ARTICLE

Differences in Nutrient Intake Associated With State Laws Regarding Fat, Sugar, and Caloric Content of Competitive Foods

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Objective: To determine whether nutrient intake is healthier among high school students in California, which regulates the nutrition content of competitive foods sold in high schools, than among students in states with no such standards.

Design: Cross-sectional study.

Setting: California and 14 states without high school competitive food nutrition standards in the 2009-2010 school year.

Participants: A total of 680 high school students sampled in February through May 2010 as part of the National Youth Physical Activity and Nutrition Study.

Interventions: State laws governing fat, sugar, and caloric content of competitive foods sold in vending machines, school stores, and cafeterias (à la carte).

Main Outcome Measures: Several measures of nutrient intake assessed by 24-hour recall, overall and stratified by location of consumption (school, home, other).

Results: On average, California students reported consuming less fat, sugar, and total calories at school than students in states with no competitive food nutrition standards. California students also reported less at-school intake of vitamins and minerals. All at-school differences in nutrient intake were null after adjusting for total caloric intake; California students consumed a lower proportion of their daily calories in school (21.5%) than students in other states (28.4%). Mean overall intake was lower in California for most measures that were analyzed, particularly added sugars.

Conclusions: California high school students consumed lower quantities of fat, sugar, and calories in school than students in states with no competitive food nutrition standards, but the nutrition composition of California students' in-school diet was similar. Policy initiatives should promote competitive foods that are consistent with the Dietary Guidelines for Americans.

Arch Pediatr Adolesc Med. 2012;166(5):452-458

SEVERAL STUDIES HAVE DEMONstrated the poor nutrition content of foods and beverages sold in schools in the United States.[1-6] Federally reimbursable school meals must abide by nutrition standards set by the US Department of Agriculture, but individual foods and beverages sold in vending machines, school stores, and cafeterias (à la carte) have historically been exempt from federal regulation except for restrictions on the sale of foods of minimal nutrition value.[7-9] Foods of minimal nutrition value include only a small number of specific items such as hard candies, gum, and soda. Competitive foods are commonly foods of high caloric density and low nutrient density,[2,5] and school food environments tend to become progressively less healthy at higher grade levels.[1,5] In 2007-2008, 77% of high schools nationwide offered regular-fat and sugar snacks in competitive venues.[3]

Policy initiatives designed to regulate nutrition content of competitive foods are increasingly being promoted at the federal, state, and local levels.[10-14] The Healthy,

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Hunger-Free Kids Act of 2010 requires, among several provisions, that the US Department of Agriculture develop regulations specifying nutrition standards for all competitive foods sold in schools that participate in federally reimbursable school meal programs.[11] This will be the first attempt to regulate competitive food nutrition content on a national scale, although some states have already taken legislative and/or regulatory action to implement similar standards.[12-14] As imple-

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mentation of the Healthy, Hunger-Free Kids Act of 2010 begins, policy makers can benefit from research on existing state regulations to identify areas where standards have been successful as well as potential pitfalls.

California was one of the first states to regulate competitive food nutrition content.[7] State Senate Bill 12, effective July 2007, required several nutrition standards for competitive foods at all grade levels, including limiting the number of calories and the fat, saturated fat, and sugar content of snacks sold in schools.[15] State Senate Bill 965 banned the sale of soda and other sweetened beverages in high schools and was scheduled to be fully implemented by July 2009.[15] Several studies have documented California's success in improving the nutrition content of competitive foods since the laws went into effect.[16-18] Woodward-Lopez et al[18] collected several measures of food and beverage availability in California schools and student intake of select food items and reported several improvements following implementation of State Senate Bill 12. They were cautiously optimistic, though, as they found that many compliant foods and beverages had limited nutrition value and that at-school intake of vegetables declined following the legislation. Without using another state as a control, it is also difficult to determine whether the positive changes in California were attributable to legislation or reflected secular trends taking place nationwide.

This study was designed to complement existing research on California's competitive food laws by comparing nutrient intake among high school students in California vs states that do not regulate competitive food nutrition content, using 24-hour recall data. In addition to analyzing several measures of overall intake, we compared intake in different locations outside school to assess whether California students compensate for school changes by consuming more elsewhere.

METHODS

POLICY DATA

State laws regarding the nutrition content of competitive foods sold in high schools for the 2009-2010 school year were compiled as part of the Bridging the Gap research program.[19] State laws were compiled from the subscription-based Westlaw and Lexis-Nexis legal research databases through primary legal research methods.[20,21] *Laws* were defined to include codified state statutory and administrative (ie, regulatory) laws effective as of September 2009. Analyses in this study are based on 9 different provisions—laws regarding 3 specific types of nutrition content (fat, sugar, total calories) for foods in each of 3 settings (vending machines, school stores, cafeteria [à la carte]).

Each state's law was 100% double-coded by 2 trained coders and verified against secondary sources to ensure complete collection and coding interpretation.[22-25] Laws were coded using an adaptation of a reliable and valid coding tool originally created to evaluate district-level policies and further modified to specifically evaluate nutrition content standards for each location of sale.[13,26] Individual provisions were categorized as strong if they were required, specified an implementation plan or strategy, and included language such as shall, must, and enforce. Laws were classified as weak if they were suggested or recommended and included language such as should, might, and try. California was classified as strong for all 9 provisions included in this study. At the high school level, California's law required that snacks contain no more than 35% of total calories from fat, no more than 10% of total calories from saturated fat, no more than 35% of its total weight from naturally occurring and added sugars, and no more than 250 calories per item and that competitive food entrée items contain no more than 400 calories and no more than 4 g of fat per 100 calories.[27]

STUDENT DATA

Student data on nutrient intake were obtained from the National Youth Physical Activity and Nutrition Study (NYPANS), conducted by the Centers for Disease Control and Prevention.[28] The NYPANS included a written survey of diet and physical activity behaviors administered to a nationally representative sample of 9th- through 12th-grade students as well as a telephone interview with a subsample of students to collect detailed information on nutrient intake using 24-hour recall. Among the 168 schools sampled as part of the NYPANS, 138 agreed to participate in the written survey component. Each school was invited to participate in the 24-hour recall component, and 60 volunteered to do so. Among the 1416 students in these schools who were eligible for the 24-hour recall, 1229 provided contact information for the telephone interview. Interviews were conducted in February through May 2010.

As part of the 24-hour recall, students provided detailed data on food intake and location of consumption for the day prior to the interview. Students participated in up to 3 recalls, but for the sake of consistency we used only the first weekday 24-hour recall for each student, unless otherwise noted. Nutrient intake data were compiled using Nutrition Data System for Research software (Nutrition Coordinating Center, University of Minnesota). In addition to calculating overall daily intake, we stratified the calculations by location of consumption—school, home, and other (eg, restaurants).

Twenty states were represented in the 24-hour recall sample. Our study sample was restricted to students in California (n=114) and 14 states with no laws for the majority of the 9 domains listed earlier (n=566; within-state median sample size=44.5). We specifically focused on these states to make results more interpretable and to improve the internal validity of our analyses. Four states that had a mixture of strong, weak, and no relevant laws were excluded because they would create a very heterogeneous comparison group that would be difficult to characterize. One state other than California had strong provisions across domains, but it was excluded because it had a small sample of students who completed a 24-hour recall (n=12). Combining the other state with California would overstate the geographic scope of our treatment group and potentially bias results.

STATISTICAL ANALYSIS

General linear models were used to estimate differences in average dietary intake between students in California and states that did not have laws regarding the nutrition content of competitive foods. First, we estimated differences in the following: (1) total caloric intake, overall and stratified by location of consumption; (2) proportions of total calories consumed in the forms of protein, carbohydrates, and different types of fat (saturated, monounsaturated, polyunsaturated); and (3) total intake of macronutrients and micronutrients (sugars, fiber, and several vitamins and minerals). We then estimated differences in macronutrient and micronutrient intake, stratified by location of consumption, and repeated each analysis with and without adjustment for total caloric intake. Each analysis adjusted for race/ethnicity, age, sex, and where students obtained their

Table 1. Descriptive Statistics of the Study Sample

Characteristic	California	States With No Laws[a]
Student level		
Students, No.	114	566
Age, mean, y	15.0	15.2
Female, %	55.8	51.2
Race/ethnicity, %		
Non-Hispanic white	11.7	43.5
Non-Hispanic black	1.0	33.8
Hispanic	76.6	14.7
Non-Hispanic other	10.8	8.1
Census region, %		
Northeast	0.0	8.3
Midwest	0.0	29.2
South	0.0	54.4
West	100.0	8.1
State level		
States, No.	1	14
Sample size, No.		
Mean	NA	40.4
Median (range)	NA	43.5 (6-67)

Abbreviation: NA, not applicable.
[a] States with no laws regarding fat, sugar, or caloric content of competitive foods.

lunch on school days (school, home, other, none). We explored controlling for school-level clustering but determined that within-school correlation of nutrient intake was low and that controlling for it could bias the estimates.

The California sample had a substantially higher proportion of Hispanic students than other states. We repeated the analyses in Hispanic students only to determine whether nutrient intake was more favorable in California, specifically among this population that tends to have higher prevalence of youth obesity, particularly among boys.[29,30]

As a supplementary analysis, we modeled within-student differences between weekday and weekend intake, stratified by location of consumption, in the overall sample. The purpose was to explore whether students in California compensated for changes to their school environment by consuming more at home or other locations during the school week, relative to students in states that did not govern competitive food nutrition content. A fixed-effect model was used to estimate within-student differences between weekday and weekend consumption at home and in locations outside school and home and to compare these differences between California and other states. Each student's weekend intake effectively served as his or her own control and enabled us to adjust for unmeasured characteristics such as socioeconomic status. This analysis was restricted to students who completed one 24-hour recall for both a weekday and a weekend day (n=515).

This study was approved by the institutional review board of the University of Illinois at Chicago. All statistical analyses were conducted with Stata version 11 statistical software (StataCorp LP).

RESULTS

Descriptive statistics of the study sample can be found in **Table 1**. As described earlier, the California sample had a greater proportion of Hispanic students (76.6%) than other states included in the sample (14.7%). The sex and age distributions were approximately equal between the 2 groups. All census regions were represented in the sample of states with no competitive food nutrition standards, although the sample contained a relatively high proportion of students from the South (54.4%).

Table 2. Adjusted Mean Weekday Intake Among 114 Students in California and 566 Students in States With No Laws Regarding Fat, Sugar, or Caloric Content of Competitive Foods

Outcome	Adjusted Mean[a] California	Adjusted Mean[a] No Laws[b]	Difference, β (95% CI)
Caloric intake			
Overall	1629.6	1787.3	−157.8 (−371.0 to 55.5)
By location			
School	350.9	520.9	−170.0 (−288.8 to −51.2)
Home	947.2	1014.6	−67.4 (−253.7 to 118.9)
Other	331.5	251.8	79.7 (−57.4 to 216.7)
Caloric distribution overall, %			
Protein	15.2	15.6	−0.4 (−1.8 to 1.0)
Carbohydrates	52.9	51.7	1.3 (−1.6 to 4.1)
Fat	31.8	32.6	−0.8 (−3.0 to 1.4)
Total intake overall			
Protein, g	62.8	67.3	−4.4 (−14.1 to 5.2)
Carbohydrate, g			
Sugars			
Total	96.5	114.4	−17.9 (−36.1 to 0.4)
Added	65.8	83.3	−17.5 (−34.3 to −0.8)
Fiber	11.2	11.4	−0.2 (−2.0 to 1.6)
Fat			
Total, g	60.9	67.1	−6.2 (−15.6 to 3.3)
Saturated, g	21.9	23.5	−1.5 (−5.3 to 2.2)
Trans, g	2.9	3.2	−0.3 (−0.9 to 0.4)
Monounsaturated, g	21.1	23.8	−2.8 (−6.2 to 0.6)
Polyunsaturated, g	12.8	14.3	−1.5 (−4.1 to 1.0)
PFA:SFA ratio	0.7	0.7	0.0 (−0.2 to 0.1)
Cholesterol, mg	183.6	197.9	−14.3 (−56.1 to 27.5)
Vitamin			
A, IU	2539.9	3465.2	−925.3 (−2083.4 to 232.8)
B_6, mg	1.4	1.6	−0.2 (−0.4 to 0.1)
B_{12}, μg	4.3	4.4	−0.1 (−1.4 to 1.2)
C, mg	66.5	77.0	−10.5 (−32.8 to 11.8)
Mineral, mg			
Sodium	2843.7	2962.2	−118.6 (−549.3 to 312.2)
Calcium	814.0	812.9	1.1 (−146.2 to 148.4)
Potassium	1748.3	1870.6	−122.3 (−386.6 to 142.0)
Iron	13.4	13.2	0.2 (−2.1 to 2.5)

Abbreviations: PFA, polyunsaturated fatty acids; SFA, saturated fatty acids.
[a] Adjusted for age, sex, race/ethnicity, and where students obtained their lunch.
[b] States with no laws regarding fat, sugar, or caloric content of competitive foods.

Adjusted differences in mean intake between California and states with no competitive food nutrition standards are displayed in **Table 2**. California students consumed a mean of 157.8 fewer calories (95% CI, −371.0 to 55.5), with the difference coming largely from at-school intake (β=−170.0; 95% CI, −288.8 to −51.2). Overall, California students consumed less of almost every nutrient that we examined. When taking both effect size and precision into account, the strongest evidence of lower intake among California students was found when analyzing total sugars (β=−17.9; 95% CI, −36.1 to 0.4) and added sugars (β=−17.5; 95% CI, −34.3 to −0.8).

Table 3. Differences in Mean Weekday Intake by Location of Consumption Between 114 Students in California and 566 Students in States With No Laws Regarding Fat, Sugar, or Caloric Content of Competitive Foods, With and Without Adjustment for Total Caloric Intake

	Difference (SE)			
	School		Outside School/Home[a]	
Outcome	Unadjusted[b]	Adjusted	Unadjusted[b]	Adjusted
Carbohydrate, g				
Sugars				
Total	−12.5 (4.3)[c]	−3.0 (2.6)	1.5 (5.2)	−3.4 (2.9)
Added	−10.8 (3.5)[c]	−4.3 (2.6)	1.2 (4.9)	−3.2 (3.0)
Fiber	−0.6 (0.5)	0.4 (0.3)	0.9 (0.4)[d]	0.4 (0.2)[d]
Fat				
Total, g	−6.5 (2.8)[d]	0.8 (1.0)	3.9 (2.9)	0.7 (0.9)
Saturated, g	−1.8 (1.0)	0.7 (0.5)	1.8 (1.1)	0.7 (0.4)
Trans, g	−0.5 (0.2)[d]	−0.1 (0.1)	0.3 (0.2)	0.2 (0.1)
Monounsaturated, g	−2.7 (1.0)[c]	−0.2 (0.4)	1.5 (1.0)	0.4 (0.4)
Polyunsaturated, g	−1.5 (0.8)	0.2 (0.5)	0.2 (0.8)	−0.6 (0.4)
PFA:SFA ratio	−0.1 (0.1)	−0.1 (0.1)	0.0 (0.2)	0.0 (0.2)
Cholesterol, mg	−13.9 (8.0)	2.5 (5.4)	13.1 (7.9)	5.9 (4.7)
Protein, g	−5.0 (2.4)[d]	1.0 (1.2)	2.9 (2.6)	1.2 (1.2)
Vitamin				
A, IU	−458.4 (313.0)	−252.0 (306.4)	63.1 (201.2)	−42.4 (179.0)
B_6, mg	−0.07 (0.05)	0.05 (0.03)	0.01 (0.06)	−0.04 (0.04)
B_{12}, μg	−0.3 (0.2)[d]	0.0 (0.1)	0.4 (0.2)[d]	0.2 (0.1)[d]
C, mg	−3.0 (4.7)	2.1 (4.4)	3.9 (3.7)	1.3 (2.9)
Mineral, mg				
Sodium	−262.0 (108.7)[d]	−15.8 (64.7)	245.5 (123.0)[d]	116.6 (48.5)[d]
Calcium	−48.4 (36.8)	29.5 (24.3)	27.6 (32.8)	−4.1 (17.5)
Potassium	−168.1 (69.7)[d]	−5.8 (39.2)	91.0 (63.7)	24.9 (26.4)
Iron	−0.8 (0.4)[d]	0.2 (0.2)	0.9 (0.5)	0.4 (0.2)[d]

Abbreviations: PFA, polyunsaturated fatty acids; SFA, saturated fatty acids.
[a]Any location outside school and home.
[b]Unadjusted with respect to caloric intake; both unadjusted and adjusted models include race/ethnicity, age, sex, and where students obtained lunch.
[c]$P < .01$.
[d]$P < .05$.

California students consumed a relatively low proportion of their calories at school compared with students in other states (21.5% vs 28.4%, respectively) and a relatively high proportion outside school and home (19.8% vs 14.1%, respectively). Differences in nutrient intake by location are presented in **Table 3**. At school, California students consumed less than students in other states for every measure that we examined, particularly added sugars, trans fat, monounsaturated fat, sodium, potassium, iron, and vitamin B_{12}. After adjusting for total caloric intake, however, the at-school differences were substantially reduced. In some cases, the direction of association changed after adjusting for total calories, such that California students consumed more of specific nutrients (eg, calcium) than students in other states. Mean intake from locations other than school and home was higher in California for most measures; intake of fiber, vitamin B_{12}, sodium, and iron remained higher in California after adjusting for total calories. There were virtually no differences between states in at-home intake, regardless of whether we adjusted for total caloric intake (results not shown).

Results were very similar when restricting the analysis to Hispanic students (**Table 4**). The estimated differences between California and other states in at-school intake were slightly larger than those for the full sample prior to adjusting for total caloric intake. As with the full sample, though, results were virtually eliminated after adjustment. The results for total intake among Hispanic students (not shown) were also similar to the results in Table 2, as Hispanic students in California consumed only 20.1% of their total calories within school.

The fixed-effect analysis suggested that California students did not compensate for consuming less within school by consuming more elsewhere. We found no evidence that California students consumed more outside school on weekdays, relative to weekends, than students in other states did. The average within-student difference in weekday vs weekend intake at home and other locations was approximately equal in California vs other states for all measures that we examined (results not shown).

COMMENT

In previous research on California's competitive food laws, Woodward-Lopez et al described the laws as "an effective first step"[18] while cautioning that the public health impact may be limited without more comprehensive initiatives. Their conclusions were based on analyses of school environment measures and a survey of select food items administered only among California students. We

Table 4. Differences in Mean Weekday Intake by Location of Consumption Between 85 Hispanic Students in California and 82 Hispanic Students in States With No Laws Regarding Fat, Sugar, and Caloric Content of Competitive Foods, With and Without Adjustment for Total Caloric Intake

	Difference (SE)			
	School		Outside School/Home[a]	
Outcome	Unadjusted[b]	Adjusted	Unadjusted[b]	Adjusted
Carbohydrate, g				
Sugars				
Total	−18.7 (4.8)[c]	−4.1 (2.8)	7.3 (6.5)	1.9 (3.2)
Added	−14.5 (3.8)[c]	−5.1 (3.0)	6.3 (5.8)	1.7 (3.1)
Fiber	−1.0 (0.6)	0.7 (0.4)	0.5 (0.7)	−0.1 (0.3)
Fat				
Total, g	−9.7 (2.5)[d]	2.3 (1.4)	4.5 (5.0)	−1.0 (1.1)
Saturated, g	−2.9 (1.0)[d]	0.4 (0.5)	1.9 (1.9)	0.2 (0.6)
Trans, g	−0.7 (0.2)[d]	−0.2 (0.1)	0.3 (0.3)	0.1 (0.1)
Monounsaturated, g	−4.0 (1.3)[d]	0.3 (0.6)	1.5 (1.8)	−0.1 (0.5)
Polyunsaturated, g	−2.1 (1.3)	1.4 (0.9)	0.5 (1.1)	−0.4 (0.5)
PFA:SFA ratio	−0.1 (0.2)	0.0 (0.2)	−0.1 (0.3)	0.0 (0.3)
Cholesterol, mg	−26.3 (9.7)[d]	0.0 (6.8)	14.4 (13.7)	3.4 (6.9)
Protein, g	−8.0 (2.8)[d]	1.0 (1.4)	3.6 (4.2)	0.1 (1.8)
Vitamin				
A, IU	−618.6 (743.4)	−447.9 (778.2)	−107.2 (183.2)	−224.9 (133.4)
B_6, mg	−0.17 (0.07)[e]	0.02 (0.05)	−0.09 (0.10)	−0.15 (0.08)
B_{12}, µg	−0.4 (0.2)[e]	−0.1 (0.1)	0.4 (0.3)	0.1 (0.2)
C, mg	−7.6 (8.0)	2.6 (7.8)	3.2 (6.1)	−1.1 (3.9)
Mineral, mg				
Sodium	−475.3 (125.8)[c]	−69.6 (64.4)	259.3 (194.3)	86.5 (57.4)
Calcium	−58.0 (38.8)	44.5 (28.5)	31.7 (46.3)	−8.3 (17.3)
Potassium	−253.2 (91.9)[d]	7.0 (61.8)	76.5 (98.9)	−9.8 (34.6)
Iron	−1.3 (0.5)[d]	0.3 (0.3)	0.8 (0.7)	0.2 (0.2)

Abbreviations: PFA, polyunsaturated fatty acids; SFA, saturated fatty acids.
[a] Any location outside school and home.
[b] Unadjusted with respect to caloric intake; both unadjusted and adjusted models include age, sex, and where students obtained their lunch.
[c] $P < .001$.
[d] $P < .01$.
[e] $P < .05$.

complemented their research by comparing detailed nutrient intake data in an independent sample of students in California vs states with no laws regarding competitive food nutrition content, and we similarly conclude that California's laws have been successful in certain respects but that their limitations should be highlighted as school districts begin to implement competitive food nutrition standards as part of the Healthy, Hunger-Free Kids Act of 2010.

Unequivocally, California students in this study reported less at-school intake of fat, sugar, and total calories—the nutrition measures that California laws were designed to regulate—compared with other states in our sample. Reported intake of these measures was lower in California in the overall sample and specifically among Hispanic students. The reductions among Hispanic students are particularly encouraging given the high prevalence of youth obesity among Hispanic individuals in California[29] and the United States overall.[30] It is also encouraging in light of research that documented the high presence of convenience stores, mobile food vendors, and other food outlets surrounding schools in Hispanic communities,[31,32] including one study of a predominantly Hispanic school district in California.[31] Estimated differences were in fact greater among Hispanic students than among the overall sample, and one could argue that the internal validity of results is greater when analyzing this subgroup because of the substantial racial/ethnic differences between our comparison groups.

California students also reported lower at-school intake of several vitamins and minerals, and all differences in nutrient intake were eliminated after adjusting for total caloric intake. This suggests that the nutrition composition of California students' in-school diet was similar to that of students in other states even if they consumed less. The lack of difference in overall nutrition quality is not surprising given the following: (1) California's competitive food laws limit fats, sugars, and calories but do not require vegetables, whole grains, and other foods that are compliant with the Dietary Guidelines for Americans[33]; and (2) Woodward-Lopez et al[18] reported that many California schools complied with competitive food laws by offering items such as baked chips that were technically compliant but had limited nutrition value. This does not take away from the fact that California students in this study consumed fewer calories in school, which suggests that competitive food standards may be a method of reducing adolescent weight gain. Yet, to improve students' overall nutrient intake, policy makers may need to promote more stringent competitive food regulations that are consistent with the Dietary Guidelines for Americans and do not merely ban junk food.

Overall, students in the sample consumed less than one-third of their total calories at school. Larger studies have reported similar estimates of the proportion of total caloric intake that comes from at-school consumption.[34,35] On average, California students consumed an even lower proportion of their calories at school and consequently had an only slightly lower overall intake of sugar, fat, and calories than students in other states. The fixed-effect analysis indicated that California students relied on other sources more in general, not owing to differences in their school food environment. Regardless, as Woodward-Lopez et al[18] and other experts[36] have argued, the low proportion of at-school intake suggests that school-based policy initiatives are a starting point but must be complemented with nutrition education and policy changes in other sectors to improve the overall health of the adolescent population.

California may differ from other states in its educational system and other school nutrition policies that could account for differences in intake or lack thereof. This limitation is heightened by the cross-sectional design, which precludes us from concluding that California's laws were the cause of any differences in intake. Our study was also limited by the reliance on self-reported measures; although 24-hour recall is a common measure of diet, children are known to underreport their intake.[37] Students in our study sample generally reported less intake than larger studies have reported, although the distribution of calories between fats, carbohydrates, and proteins was similar.[38] Lower intake in our study sample may also be attributable to self-selection bias. The 24-hour recall sample represented a small proportion of the full NYPANS sample, and students who consented to the recall may have had less average consumption.

It should also be reiterated that the NYPANS sample was not designed to represent individual states. The large proportion of Hispanic students in the California sample illustrates that the sample was not representative of California. The evidence from this study is inconclusive because of these limitations, although there is sufficient evidence to support the development of larger studies that collect nutrient intake from a more representative sample. Future studies should also include data on socioeconomic status, a key covariate for which we were unable to control.

One should assess this as a study of California's specific standards, not as a reflection of competitive food regulations in general. California's competitive food standards are more strict than those of most states, but some of California's standards for high schools in 2009-2010 remained lower than the standards recommended by the Institute of Medicine.[9] California did not regulate sodium content, for example, and had a higher caloric limit for individual food items (250 calories) than the limit recommended by the Institute of Medicine (200 calories). Interestingly, California's laws regarding sugar content for competitive foods in high school in 2009-2010 were equal to the standards set by the Institute of Medicine; the relative stringency of sugar content policies may explain why sugar intake was the dietary measure for which we found the strongest evidence of lower consumption in California. Policy makers should look to standards set by the Institute of Medicine and Dietary Guidelines for Americans, and consider how to incorporate policy changes in other sectors, to enhance the potential for school changes to improve adolescents' overall diet.

Accepted for Publication: December 16, 2011.
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Author Contributions: Dr Taber had full access to all of the data and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Taber, Chriqui, and Chaloupka. *Acquisition of data:* Chriqui and Chaloupka. *Analysis and interpretation of data:* Taber and Chriqui. *Drafting of the manuscript:* Taber and Chriqui. *Critical revision of the manuscript for important intellectual content:* Chriqui and Chaloupka. *Statistical analysis:* Taber. *Obtained funding:* Chaloupka. *Administrative, technical, and material support:* Chriqui. *Study supervision:* Chriqui and Chaloupka.
Financial Disclosure: None reported.
Funding/Support: The Robert Wood Johnson Foundation provided support to the Bridging the Gap program, Health Policy Center, University of Illinois at Chicago (Dr Chaloupka).
Disclaimer: The views expressed herein are solely those of the authors and do not reflect the official views or positions of the Robert Wood Johnson Foundation.
Additional Contributions: Linda Schneider, MS, Camille Gourdet, JD, Tessa Adcock, BA, and Rebecca Schermbeck, MPH, MS, provided research support in compiling and analyzing the laws. Nancy Brener, PhD, Centers for Disease Control and Prevention, provided the NYPANS data used in this study.

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