs: Legislative history highlights. <http://www.schoolnutrition.org/Content.aspx?id=2374>. Accessed July 23, 2013.
14. Han-Markey TL, Wang L, Schlotterbeck S, et al. A public school district's vending machine policy and changes over a 4-year period: Implementation of a national wellness policy. *Public Health*. 2012;126(4):335-337.
15. Cullen KW, Watson KB. The impact of the Texas public school nutrition policy on student food selection and sales in Texas. *Am J Public Health*. 2009;99(4):706-712.
16. Wojcicki JM, Heyman MB. Healthier choices and increased participation in a middle school lunch program: Effects of nutrition policy changes in San Francisco. *Am J Public Health*. 2006;96(9):1542-1547.
17. Samuels SE, Bullock SL, Woodward-Lopez G, et al. To what extent have high schools in California been able to implement state-mandated nutrition standards? *J Adolesc Health*. 2009;45(3 suppl):S38-S44.
18. Cullen KW, Watson K, Zakeri I. Improvements in middle school student dietary intake after implementation of the Texas Public School Nutrition Policy. *Am J Public Health*. 2008;98(1):111-117.
19. Cradock AL, McHugh A, Mont-Ferguson H, et al. Effect of school district policy change on consumption of sugar-sweetened beverages among high school students, Boston, Massachusetts, 2004-2006. *Prev Chronic Dis*. 2011;8(4):A74.
20. Long MW, Henderson KE, Schwartz MB. Evaluating the impact of a Connecticut program to reduce availability of unhealthy competitive food in schools. *J Sch Health*. 2010;80(10):478-486.
21. Whatley Blum JE, Beaudoin CM, O'Brien LM, Polacsek M, Harris DE, O'Rourke KA. Impact of Maine's statewide nutrition policy on high school food environments. *Prev Chronic Dis*. 2011;8(1):A19.
22. Woodward-Lopez G, Gosliner W, Samuels SE, Craypo L, Kao J, Crawford PB. Lessons learned from evaluations of California's statewide school nutrition standards. *Am J Public Health*. 2010;100(11):2137-2145.
23. *Competitive Foods and Beverages in U.S. Schools*. Atlanta, GA: Centers for Disease Control and Prevention; 2012.
24. National Research Council. *Nutrition Standards for Foods in Schools: Leading the Way Toward Healthier Youth*. Washington, DC: The National Academies Press; 2007.
25. *National School Lunch Program and School Breakfast Program: Nutrition Standards for all Foods Sold in Schools as Required by the Healthy, Hunger-Free Kids Act of 2010. 7 C.F.R. Parts 210-20*. Washington, DC: US Department of Agriculture; 2013.
26. *Healthy Students, Healthy Schools: Revised Guidance for Implementing the Massachusetts School Nutrition Standards for Competitive Foods and Beverages*. Boston, MA: Massachusetts Department of Public Health; 2012.
27. Massachusetts Department of Elementary and Secondary Education. School district profiles. <http://profiles.doe.mass.edu/>. Accessed February 27, 2015.
28. John C Stalker Institute of Food and Nutrition. JSI A-list. <http://www.johnstalkerinstitute.org/alist/>. Accessed January 9, 2015.
29. Landis J, Koch G. The measurement of observer agreement for categorical data. *Biometrics*. 1977;33(1):159-174.
30. Singer J, Willett J. *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence*. New York, NY: Oxford University Press; 2003.
31. Snelling AM, Kennard T. The impact of nutrition standards on competitive food offerings and purchasing behaviors of high school students. *J School Health*. 2009;79(11):541-546.
32. Taber DR, Chiqui JF, Powell LM, Chaloupka FJ. Banning all sugar-sweetened beverages in middle schools. *Arch Pediatr Adolesc Med*. 2012;166(3):256-262.
33. Hood NE, Turner L, Colabianchi N, Chaloupka FJ, Johnson LD. Availability of drinking water in US public school cafeterias. *J Acad Nutr Diet*. 2014;114(9):1389-1395.

AUTHOR INFORMATION

J. A. Hoffman is an associate professor, Department of Counseling and Applied Educational Psychology, and with the Institute on Urban Health Research and Practice, Bouvé College of Health Sciences, Northeastern University, Boston, MA. L. Rosenfeld is a scientist and lecturer, Institute on Urban Health Research and Practice, Bouvé College of Health Sciences, Northeastern University, Boston, MA, and the Heller School of Public Policy, Brandeis University, Waltham, MA. N. Schmidt is a research associate, Institute on Urban Health Research and Practice, Bouvé College of Health Sciences, Northeastern University, Boston, MA. J. F. W. Cohen is a research associate, Harvard School of Public Health, Harvard University, Boston, MA. M. Gorski is a doctoral student, Harvard Graduate School of Arts and Sciences, Harvard University, Cambridge, MA. R. Chaffee is a doctoral student, Department of Counseling and Applied Educational Psychology, Bouvé College of Health Sciences, Northeastern University, Boston, MA. L. Smith is an associate professor, Department of Pediatrics, Boston University School of Medicine, Boston, MA. E. B. Rimm is a professor, Harvard School of Public Health, and Channing Division of Network Medicine, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA.

Address correspondence to: Jessica A. Hoffman, PhD, Department of Counseling and Applied Educational Psychology, Northeastern University, 415 International Village, Boston, MA 02115. E-mail: j.hoffman@neu.edu

STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT

Funding for the NOURISH study was provided by Harvard Catalyst and The Robert Wood Johnson Foundation. These funding agencies had no involvement in the study design, interpretation of data, manuscript preparation, or the decision to submit the manuscript for publication. J. F. W. Cohen is supported by the Nutritional Epidemiology of Cancer Education and Career Development Program (grant no. R25 CA 098566). M. Gorski is supported by the Agency for Healthcare Research and Quality (grant no. T32HS000055). The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality.

ACKNOWLEDGEMENTS

The authors thank the participating school districts and research assistants who made this study possible.

Table 1. Comparing Massachusetts competitive food and beverage nutrition standards^a with Institute of Medicine (IOM) recommendations and the US Department of Agriculture Smart Snacks in Schools regulations

Massachusetts school nutrition standards	IOM nutrition standards	Smart Snacks in Schools standards
100% Fruit or vegetable juice		
8-oz portion limit across all grades	4-oz portion for elementary and middle schools; 8-oz portion for high school	8-oz portion limit in elementary schools; 12-oz limit in middle and high schools
Allow juice diluted with water/ carbonated water		Allow 100% juice diluted with water
Milk and milk substitutes		
Must be nonfat or low-fat	Must be nonfat or low-fat	Must nonfat or low-fat
Allows flavored nonfat milk with no more than 22 g total sugar per 8-oz portion	Allows flavored milk with no more than 22 g total sugar per 8-oz portion	Allows flavored nonfat milk
8-oz portion limit across all grades	8-oz portion limit across all grades	8-oz limit for elementary schools; 12-oz limit for middle and high schools
Sugar-sweetened beverages		
Contains no added sugar, sweeteners, or artificial sweeteners, but may contain natural flavorings and/or carbonation	Contains no added sugar, sweeteners, artificial sweeteners, nor carbonation	Allows beverages up to 40 kcal per 8 oz or 60 kcal per 12 oz in high schools
Calories		
≤200 kcal per snack item or side dish; ≤350 kcal for à la carte entrées (calorie counts include accompaniments)	≤200 kcal per food item; except à la carte entrées, which shall not exceed calories of comparable NSLP ^b entrée items	≤200 kcal per snack item or side dish; ≤350 kcal for à la carte entrées (calorie counts include accompaniments) unless they meet an exemption for NSLP/SBP entrée items
Fat and saturated fat		
≤35% of total energy from fat	≤35% of total energy from fat	≤35% of total energy from fat
<10% of total energy from saturated fat	<10% of total energy from saturated fat	<10% of total energy from saturated fat
All foods are <i>trans</i> fat-free	All foods are <i>trans</i> fat-free	All foods are <i>trans</i> fat-free
Exemptions for certain foods (seafood and 1-oz portions of nuts, seeds, nut butters, or reduced-fat cheese)		Same exemptions as in Massachusetts, but exemptions are not restricted by size
Sugar		
Total sugar must be less than or equal to 35% by weight; same exemptions as the Smart Snacks in Schools	≤35% of total energy from sugar; exemptions for 100% fruit with no added sugar; and nonfat or low-fat yogurt, including drinkable yogurt, with no more than 30 g total sugar per 8 oz package	Total sugar must be less than or equal to 35% by weight; exemptions for dried/dehydrated fruits and vegetables; dried fruit with nutritive sweeteners
Sodium		
≤200 mg sodium per item; except à la carte entrées, which shall contain ≤480 mg sodium per item	≤200 mg sodium per item; except à la carte entrées, which shall contain ≤480 mg sodium per item	≤240 mg per item (≤200 mg per item after July 1, 2016); except à la carte entrées which shall contain ≤480 mg sodium per item unless they meet the exemption for NSLP/School Breakfast program

(continued on next page)

Table 1. Comparing Massachusetts competitive food and beverage nutrition standards^a with Institute of Medicine (IOM) recommendations and the US Department of Agriculture Smart Snacks in Schools regulations (*continued*)

Massachusetts school nutrition standards	IOM nutrition standards	Smart Snacks in Schools standards
Grains		
Contain $\geq 50\%$ whole grains by weight or have the first ingredient as a whole grain	All breads and other grain-based products should be whole grain	Contain $\geq 50\%$ whole grains by weight or have the first ingredient as a whole grain
Additional guidelines		
No food/beverage shall contain artificial sweeteners	Artificial sweeteners allowed in beverages sold after school in high schools	No ban on artificial sweeteners
No food/beverage shall contain more than trace amounts of caffeine	No food/beverage shall contain more than trace amounts of caffeine	Caffeine allowed in beverages sold in high schools
A packaged item may be no more than one serving per package	Not addressed	No limit on servings per package, but the standards apply to the entire package
Make water available to all students during the day without charge	Make water available to all students during the day without charge	Make water available to all students during the day without charge
Offer for sale fresh fruits and nonfried vegetables at any location where food is sold, except in nonrefrigerated vending machines and vending machines offering only beverages	Not addressed	Not addressed
The use of fryolators is prohibited for competitive foods	Not addressed	Not addressed
By August 1, 2013, nutrition information available to students for non-prepackaged competitive foods and beverages served in the cafeteria (does not apply to fresh fruit or vegetables)	Not addressed	Not addressed
Fundraisers are exempted	If food is used for fundraising, only those products that meet IOM recommendations should be sold during the school day	Fundraisers are exempted but exempted products may not be sold in the cafeteria during school meals

^aThis table includes changes to the Massachusetts standards that went into effect December 5, 2014. The changes were made to incorporate some elements of the US Department of Agriculture Smart Snacks in School standards.

^bNSLP=National School Lunch Program/School Breakfast Program.