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State-level school competitive food and beverage laws are associated with children's weight status

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Human Subjects Approval Statement

This study was exempted from research ethics board approval at the National Institutes of Health because it used only publicly available documents.

Abstract

BACKGROUND—This study attempted to determine whether state laws regulating low nutrient, high energy-dense foods and beverages sold outside of the reimbursable school meals program (referred to as ‘competitive foods’) are associated with children’s weight status.

METHODS—We use the Classification of Laws Associated with School Students (CLASS) database of state codified law(s) relevant to school nutrition. States were classified as having strong, weak, or no competitive food laws in 2005 based on strength and comprehensiveness. Parent-reported height and weight along with demographic, behavioral, family, and household characteristics were obtained from the 2007 National Survey of Children’s Health. Bivariate and logistic regression analyses estimated the association between states’ competitive food laws and children’s overweight and obesity status (BMI-for-age 85th percentile). Children (n=16271) between the ages of 11–14 years with a BMI for age 5th percentile who attended public school were included.

RESULTS—Children living in states with weak competitive food laws for middle schools had over a 20% higher odds of being overweight or obese than children living in states with either no or strong school competitive food laws.

CONCLUSION—State-level school competitive food and beverage laws merit attention with efforts to address the childhood obesity epidemic. Attention to the specificity and requirements of these laws should also be considered.

Keywords

policy; legislation; child and adolescent health; nutrition & diet

Recent estimates report that over one-third of children between the ages of 6- to 19-years old are now overweight or obese.¹ This trend is alarming given the short- and long-term health impact of obesity. Obese youth are more likely to experience metabolic risk factors, asthma, and dental health issues as well as internalizing and externalizing disorders, attention-deficit hyperactivity disorder, and sleep problems.² Studies have also shown that the impact of childhood obesity is witnessed throughout the lifespan and increases the risk of all-cause mortality in adulthood.³ This makes preventing obesity among youth a national public health priority.

Recent attention has been placed on the role of state law governing school competitive foods as a means of addressing the childhood obesity epidemic.^{4–6} Competitive foods, defined as all foods and beverages sold or served outside of the reimbursable federal school meal program (FSMP),^{7,8} have been shown to contribute excess fat and calories to children’s diets.^{9–11} Emerging evidence suggests a link between strong competitive food policies, children’s diets, and healthy weight status^{12,13} however, not all studies have had consistent findings.^{14,15} More research is needed to understand whether competitive food policies influence youth behavior and health outcomes. This evidence could, in turn, help guide state policymakers, school administrators, and public health advocates on what aspects of school health policy require the most attention.

The majority of this literature has focused predominantly on within-state analyses or used self-reported policy data.^{16–20} Riis et al²¹ examined the relationship between children's weight status and state policies governing school nutrition and physical education. They found no relationship between laws governing middle or high school competitive foods and beverages and children's weight status, and limited evidence for elementary school. However, these findings should take into account several methodological decisions.

First, the Riis et al²¹ study categorizes states as having a strong policy for all states that require standards for competitive foods regardless of whether such standards are undefined or specified. However, prior work has empirically demonstrated that it may be more appropriate to categorize states as having a strong policy in cases where the policy is both required and standards are defined.^{12,13, 22} Second, the methods allowed for inclusion of school students from private schools. In the United States, nearly all public schools participate in the FSMP and are therefore required to follow federal and state policy governing this program.²³ In contrast, fewer private schools participate in the FSMP. Schools that do not participate would be exempt from such standards. For this reason, other investigations have excluded students attending private schools.¹² Lastly, the analysis examined competitive food and beverage laws for each location (*ala carte*, vending, or other venue) separately rather than as a composite score. A composite score provides a more comprehensive evaluation of the competitive food and beverage environment that children are exposed to within the school setting. Current knowledge remains limited in evaluating enacted state laws for competitive foods in a state- and nationally-representative sample.

This study refines and extends the work of Riis et al²¹ by focusing on public middle schools only, using a comprehensive measure of competitive food and beverage laws, and adopting a more rigorous definition of policy strength. The purpose of this analysis is to determine if public middle school students living in states with strong competitive food and beverage laws had a significantly lower weight status as compared to students living in states with no or weak school competitive food and beverage laws using a nationally and state-representative sample. The focus on laws governing middle schools only is based on the prevalence of competitive foods and beverages in public middle schools, the declining strength of laws governing these competitive foods as children progress from elementary to middle to high school, and the high rates of obesity among this age (11–14 years) group.^{1, 24}

METHODS

Participants

Data were extracted from the 2007 National Survey of Children's Health (NSCH). NSCH examined the physical and emotional health of children aged 0–17 years. NSCH sample was selected to represent the population of non-institutionalized children nationally, and in each state. In each household, one child was randomly selected to be the subject of the interview, and the survey respondent was the parent or guardian who knew most about the child's health status.²⁵ Data were collected via telephone survey from April 2007 to July 2008 with 91,642 interviews completed (47% national response rate; state response rates ranged from 40–62%). Details of the NSCH study have been previously described and more information can be found at <http://www.childhealthdata.org/learn/NSCH>.²⁶

Instruments

The National Cancer Institute's Classification of Laws Associated with School Students (CLASS) database was used to evaluate the stringency of codified school nutrition laws for each of the 50 states and the District of Columbia. Codified laws are the compilation of written statutes, rules, orders, and regulations that govern the nutrient content of foods and beverages sold in schools. CLASS uses independent document review to empirically score codified school nutrition laws against national standards. Competitive food laws were scored in relation to the Institute of Medicine standards.²⁷ Details on CLASS's development, reliability, validity, and procedures for extracting and rating the codified law have been previously described.^{28,29} The 2005 data (laws effective as of December 31, 2005) were used in this analysis to allow for lag-time between the effective date of the codified laws and possible implementation.

Procedure

The dependent variable of interest was overweight and obesity weight status defined as BMI-for-age 85th percentile.^{30,31} This variable is computed by the NSCH based on parent-reported child height and weight. NSCH suppresses data for extreme height and weight values to protect the confidentiality of individual children. Suppressing this data hinders end-user calculations of BMI as a continuous variable, thus NSCH computes a 4-category weight status variable and provides this information in the publically available dataset. Children who had missing data for weight status or were underweight were excluded. Inclusion criteria included children aged 11–14 years attending public schools yielding a sample size of 16,271.

The main independent variable of interest was a composite score of competitive food and beverage laws for middle schools. The composite score used the procedures described by Tabor et al and is briefly described as follows.^{12,13} First, we calculated the average CLASS score at three locations: vending machines, cafeterias-à la carte, and other venues for both competitive foods and competitive beverages, yielding an average of six competitive food and beverage laws.¹² Average scores could range from 0 to 6, where 0 and 1 signified no law or recommendation, 2 equated to a nonspecific requirement, 3 to 5 reflect stronger laws approaching the IOM standard for competitive foods and beverages sold in schools, and 6 represents fully meeting the IOM standard (Table 1). Because all but two states applied the same laws across locations-law governing the nutrition content of foods and beverages sold through vending machines, cafeteria *a la carte* lines, and other venues-the average of the 6 ratings was used as a comprehensive measure.¹² Second, states were classified into one of 3 categories based on their average score. States were classified with “strong” laws if their average score was >2; “weak” laws if their average score was between 0–2; and “no” law if the composite score was 0. Weak laws were distinguished by those containing language such as ‘recommend’ nutrition standards or make reference to a nutritional requirement but lack specific standards, whereas strong laws contain specific nutritional requirements or fully meet IOM standards. This scoring approach has also been validated in other analyses.¹²

Demographic, behavioral and family/home characteristics were included as covariates: age, sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and other), presence of a television in the child's bedroom, physical activity (days of vigorous physical activity per week), sleep (nights child gets adequate sleep in the past week), family meals (days per week the family eats dinner together), parent's age, family structure (2-parent family or single mother/other), and household poverty status measured as a ratio of family income to poverty threshold (<100%, 100–199%, 200–299%, 400%). Percentage <100% reflects income below the established poverty line. These categories were based on Department of Health and Human Standards guidelines, are compatible with income eligibility requirements for State Children's Health Insurance Program, and are computed directly by the NSCH.²⁶

Data Analysis

This cross-sectional analysis merged data from CLASS 2005 and NSCH 2007 based on state identification number. To account for the complex sample design of the NSCH and clustering of data by state, SUDAAN 10.0.1 (RTI International, Research Triangle Park, NC) was used to conduct all bivariate and multivariate logistic analyses. This allowed us to test the hypothesis that there is an association between state-level school competitive food and beverage laws and child weight status while controlling for known covariates and clustering by state. First, weight status was regressed on demographic factors and competitive food/beverage law (Model 1). Second, weight status was regressed on demographic factors, competitive food/beverage law, and behavioral and family characteristics (Model 2). All analyses were weighted to estimate population-level parameters. To ensure adequate power, weight status was modeled using logistic regression by combining the overweight and obese categories and comparing the overweight/obese group against a healthy weight status.

RESULTS

Most children lived in states that did not have middle school competitive food and beverage laws in 2005 (Table 2). There were 31 states without a codified state law regulating middle school competitive food and beverages, 11 states that had weak laws, and 9 states that had strong laws (data not shown). In bivariate analyses, child overweight/obesity was associated with all individual-level characteristics except sleep and family meals (Table 2).

Overweight/obese children were more likely to be younger, male, non-Hispanic black or Hispanic, have a TV in their bedroom, be less vigorously active, not come from a 2-parent family, have younger parents, and live in a poor household. State-level competitive food and beverage laws were not significantly associated with child weight status in the unadjusted bivariate comparisons. Table 3 illustrates that in both models, state laws were significantly associated with child weight status when controlling for covariates. Children living in states with weak competitive food and beverage laws had a 21% or 23%, higher odds of being overweight or obese compared with children living in states with either no law (Table 3) or strong laws (data not shown).

DISCUSSION

This study assessed the relationship between codified school competitive food and beverage state laws and adolescent's weight status in a state- and nationally-representative sample of children aged 11–14 across the US. There are 2 important findings. First, this study found partial support for the hypothesis that state laws would be associated with children's weight status even after controlling for known covariates. Second, only weak laws were associated with children's unhealthy weight status. A possible reason for this pattern of relationships during this period in history may be attributable to state policymakers responding to their state's obesity epidemic by passing laws relative to the school nutrition-environment, but those laws only recommended or contained non-specific standards. It may be that more stringent, comprehensive laws, such as those that prohibit or restrict competitive foods and beverages are needed to combat the childhood obesity epidemic.³²

Support for this hypothesis was demonstrated by Kubik et al³³ who found that middle schools that required prohibiting junk food in vending machines and school stores offered less junk food than middle schools that recommended prohibiting junk food. However, this does not explain why strong laws were not associated with children's weight status. The lack of association may be due in part to: (1) a smaller sample size for states with strong laws (N=9 vs. N=11 and N=31 for weak and no laws, respectively); (2) stronger laws may take longer or greater resources to implement; or (3) a greater lag time required for laws to have an impact on children's weight status, particularly if laws were enacted in states responding to relatively high child obesity rates. Among strong law states during the 2005–07 period, approximately half had childhood obesity rates in the upper quartile and 2 of these states actually weakened their competitive food/beverage laws, which did not occur for other states. These factors may have mitigated the association between strong law and children's weight status in these states. The findings of this study also extend what has been shown by others. For instance, research by Nanney et al³⁴ found a positive association ($r = .35$, $p = .01$) between the food and nutrition policies adopted by states and the prevalence of youth obesity as well as the study by Riis et al²¹ suggesting that states were responding to obesity rates by enacting school nutrition laws.

The findings in this study might also be reflective of the fact that mobilization for enacting more stringent school nutrition policies has rapidly increased since the 2004 Child Nutrition Reauthorization Act, which required schools to adapt local wellness policies no later than the first day of the school year beginning after June 30, 2006.³⁵ This study examines policies that were enacted by December 31, 2005 and there was very little change in state-level school competitive food policy from the 2003–2005 period. However, many more states passed policies governing this school nutrition domain since 2006.²⁹ Follow-up studies using new cycles of NSCH data may help to provide more insight into how school competitive food policies influence child weight status over time.

Future Research Directions

Policy research related to nutrition, physical activity, and obesity is growing. Much more information is needed to understand how aspects of particular policies such as strength, specificity of the law, implementation, etc, may or may not influence children's behavioral

or health outcomes. Additionally, attention should be placed as to whether certain policies may have differential effects for certain subpopulations (eg children of lower socioeconomic status or racial/ethnic minority groups) and possible unintended consequences. Longitudinal studies are needed to determine if more stringent state laws are reducing rates of adolescent overweight and obesity over time, especially since the enactment of the school wellness policy mandate in 2006.¹² Longitudinal studies address the question as to whether states are responding to their obesity epidemic by passing laws or if the laws are having the intended effect desired. This study highlights a rich data resource for evaluating state-level school nutrition policies (CLASS). CLASS can be linked to extant data resources to evaluate the relationship between policies and behavioral or health outcomes, and to practice-based outcomes. For instance, Perna et al²² evaluated state-level physical education policies and school practices using CLASS physical education data and the School Health Policies and Programs Study. A similar approach could be used for evaluating nutrition policy and practice by linking CLASS with the School Nutrition Dietary Assessment Study, which provides additional information on food service practices and trends.

Limitations

This study has several notable strengths that include the use of codified law that has been compared against relevant national standards, linking this data to individual-level data that is representative at the state and national levels, as well as the ability to control for known individual-level covariates. However, findings of this study should be interpreted within the context of study limitations. This is a cross-sectional analysis so causality cannot be inferred. Also, height and weight were not directly measured, and the NSCH data limits analyses to examining weight status categories only. Additionally, this study evaluates state-level policy. Local policy, such as district-level policies may supersede state law if more stringent, and district-level data may also provide insight regarding implementation of school nutrition policy. However, this study does provide a base for understanding the complicated state-level school nutrition policy environment, sets and important benchmark for research in this area, and raises important issues that warrant further attention.

IMPLICATIONS FOR SCHOOL HEALTH

It is important for school health personnel to understand the role of state level policy and policy implementation as potential mechanisms to influence student's nutrition-related behaviors and health outcomes. School personnel should be aware that not all state-level policies are created equal. This study suggests that required state school competitive food and beverage laws may play an important role in shaping student health. States that have not yet adopted this type of nutrition policy or those that have passed weak, non-specific laws should consider strengthening their state policy. Additionally, national standards exist that can serve as a benchmark for framing specific policies. School health personnel can help to support the adoption of strong state school nutrition policies and work to implement these policies as intended. The CLASS resource (class.cancer.gov) is designed not just for research purposes, but for practitioners, the general public, and organizations interested in school health as well. School health personnel can use this resource to understand their state's school nutrition and physical education policy and compare their state policies

against the national median score for each policy area, against other states, and compare across grade-levels within their own state. These tools are easy to use and school health personnel can download state-specific profiles and maps for educational presentations as well as advocacy purposes. More evaluation work is also needed to understand the time lag between policy adoption, implementation, and achieving short- and long-term outcomes since these outcomes may differ by level (eg, organizational/practice level changes may be witnessed before changes in individual-level behavior and relevant health outcomes).

Conclusion

This study provides some support that enacting required state school competitive food and beverage laws may be one important component of a multi-faceted strategy for addressing the childhood obesity epidemic. Additional consideration and attention should be given to the degree of specificity and strength of competitive food and beverage laws as this may be relevant to the effectiveness of the law on children's health outcomes.

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Table 1

An Example of the CLASS Scoring Protocol for State Laws Governing the Sale or Service of *a la Carte* Food Outside of the Reimbursable School Meals Program

Policy Strength	CLASS Score	Description
Strong Law	6	State prohibits the sale or service of <i>a la carte</i> (individual, non-entrée) food outside the reimbursable school meal programs, during the service of meals in the cafeteria, <u>or</u> allows only the following exceptions: Non-entrée food items limited to: <ul style="list-style-type: none"> Non-fried fruit (fresh or packed in juice or water), and vegetables, whole grain products, non-fat and low fat dairy products (nonfat or 1% only, flavored or non-flavored) that are 200 calories or less per serving <u>and</u> No more than 35% of total calories from fat (with the exception of nut/seed products) <u>and</u> Less than 10% calories from saturated fat <u>and</u> Zero trans fat <u>and</u> 35% or less by weight of total sugars or 35% or less of calories from total sugars (does not apply to dairy or fruit products) <u>and</u> Sodium content 200 mg or less
	5	State allows the sale or service of only the following <i>a la carte</i> (individual, non-entrée) food outside the reimbursable school meal programs, during the service of meals in the cafeteria: Non-entrée food items limited to: <ul style="list-style-type: none"> 200 calories or less per serving <u>and</u> No more than 35% of total calories from fat (with the exception of nut/seed products) Less than 10% calories from saturated fat <u>and</u> Zero trans fat <u>and</u> 35% or less by weight of total sugars or 35% or less of calories from total sugars (does not apply to dairy or fruit products) <u>and</u> Sodium content 200 mg or less
	4	State mandates nutrition standards of <i>a la carte</i> (individual, non-entrée) food meet or exceed federal dietary guidelines, with specified limits on calories, or fats (saturated and trans), or total or added sugar, or sodium.
	3	State restricts sale/service of <i>a la carte</i> food of low nutritive value beyond federal requirements for FMNV, but without establishing nutrition standards that meet or exceed federal dietary guidelines
Weak Law	2	State requirement for <i>a la carte</i> food sold or served in cafeterias outside the school meal program is undefined (eg, "healthy" foods and beverages must be available); or state requires a state agency to develop and adopt nutrition standards applicable to <i>a la carte</i> sales/service.
	1	State recommends nutrition standards for <i>a la carte</i> items.
No Law	0	No provision

Note. The *a la carte* in cafeterias snacks score reflects the degree to which state law addresses the amount of cafeteria snacks with respect to the IOM recommended standard at the ES, MS, and HS grade level. Adapted from class.cancer.gov.

Table 2

Descriptive Demographic, Behavioral, and Household Characteristics of Public United States School-Children Aged 11–14 Years By Weight Status (N = 16271)

Characteristic	Healthy weight ^a (N = 10,750)	Overweight/Obese ^a (N = 5521)	p-value
<i>State-level</i>			
Competitive Food/Beverage Composite Score, %			
No Law	49.3	48.3	.31
Weak Law	22.3	23.4	
Strong Law	28.4	28.2	
<i>Individual-level</i>			
<i>Demographic characteristics</i>			
Age (years), mean (SE)	12.7 (0.03)	12.5 (0.04)	< .001
Female sex, %	53.2	46.1	< .001
Race/ethnicity, %			
White, non-Hispanic	63.6	46.7	< .001
Black, non-Hispanic	13.6	21.1	
Hispanic	14.9	25.1	
Other, non-Hispanic	8.0	7.2	
<i>Behavioral characteristics</i>			
TV in bedroom ^b , % Yes	50.0	63.5	< .001
Adequate sleep			.65
(nights/week) ^c , mean (SE)	6.0 (0.04)	6.0 (0.05)	
Physical activity			< .001
(days/week) ^d , mean (SE)	4.5 (0.06)	4.0 (0.08)	
<i>Family and Household characteristics</i>			
Family meals (days/week) ^e , mean (SE)	4.9 (0.05)	5.0 (0.08)	.17
Parent's age (years), mean (SE)	41.5 (0.16)	40.3 (0.22)	< .001
Marital status (married), %	72.3	63.0	< .001
Family structure (two parent), %	74.3	65.3	< .001
Poverty level, % Federal Poverty Level			
0–99	12.7	22.3	< .001
100–199	19.0	24.9	
200–399	33.9	34.8	
400	34.4	17.9	

^a Healthy weight defined as BMI ≥ 5th percentile and BMI < 85th percentile; Overweight and obese defined as BMI ≥ 85th percentile)

^b Is there a television in [S.C.]'s bedroom?

^c During the past week, on how many nights did [S.C.] get enough sleep for a child (his/her) age?

^d During the past week, on how many days did [S.C.] exercise, play a sport, or participate in physical activity for at least 20 minutes that made [him/her] sweat and breathe hard?

^e During the past week, on how many days did all the family members who live in the household eat a meal together?

Table 3

Multivariate Logistical Regression Analyses Predicting US Child (11–14 Years) Overweight/Obesity Status According to State-Level School Competitive Food and Beverage Laws and Select Demographic, Behavioral, and Household Characteristics

Covariate	Adjusted OR (95% CI), BMI 85th Percentile	
	Age, Sex, Race/ethnicity Adjusted (N = 16034)	All-Covariate Adjusted (N = 14298)
<i>State-level</i>		
Competitive Food Composite Score		
No law	1.00 [Reference]	1.00 [Reference]
Weak law	1.21 (1.04, 1.40)**	1.23 (1.05, 1.44)**
Strong law	0.94 (0.74, 1.19)	1.01 (0.798, 1.30)
<i>Individual-level</i>		
<i>Demographic characteristics</i>		
Age, y	0.81 (0.75, 0.87)***	0.80 (0.73, 0.86)***
Sex		
Male	1.00 [Reference]	1.00 [Reference]
Female	0.74 (0.62, 0.87)***	0.70 (0.59, 0.84)***
Race/ethnicity		
White, non-Hispanic	1.00 [Reference]	1.00 [Reference]
Black, non-Hispanic	2.15 (1.77, 2.62)***	1.58 (1.25, 2.01)***
Hispanic	2.53 (1.92, 3.33)***	1.97 (1.45, 2.70)***
Other	1.23 (0.92, 1.65)	1.11 (0.82, 1.51)
<i>Behavioral characteristics</i>		
TV in bedroom		
Yes		1.45 (1.21, 1.74)***
No		1.00 [Reference]
Sleep, nights/wk		0.96 (0.91, 1.02)
Physical activity, d/wk		0.91 (0.88, 0.95)***
<i>Family and Household characteristics</i>		
Family meals, d/wk		1.04 (0.99, 1.09)
Parent's age, y		0.99 (0.98, 1.01)
Family structure		
Two parent		0.84 (0.66, 1.06)
Single mother/Other		1.00 [Reference]
Poverty status, %FPL		
<100		2.11 (1.55, 2.86)***
100–199		1.74 (1.33, 2.26)***
200–399		1.73 (1.41, 2.13)***
>400		1.00 [Reference]

OR = odds ratio; CI = confidence interval; FPL = Federal Poverty Level; Adjusted Wald F test: *p < .05,

**
p < .01,

p < .001