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Factors Affecting Sugar-Sweetened Beverage Availability in Competitive Venues of US Secondary Schools

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ABSTRACT

BACKGROUND: This study explores sugar-sweetened beverage (SSB) availability in US secondary school competitive venues during the first 3 years following the school wellness policy requirement (2007-2009). Furthermore, analyses examine associations with school policy and SSB availability.

METHODS: Analyses use questionnaire data from 757 middle and 762 high schools in the nationally representative Youth, Education, and Society study to examine soda and non-soda SSB availability associations with school policy including (1) beverage bottling contracts and related incentives, (2) individuals/organizations responsible for decisions regarding beverages available in vending machines, and (3) school wellness policies and nutrition guidelines.

RESULTS: Non-soda SSBs made up the majority of SSBs in both middle and high schools. Soda was especially likely to be found in vending machines; non-soda SSBs were widely available across competitive venues. Access to soda decreased significantly over time; however, non-soda SSB access did not show a similar decrease. School policy allowing beverage supplier contractual involvement (bottling contract incentives and beverage supplier "say" in vending machine beverage choices) was related to increased SSB access. However, the existence of developed nutritional guidelines was associated with lower SSB availability.

CONCLUSIONS: Students had high access to SSBs across competitive school venues, with non-soda SSBs making up the majority of SSB beverage options. Efforts to reduce access to SSBs in US secondary schools should include a focus on reducing both soda and non-soda SSBs, reducing beverage supplier involvement in school beverage choices, and encouraging the development of targeted nutritional guidelines for all competitive venues.

Keywords: child and adolescent health; health policy; nutrition and diet; public health; school policy.

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Sugar-sweetened beverage (SSB) consumption has increased dramatically in the United States over the last 30 years.[1] Whereas SSB consumption is highest among young adults, child and adolescent consumption is not far behind.[1] Research supported by the American Beverage Association (the national voice for the non-alcoholic refreshment beverage industry) shows few relationships between SSB consumption and adverse health-related outcomes;[2,3] however, other publicly and privately funded research indicates SSB consumption relates to increased caloric intake, weight change, and BMI among both adults[4] and adolescents.[5-7] Further, adolescent SSB consumption is associated with increased insulin resistance-associated metabolic parameters[5] and lower calcium and nutrient intake.[7]

The American Academy of Pediatrics issued a statement regarding potential health problems associated with SSB consumption in schools and noted concerns regarding SSB sales through exclusive bottling contracts between schools and beverage suppliers.[8] A nationally representative study of US schools found that in 2004 and 2005, most middle and high school students attended schools with bottling contracts and

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the majority had regular soda (non-diet soft drinks) available through vending machines and à la carte cafeteria sales.[9] Another nationally representative study of public schools in 2005 found that SSBs obtained at school significantly contributed to the total caloric intake of secondary school students;[10] total energy intake from SSB consumption was significantly higher in schools with bottling contracts and with the competitive venues of stores/snack bars or à la carte cafeteria sales. Competitive venues are so-called because they compete with meals served through the federally sponsored School Breakfast and National School Lunch Programs. Federally sponsored meal programs are required to meet specified nutrition recommendations.[11,12] However, competitive venues have been exempt from such regulations. In 2004, the US Congress required school districts participating in federally sponsored meal programs to adopt and implement school wellness policies by the first day of the 2006-2007 school year.[13] Wellness policies were to include competitive venue food and beverage guidelines. Individual school wellness policies (and related guidelines) include not only the actual language adopted by the school board or district, but also a myriad of district- and state-level rules, regulations, guidelines, and procedures.[14] Districts vary on the extent to which they have provisions for health advisory councils that serve in an ongoing capacity for policy and guideline development,[14] and as to whether or not they look to available model school wellness policies.[15] A review of school district policies in place on the first day of the 2007-2008 school year found that while most US students attended schools with a district wellness policy, the quality, strength, and coverage of the policies varied significantly, including the degree to which nutritional guidelines for competitive foods and beverages were included.[13] In regards to SSBs, 50% of middle school and 28% of high school students were in school districts that prohibited regular soda sales.[13] Only 13% of middle school and 2% of high school students were in school districts that prohibited other SSB sales. Thus, a significant percentage of students continue to have school SSB access, and access varies by SSB type.

This study examines SSB availability in a national sample of US secondary schools during the first 3 years following the school wellness policy requirement (2007-2009) through the following research questions:

1. What percentage of secondary school students had school competitive venue access to any SSBs, soda, and non-soda SSBs? Did availability change over time and/or by competitive venue type?
2. What percentage of secondary school youth attended schools with policies that were related to SSB access?
3. Did school wellness policies and nutritional guidelines relate to which individuals/organizations were responsible for decisions regarding beverages available in vending machines, or to the likelihood that schools had bottling contracts and associated benefits?
4. To what extent were overall SSB, soda, and non-soda SSB availability affected by bottling contracts, school wellness policies, or nutrition guidelines?

METHODS

Participants and Procedure

This study utilizes 3 years of data (2007-2009) from 1 component of the annual Youth, Education, and Society (YES) study conducted by the Institute for Social Research at the University of Michigan. A rotating sample design of approximately 600 schools is drawn from 380 school districts, so as to be representative of all public middle and high schools in the coterminous United States. One-half of sampled schools contains an 8th-grade target class; remaining schools are divided equally between targeted 10th and 12th-grade classes.[16] Mailed questionnaires (with a modest monetary incentive) were sent to each sampled school's principal in the spring; follow-up calls and questionnaire mailings were made as necessary to encourage participation. Response rates averaged 76% without replacement for non-responding schools and 86% with replacement. Schools were invited to participate for 3 years. Principals completed questionnaire sections on general school characteristics, nutrition policies/programs, food and beverage supplier agreements, and school wellness policies (some principals assigned the task to other administrators). It was suggested that food service personnel complete the detailed questions on food and beverage availability across venues, and this occurred in 60% of schools. At the start of the study, pilot testing of various measures of food and beverage availability as well as school policy was conducted with a convenience sample of both middle and high school principals. Detailed reliability and validity studies of the measures used were not conducted; however, participants reported no difficulties in completing the measures.

Instruments

Dependent Measures. Respondents were asked if students had beverage access in each of the following: (1) vending machines; (2) school/student stores and/or snack bars/carts; and (3) à la carte sales in the cafeteria. Respondents were asked about the availability of specific beverages in each venue. SSBs included any of the following: ''regular soft drinks (such as Coke, Pepsi, or Dr. Pepper),'' ''sports drinks (such as Gatorade or

Powerade),'' and ''fruit drinks that are not 100% fruit juice and that are high in calories (such as Hawaiian Punch, Sunny Delight, or Hi-C).'' For these analyses, soda was defined as including only regular soft drinks (excluding diet soft drinks). Non-soda SSBs included all SSBs other than soda.

Independent Measures. For bottling contracts, respondents were asked: ''Does your school or school district have a contract with a beverage supplier, such as Coca-Cola, PepsiCo, or Cadbury Schweppes (Dr. Pepper), giving the company exclusive rights to sell beverages to students at your school?'' (yes/no response options). If a contract existed, 2 additional questions followed: ''Does your school or school district receive incentives, such as cash awards or donations of equipment, supplies, or other donations, once total beverage sales receipts exceed a specified amount?''; and ''Does your school or school district receive a specified percentage of the beverage sales receipts?'' (yes/no response options). Vending beverage decision involvement was assessed by asking, ''Who has a major 'say' in deciding what beverages are offered in the vending machines to students at your school?'' Response options included beverage supplier or other vending company; school; school district; state (respondents were instructed to check all applicable). Wellness policies and nutrition guidelines were assessed with 2 separate and independent items: ''Has your school district or your school established a school wellness policy that addresses student nutrition and/or physical activity issues?'' (yes; no; don't know), and ''Has your school district or school developed nutrition guidelines for all foods available during the school day, designed to promote student health and reduce student obesity?'' (yes, have developed guidelines; currently developing guidelines; no; don't know).

Control Variables. Control variables were based on prior research examining school beverage availability and included school size, percent of students eligible for free and reduced-price lunch, majority student race/ethnicity, region, grade, and year.[17,18]

Data Analysis

Descriptive analyses used the SAS v.9.2 (SAS Institute, Cary, NC) surveymeans and surveyfreq procedures to test for significant differences between middle and high school measures. All multivariate analyses used the surveylogistic procedure. Data were weighted to adjust for differential probability of school selection and the estimated enrollment in the target grade. Weighted results represent the percentage of all target grade *students* with specified outcomes or conditions. Analyses were clustered by school to adjust for individual schools repeating study participation (as noted previously, schools were invited to participate for up to 3 years). Results are presented separately for middle schools (8th grade) and high schools (10th and 12th grades combined). After removing cases with missing data on control and independent variables other than bottling contract benefits, 757 middle school cases (479 unique schools) and 762 high school cases (481 unique schools) were available for analysis.

Relationships between school policies were first examined by running bivariate models to obtain zero order relationships using either wellness policies or nutritional guidelines as independent variables and the remaining school policy measures as dependent variables. Multivariate models were then estimated controlling for school size, socioeconomic status, majority race/ethnicity, region, and year. Relationships between SSB availability and school policies first involved bivariate models between policies and SSB availability, followed by multivariate models with only 1 main policy predictor and control variables. Finally, multivariate models including all policies simultaneously (other than bottling contract benefits due to the constrained sample size) and control variables were estimated.

RESULTS

The Status of Beverage Availability and School Policy

Descriptive statistics are presented in Table 1. Among all students, 73% of middle school and 93% of high school students had SSB access. Regular soda was significantly less prevalent than non-soda SSBs for both middle and high school students. Nineteen percent of all middle school and 43% of high school students had soda access. In contrast, non-soda SSBs were available to 71% of all middle school and 91% of high school students. Access was similar when measured only among students with competitive venue access due to high competitive venue prevalence (96% for middle school and 99% for high school).

SSB access varied significantly across venue. Among all middle school students, approximately half had vending machine or à la carte sales SSB access, and 30% through stores/snack bars/carts. Corresponding rates for all high school students were 86%, 64%, and 45%. SSB access rates were significantly higher among students in schools that actually had each competitive venue. Student access to regular soda was predominantly through vending machines with some additional store/snack bar/cart access. Virtually no middle school students had access to soda through à la carte sales; less than 10% of high school students had such access if the venue was available. Non-soda SSB availability also varied somewhat by competitive venue. Among middle school students with venue availability, significantly fewer had non-soda SSB access through à la carte sales than through stores/snack bars/carts

Table 1. **Characteristics of the Sugar-Sweetened Beverage Environment in US Secondary Schools, 2007-2009 (Middle School = 8th Grade [MS]; High School = 10th and 12th Grades [HS]; SE = Standard Error)**

	Middle School		High School	
	% Students	(SE)	% Students	(SE)
Competitive venue beverage availability				
Any competitive venue beverages (N = 755 MS, 762 HS)	96.2	(0.760)	99.2	(0.320)
À la carte beverages (N = 754 MS, 759 HS)	75.6	(1.875)	82.8	(1.669)
Store/snack bar/cart beverages (N = 754 MS, 762 HS)	41.2	(2.216)	55.4	(2.279)
Vending machine beverages (N = 754 MS, 762 HS)	74.3	(2.102)	95.7	(0.986)
SSB availability*				
Any SSBs				
All students (N = 753 MS, 760 HS)	72.5	(1.931)	92.5	(1.065)
Students with competitive venues (N = 719 MS, 750 HS)	75.9	(1.907)	93.7	(1.013)
À la carte SSBs				
All students (N = 749 MS, 756 HS)	45.8	(2.181)	63.5	(2.121)
Students with venue (N = 565 MS, 625 HS)	60.7	(2.335)	76.7	(1.977)
Store/snack bar/cart SSBs				
All students (N = 752 MS, 760 HS)	29.7	(2.110)	44.7	(2.230)
Students with venue (N = 309 MS, 420 HS)	72.3	(2.934)	80.9	(2.211)
Vending machine SSBs				
All students (N = 750 MS, 755 HS)	53.6	(2.243)	86.4	(1.464)
Students with venue (N = 556 MS, 721 HS)	72.3	(2.196)	90.4	(1.191)
Regular soda† availability				
Any soda				
All students (N = 753 MS, 760 HS)	19.0	(1.806)	43.1	(2.296)
Students with competitive venues (N = 724 MS, 754 HS)	19.8	(1.872)	43.4	(2.313)
À la carte soda				
All students (N = 749 MS, 751 HS)	00.3	(0.183)	06.0	(1.082)
Students with venue (N = 564 MS, 621 HS)	00.3	(0.243)	07.2	(1.300)
Store/snack bar/cart soda				
All students (N = 752 MS, 759 HS)	04.4	(0.960)	12.2	(1.413)
Students with venue (N = 309 MS, 418 HS)	10.6	(2.243)	22.1	(2.391)
Vending machine soda				
All students (N = 746 MS, 751 HS)	16.9	(1.722)	41.5	(2.291)
Students with venue (N = 552 MS, 718 HS)	22.8	(2.234)	43.4	(2.349)
Non-soda SSB‡ availability				
Any non-soda SSBs				
All students (N = 753 MS, 760 HS)	71.0	(1.937)	90.7	(1.183)
Students with competitive venues (N = 718 MS, 749 HS)	74.5	(1.912)	92.0	(1.140)
À la carte non-soda SSBs				
All students (N = 747 MS, 753 HS)	45.9	(2.185)	63.3	(2.140)
Students with venue (N = 562 MS, 623 HS)	60.9	(2.339)	76.5	(1.989)
Store/snack bar/cart non-soda SSBs				
All students (N = 751 MS, 758 HS)	28.7	(2.065)	43.2	(2.216)
Students with venue (N = 308 MS, 417 HS)	70.0	(3.039)	78.4	(2.339)
Vending machine non-soda SSBs				
All students (N = 749 MS, 755 HS)	51.9	(2.228)	83.1	(1.646)
Students with venue (N = 555 MS, 721 HS)	70.1	(2.206)	87.0	(1.459)
Independent variables				
Established school wellness policy (N = 757 MS, 762 HS)				
Yes	78.4	(1.725)	80.4	(1.613)
No	10.8	(1.263)	13.4	(1.402)
Don't know or missing	10.8	(1.251)	06.2	(0.954)
Nutrition guidelines developed (N = 757 MS, 762 HS)				
Yes	67.9	(1.936)	64.7	(1.991)
In process	11.4	(1.205)	12.7	(1.268)
No	13.2	(1.428)	16.8	(1.522)
Don't know or missing	07.5	(0.995)	05.9	(0.883)
Bottling contract in place (N = 757 MS, 762 HS)	64.8	(2.139)	75.2	(1.970)
Bottling contract benefits (N = 463 MS, 560 HS)				
Receive neither incentives nor receipts	11.9	(1.684)	08.9	(1.331)
Receive either incentives or receipts	52.1	(2.517)	50.5	(2.383)
Receive both incentives and receipts	36.0	(2.397)	40.6	(2.372)

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Table 1. **Continued from previous page**

	Middle School		High School	
	% Students	(SE)	% Students	(SE)
Decision makers for vending machine beverages[§] (N = 757 MS, 762 HS)				
Beverage supplier	10.6	(1.282)	21.3	(1.777)
School	34.5	(2.010)	48.0	(2.168)
School district	44.6	(2.139)	58.5	(2.135)
State	20.0	(1.787)	26.2	(1.820)
Controls (N = 757 MS; 762 HS)				
Grade				
8th	100.0	(0.000)	00.0	(0.000)
10th	00.0	(0.000)	50.3	(2.554)
12th	00.0	(0.000)	49.7	(2.554)
School size				
≤500 students	24.9	(2.138)	13.1	(1.640)
501-1000 students	51.4	(2.466)	19.4	(1.936)
1001-1500 students	20.5	(2.002)	22.5	(2.067)
1501-2000 students	02.7	(0.814)	19.4	(1.873)
2001+ students	00.5	(0.313)	25.5	(2.194)
Percentage of students eligible for free and reduced price lunch				
≤20%	21.1	(1.979)	29.6	(2.249)
20.1-33.0%	13.8	(1.568)	20.8	(1.875)
33.01-66.0%	36.2	(2.286)	34.6	(2.280)
≥66.01%	28.9	(2.210)	15.0	(1.662)
Majority student race and ethnicity				
>66% students white	45.2	(2.515)	53.2	(2.471)
>50% students black	12.6	(1.628)	09.3	(1.382)
>50% students black	17.1	(1.923)	11.5	(1.569)
Other	25.1	(2.081)	26.0	(2.122)
Region				
Northeast	17.2	(2.004)	16.4	(1.925)
Midwest	21.8	(2.091)	23.7	(2.177)
South	36.6	(2.443)	36.0	(2.438)
West	24.4	(2.200)	23.9	(2.181)
Year				
2007	29.2	(1.060)	29.0	(1.117)
2008	34.9	(1.070)	33.7	(1.056)
2009	35.9	(1.703)	37.4	(1.757)

*SSB: Sugar-sweetened beverages, including any of the following: regular soft drinks, sports drinks, fruit drinks that are not 100% fruit juice and that are high in calories.
†Regular soda: regular soft drinks (such as Coke, Pepsi, or Dr. Pepper).
‡Non-soda SSB: sports drinks, fruit drinks that are not 100% fruit juice and that are high in calories.
§Response categories for beverage decision makers not mutually exclusive.

and vending machines. For high school students with competitive venue access, non-soda SSB availability was significantly higher in vending machines than stores/snack bars/carts or à la carte sales.

Most students attended schools with established wellness policies. Developed nutrition guidelines were in place in schools attended by more than two thirds of middle and high school students, and were in process for an additional 11% and 13% of middle and high school students, respectively. Significantly more high school students (75%) than middle school students (65%) attended schools with bottling contracts. Within schools with bottling contracts, half of middle and high school students attended schools receiving *either* a percentage of receipt sales or contract incentives; approximately one third of middle and two fifths of high school students attended schools receiving *both* forms of contract benefits. Input on vending machine beverage choices was provided significantly more frequently by either the school district or school than by the state or beverage suppliers.

Relationships Between School Policies

Neither school wellness policies nor nutrition guidelines were significantly associated with the percentage of students attending schools with bottling contracts or contracts benefits. However, as shown in Table 2, school district ''say'' in vending machine beverage choices was significantly higher for both middle and high school students attending schools with a wellness policy than without. High school students attending schools with developed nutrition guidelines were significantly more likely than those schools without to have both school district and state ''say'' in vending machine beverage choices. For middle school students, attending a school where the principal either

Table 2. **Logistic Regression Relationships Between the Percentage of Students in Schools With School Beverage-Related Policies and School Wellness and Nutrition Guidelines, 2007-2009 (Middle School = 8th Grade, High School = 10th and 12th Grades; Weighted Ns = 757 for Middle School, 762 for High School)**

	Vending Machine Beverage Decision Makers[†]											
	Beverage Supplier		School		School District		State		Wellness Policy		Nutrition Guidelines	
	%	p[‡]	%	p	%	p	%	p	%	p	%	p
Middle school												
Model 1: School wellness policies												
Yes	10.3	(ref)	34.5	(ref)	47.5	(ref)	20.5	(ref)	—		75.5	(ref)
No	6.6	ns	43.3	ns	29.2	**	17.7	ns	—		32.4	***
DK[§]/missing	17.0	ns	25.7	ns	38.9	ns	18.4	ns	—		47.9	***
Model 2: Nutrition guidelines												
Yes	8.6	(ref)	35.0	(ref)	47.2	(ref)	22.5	(ref)	87.2	(ref)	—	
In process	14.4	ns	35.8	ns	46.1	ns	15.6	ns	76.1	**	—	
No	14.1	ns	34.5	ns	42.2	ns	16.5	ns	58.9	***	—	
DK/missing	16.9	*	28.3	ns	23.3	**	9.9	*	36.7	***	—	
High school												
Model 1: School wellness policies												
Yes	20.3	(ref)	48.9	(ref)	61.7	(ref)	27.8	(ref)	—		70.5	(ref)
No	23.8	ns	45.0	ns	40.9	***	20.3	ns	—		41.2	***
DK/missing	27.9	ns	43.1	ns	55.4	ns	18.8	ns	—		39.0	***
Model 2: Nutrition guidelines												
Yes	19.3	(ref)	45.4	(ref)	61.4	(ref)	31.0	(ref)	87.7	(ref)	—	
In process	19.3	ns	55.9	ns	57.7	ns	22.0	ns	88.4	ns	—	
No	28.6	ns	50.1	ns	47.3	*	14.7	**	55.0	***	—	
DK/missing	25.5	ns	54.0	ns	61.1	ns	15.6	ns	55.4	***	—	

*p < .05; **p < .01; ***p ≤ .001; ns = not significant.
[†]Individuals/organizations responsible for decisions regarding beverages available in vending machines; response categories not mutually exclusive.
[‡]Multivariate models included only a single policy predictor and outcome but also controlled for school size, percentage of the student population eligible for free and reduced-price lunch, majority student race/ethnicity, region, grade (for high school models), and year.
[§]DK = Don't know.

did not know if nutrition guidelines were developed or if the item was not answered was associated with significantly higher odds that beverage suppliers were involved in vending machine beverage choices, and lower odds that the school district or state had similar involvement.

Table 2 also shows that wellness policies were closely associated with developed nutrition guidelines, but not equivalent. For middle school, three fourths of students with a wellness policy also had developed nutrition guidelines, compared with only one third in schools without wellness policies. High school student results were similar. The relationship can also be considered this way: while almost all students in schools *with* developed nutrition guidelines also had wellness policies (87% for middle school and 88% for high school), students in schools with *no* nutrition guidelines were approximately evenly divided, as to whether their school had a wellness policy (59% and 55% for middle and high school, respectively). For both middle and high school students, attending a school where the principal either did not know if nutrition guidelines were developed or if the item was not answered was associated with significantly lower odds of having a wellness policy (and vice versa).

Relationships Between School Policies and Beverage Availability

Table 3 contains full multivariate model results examining any competitive venue SSB, regular soda, and non-soda SSB availability in relation to school policy. Displayed results for all policies other than bottling contract benefits were obtained from the full multivariate models where all policies were entered simultaneously together with control variables. As a result of constrained sample size, displayed results for bottling contract benefits are from multivariate models containing control variables, but not including any other policy predictors.

Having a bottling contract was associated with significantly higher middle school soda access and higher high school SSB access. Significant relationships with bottling contract benefits were found only for middle school students. Compared to students in schools receiving *both* incentives and receipts, students in schools receiving *neither* benefit (but still having a bottling contract) were less likely to have access to SSBs, soda, and non-soda SSBs. Middle schools students in schools receiving *either* incentives or receipts were also less likely than those in schools with *both* benefits to have soda or non-soda SSB access.

Table 3. **Middle and High School Multivariate Policy Associations With Any Competitive Venue Sugar-Sweetened Beverage Availability, 2007-2009 (Percentages Reflect the Percentages of Students in Schools With Respective Policies and Beverage Availability; Middle School = 8th Grade, High School = 10th and 12th Grades)[†]**

	SSBs[‡]		Regular Soda[§]		Non-Soda SSBs[‖]	
	%	p	%	p	%	p
Middle school (N[¶])	(719)		(724)		(719)	
Bottling contract in place						
No	72.5	(ref)	11.0	(ref)	70.2	(ref)
Yes	77.6	ns	24.3	*	76.7	ns
Bottling contract benefits						
None	63.8	*	13.0	*	63.8	*
Incentives or receipts	74.1	ns	20.6	**	72.7	*
Both incentives and receipts	85.1	(ref)	33.8	(ref)	84.4	(ref)
Decision makers for vending machine beverages[#]						
Beverage supplier						
No	74.4	(ref)	16.9	(ref)	73.2	(ref)
Yes	87.9	*	43.0	***	85.2	ns
School						
No	73.1	(ref)	15.4	(ref)	72.6	(ref)
Yes	80.8	*	27.6	*	78.0	ns
School district						
No	73.8	(ref)	19.5	(ref)	72.0	(ref)
Yes	78.2	ns	20.1	ns	77.4	ns
State						
No	75.7	(ref)	20.0	(ref)	74.2	(ref)
Yes	76.5	ns	19.0	ns	75.7	ns
Established school wellness policy						
Yes	74.5	(ref)	20.0	(ref)	73.1	(ref)
No	76.6	ns	13.8	ns	75.1	ns
DK[††]/missing	85.6	ns	23.7	ns	84.2	ns
Nutrition guidelines developed						
Yes	74.0	(ref)	19.0	(ref)	72.8	(ref)
In process	80.2	ns	27.6	ns	78.4	ns
No	77.6	ns	14.1	ns	76.3	ns
DK/missing	83.7	ns	24.6	ns	81.8	ns
High school (N[‡‡])	(750)		(754)		(749)	
Bottling contract in place						
No	87.0	(ref)	34.1	(ref)	86.3	(ref)
Yes	95.9	**	46.5	ns	93.8	ns
Bottling contract benefits						
None	63.8	ns	13.0	ns	63.8	ns
Incentives or receipts	74.1	ns	20.6	ns	72.7	ns
Both incentives and receipts	85.1	(ref)	33.8	(ref)	84.4	(ref)
Decision makers for vending machine beverages						
Beverage supplier						
No	92.4	(ref)	36.7	(ref)	90.6	(ref)
Yes	98.6	ns	68.3	***	97.0	*
School						
No	91.9	(ref)	38.3	(ref)	90.7	(ref)
Yes	95.7	ns	48.9	ns	93.4	ns
School district						
No	92.8	(ref)	54.6	(ref)	91.6	(ref)
Yes	94.5	ns	35.6	ns	92.3	ns
State						
No	93.5	(ref)	45.4	(ref)	91.3	(ref)
Yes	94.5	ns	37.9	ns	94.0	ns

(Continued on next page)

Table 3. **Continued from Previous Page**

	SSBs‡		Regular Soda§		Non-Soda SSBs‖	
	%	p	%	p	%	p
Established school wellness policy						
Yes	93.9	(ref)	41.3	(ref)	92.1	(ref)
No	93.7	ns	54.0	ns	91.5	ns
DK/missing	92.3	ns	48.6	ns	92.4	ns
Nutrition guidelines developed						
Yes	91.2	(ref)	37.4	(ref)	89.3	(ref)
In process	99.0	*	52.5	ns	99.0	*
No	97.7	**	59.8	*	95.2	*
DK/missing	100.0	***	44.8	ns	97.9	*

*$p < .05$; **$p < .01$; ***$p \leq .001$; ns = not significant.

†Multivariate models for bottling contract benefits included only a single policy predictor and outcome but also controlled for school size, percentage of the student population eligible for free and reduced-price lunch, majority student race/ethnicity, region, grade (for high school models), and year. Multivariate models for all other outcomes simultaneously included all policy predictors (other than bottling contract benefits) as well as controlling for school size, percentage of the student population eligible for free and reduced-price lunch, majority student race/ethnicity, region, grade (for high school models), and year.

‡SSBs: any competitive venue availability of sugar-sweetened beverages, including any of the following: regular soft drinks, sports drinks, fruit drinks that are not 100% fruit juice and that are high in calories.

§Regular soda: any competitive venue availability of regular soft drinks (such as Coke, Pepsi, or Dr. Pepper). Does not include diet soda.

‖Non-soda SSBs: any competitive venue availability of sports drinks, fruit drinks that are not 100% fruit juice and that are high in calories.

¶Weighted Ns for bottling contract benefits differ from other models, and for middle school were: 451 any SSBs; 452 any soda; 450 any non-soda SSBs.

#Individuals/organizations responsible for decisions regarding beverages available in vending machines; response categories for beverage decision makers not mutually exclusive.

††DK = Don't know.

‡‡Weighted Ns for high school bottling contract benefits were: 554 any SSBs; 557 any soda; 553 any non-soda SSBs.

Decision makers involved in vending machine beverage choices significantly impacted SSB availability. Middle school students attending schools with beverage supplier ''say'' in beverage choices were significantly more likely to have SSBs and soda than students in schools without beverage supplier involvement. Further, middle school à la carte non-soda SSB access was also significantly higher for students in schools with beverage supplier ''say'' (77% versus 59%, $p < .05$ in full multipolicy multivariate model; data not shown). Similar results were observed among high school students, where beverage supplier ''say'' was associated with higher access to soda and non-soda SSBs. If the *school* had a say in decisions regarding beverages available in vending machines, middle school soda access was significantly higher than without school involvement. In contrast, if the *school district* had a say, no robust relationships were observed for either middle or high school. Additional analyses (not shown) indicated school district ''say'' was associated with significantly lower middle school vending machine soda access (18% versus 29%, $p < .05$ in full multipolicy multivariate model) and significantly lower high school student store/snack bar/cart soda access (16% versus 33%, $p < .05$ in full multipolicy multivariate model). No significant differences in SSB access were observed based on state involvement in decisions regarding beverages available in vending machines.

Having an established wellness policy was not associated with student SSB access. However, nutrition guideline development was strongly associated with high school SSB availability. Compared with high school students in schools with developed nutrition guidelines, those in schools without guidelines had higher access to SSBs, soda, and non-soda SSBs. Further, students in high schools with guidelines *in development* were also significantly more likely to have access to SSBs and non-soda SSBs than those in schools with developed guidelines.

Cross-Time Changes in Beverage Availability

Table 4 shows the results for year predictors from full multipolicy multivariate models. Student access to soda dropped significantly from 28% in 2007 to 15% in 2009 in middle schools and from 54% to 34% in high schools. The declines observed for SSBs or non-soda SSBs did not reach statistical significance. The decrease in soda access occurred primarily in vending machines, but there also was some decrease in stores/snack bars/carts (although it did not reach statistical significance for middle school). Non-soda SSB access among middle school students significantly decreased in vending machines from 83% in 2007 to 65% in 2009.

DISCUSSION

This article examined SSB availability in a national sample of US public middle and high schools from 2007 to 2009, the years immediately following congressionally required implementation of school wellness policies including guidelines for competitive venue foods and beverages.[13] During these years,

Table 4. **Changes From 2007 to 2009 in the Percentage of Students in Schools With Competitive Venue Availability of Sugar-Sweetened Beverages (Percentages Reflect the Percentages of Students in Schools With Respective Policies and Beverage Availability; Middle School = 8th Grade, High School = 10th and 12th Grades)**

	SSBs[†]		Regular Soda[‡]		Non-Soda SSBs[§]	
	%	p[‖]	%	p	%	p
Middle school (N)	(719)		(724)		(719)	
Any availability						
2007	80.8	(ref)	27.9	(ref)	79.8	(ref)
2008	74.0	ns	17.6	**	72.5	ns
2009	73.7	ns	15.1	**	72.1	ns
À la carte						
2007	63.6	(ref)	—		63.9	(ref)
2008	62.4	ns	—		62.6	ns
2009	56.7	ns	—		57.0	ns
Stores or snack bars/carts						
2007	84.3	(ref)	14.4	(ref)	80.7	(ref)
2008	68.1	*	10.3	ns	67.1	ns
2009	66.8	*	7.9	ns	64.0	ns
Vending machines						
2007	84.3	(ref)	31.0	(ref)	83.0	(ref)
2008	67.4	***	20.4	**	64.0	***
2009	67.0	***	18.2	**	65.1	***
High school (N)	(750)		(754)		(749)	
Any availability						
2007	94.9	(ref)	54.1	(ref)	93.0	(ref)
2008	93.0	ns	44.7	**	91.2	ns
2009	93.5	ns	33.9	***	92.0	ns
À la carte						
2007	79.8	(ref)	—		79.2	(ref)
2008	74.7	ns	—		74.7	ns
2009	76.2	ns	—		76.2	ns
Stores or snack bars/carts						
2007	85.8	(ref)	31.4	(ref)	83.8	(ref)
2008	79.4	ns	22.7	ns	74.9	ns
2009	78.5	ns	14.4	**	77.2	ns
Vending machines						
2007	91.9	(ref)	54.2	(ref)	87.2	(ref)
2008	89.5	ns	44.5	**	86.4	ns
2009	90.0	ns	34.0	***	87.4	ns

*$p < .05$; **$p < .01$; ***$p \leq .001$; ns = not significant.
[†]SSBs: Any competitive venue availability of sugar-sweetened beverages, including any of the following: regular soft drinks, sports drinks, fruit drinks that are not 100% fruit juice and that are high in calories.
[‡]Regular soda: any competitive venue availability of regular soft drinks (such as Coke, Pepsi, or Dr. Pepper).
[§]Non-soda SSBs: any competitive venue availability of sports drinks, fruit drinks that are not 100% fruit juice and that are high in calories.
[‖]Full multivariate models simultaneously included all policy predictors (other than bottling contract benefits) as well as controlling for school size, percentage of the student population eligible for free and reduced-price lunch, majority student race/ethnicity, region, grade (for high school models), and year.

regular soda made up a comparatively small share of overall school SSBs. Whereas soda was especially likely to be found in vending machines, non-soda SSBs were widely available across competitive venues including à la carte sales. Soda access decreased significantly over time; however, non-soda SSB access did not show a comparable decrease. School policies were significantly related to soda, non-soda SSB, and overall SSB availability.

Competitive venues are almost universally available for middle and high school students. The question is not whether to have such venues, but what types of beverages to sell in them.[10] A 2006 voluntary agreement between leading members of the US beverage industry and the Alliance for a Healthier Generation aimed to reduce the caloric content and portion sizes of school beverages.[19] An evaluation of the agreement published by the American Beverage Association reported that between 2004 and 2007-2008, total beverage calories shipped to schools were reduced by 58%, including a two thirds reduction in full-calorie soft drinks.[20] Results from the current study do show a significant relative percentage decrease in soda availability for both middle (46%) and high school students (37%). However, non-soda SSB availability did not significantly decrease. Given that non-soda SSBs make up the majority of school SSBs, overall SSB availability showed no significant decrease.

Beverage industry research indicated school demand for regular carbonated soft drinks decreased from 2002 to 2004 while demand for other beverages—especially sports drinks—increased.[21] Thus, the 2006 guidelines may have only accelerated an already occurring consumption shift versus helping begin a meaningful decrease in overall school SSB consumption.[22]

The current study indicates beverage supplier connections with schools (through bottling contracts or beverage supplier say in decisions regarding beverages available in vending machines) were often associated with greater soda and non-soda SSB access. This may be simply an indication of a successful business model; the current analysis did not examine if non-SSB access increased with beverage supplier connections, but it would not be surprising if such was the case given reasonable beverage supplier goals of expanding market share. Previous research has shown beverage suppliers value the opportunity to establish early brand loyalty through school bottling contracts.[23] Contracts can result in significant school earnings that supplement food service operations and student activities.[24,25] However, if the goal is to reduce childhood obesity, a careful evaluation of the role of beverage suppliers in beverage choices may be advisable.

Legislation activity aimed at reducing and preventing childhood obesity in the United States is increasing; school nutrition standards and vending machine food and beverage sales are the most prevalent topics of such efforts.[26] The current study indicates vending machine soda access decreased for both middle and high school students from 2007 to 2009, and vending machine non-soda SSB access decreased for middle school students. Such results are encouraging. However, if overall student SSB access is to decrease, efforts must be made to reduce access across venues—including à la carte sales. Sixty-one percent of middle school and 77% of high school students attending schools with à la carte sales had access to SSBs through this venue; the goal of reducing SSBs caloric intake will likely not be met until access is reduced across *all* venues. The recent passage of The Healthy Hunger-Free Kids Act (S.3307, 111th Congress) will hopefully be a major step forward in this regard, because it provides the US Department of Agriculture with authority to set nutritional standards for all foods and beverages sold in schools including in competitive venues.[27]

The current study underscores the potential importance of developed nutritional guidelines; simply having a school wellness policy did not relate to SSB availability. In contrast, having developed nutritional guidelines was related to significantly decreased high school soda and non-soda SSB access. Research has shown that simply *having* a school district wellness policy does not equate with having a strong policy.[13] The current analyses did show that having nutrition guidelines was significantly more likely for students in schools with wellness policies, and school district involvement in decisions regarding beverages available in vending machines was more likely where school wellness policies and nutritional guidelines were in place. Wellness policies may provide an effective framework within which effective guidelines can be developed with school district input.

Limitations

This study's findings should be considered within their limitations. The data are cross-sectional (precluding causal interpretation) and are based on school administrator responses to self-administered questionnaires raising the possibility of reporting error and/or social desirability bias. To minimize social desirability bias, schools and respondents were guaranteed they would not be identified. To minimize response error, questionnaire directions called for different segments of the questionnaire to be completed by personnel most knowledgeable about the subject matter: principals for policy-related measures, and food service managers for food and beverage availability measures. In addition, follow-up calls were made to clarify incomplete or inconsistent questionnaires.[9,16] Limitations notwithstanding, these analyses provide a picture of the relationships between school beverage-related policies and SSB availability in a national sample of US public middle and high schools in the years immediately following the Congressional mandate for school wellness policy implementation.

Conclusion

Whereas access to soda decreased from 2007 to 2009, US middle and high school student access to SBBs remained high across competitive school venues, with non-soda SSBs making up the majority of SSB beverage options. Beverage supplier connections with schools were often related to increased SSB access, whereas developed nutritional guidelines were associated with lower SSB availability. Implementation of strong policies limiting access to soda *and* non-soda SSBs in *all* competitive venues (including à la carte sales) will likely be required to reduce secondary school SSB access.

IMPLICATIONS FOR SCHOOL HEALTH

School-based interventions have the potential to reach large numbers of youth. The American Dietetic Association has called for family- and school-based multicomponent programs to address child and adolescent overweight.[28] Research indicates the majority of weekday SSB calories are consumed by US youth at home; in-school SSB

consumption has been estimated at only 7-15% of total weekday SSB calories.[29] However, reduced in-school SSB consumption has been shown to relate to significantly lower total daily caloric intake by students.[10]

Efforts to reduce access to regular soda in US secondary schools appear to be working. However, if schools are to realize their potential in reducing student SSB caloric intake, efforts must also be made to lower the availability of non-soda SSBs, including popular sports drinks and high-calorie fruit drinks. Furthermore, care must be taken to make sure reductions happen equally across the various competitive venues available in today's schools: stores and snack bars/carts, vending machines, and à la carte cafeteria purchases. Such reductions should aim to lower SSB access not just during the school day, but also during after-school activities. Based on the results of the current study, school policy-related steps that might help accomplish reducing overall SSB school access may include lowering school dependence on bottling contract benefits and renegotiating existing bottling contracts to remove beverage supplier ''say'' in what beverage choices are made available to students (or disallowing such involvement in new contracts). Further, school districts should place a high emphasis on the development of effective nutritional guidelines for all foods and beverages sold on school grounds. The Institute of Medicine has recently released updated nutritional recommendations for child- and adult-care settings;[30] districts and schools should implement competitive venue nutritional guidelines based on such current dietary guidelines.

Human Subjects Approval Statement

This study received approval from the University of Michigan Behavioral Sciences Institutional Review Board.

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