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The association of soda sales tax and school nutrition laws: a concordance of policies

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Abstract

Objective: The current research examined the association between state disfavoured tax on soda (i.e. the difference between soda sales tax and the tax on food products generally) and a summary score representing the strength of state laws governing competitive beverages (beverages that compete with the beverages in the federally funded school lunch programme) in US schools.
Design: The Classification of Laws Associated with School Students (CLASS) summary score reflected the strength of a state's laws restricting competitive beverages sold in school stores, vending machines, school fundraisers and à la carte cafeteria items. Bridging the Gap (BTG) is a nationally recognized research initiative that provided state-level soda tax data. The main study outcome was the states' competitive beverage summary scores for elementary, middle and high school grade levels, as predicted by the states' disfavoured soda tax. Univariate and multivariate analyses were conducted, adjusting for year and state.
Setting: Data from BTG and CLASS were used.
Subjects: BTG and CLASS data from all fifty states and the District of Columbia from 2003 to 2010 were used.
Results: A higher disfavoured soda sales tax was generally associated with an increased likelihood of having strong school beverage laws across grade levels, and especially when disfavoured soda sales tax was >5%.
Conclusions: These data suggest a concordance between states' soda taxes and laws governing beverages sold in schools. States with high disfavoured sales tax on soda had stronger competitive beverage laws, indicating that the state sales tax environment may be associated with laws governing beverage policy in schools.

Keywords
Soda tax
Competitive foods
Policy
School

An estimated 10% of daily energy is filled by nutrient-deficient sugar-sweetened beverages (SSB), with soda being the predominant product[1]. SSB, and 'regular' sodas in particular, are the leading sources of added sugar in children's diets and their overconsumption has been implicated in the rise of childhood obesity[2]. Two policy approaches that have been recommended to reduce overconsumption include taxation of SSB and increasing the stringency of laws regulating the nutrient content of foods and beverages sold in public schools[3]. For example, specific populations of children (e.g. African Americans, low-income, overweight) have a greater price sensitivity[4]. However, state-level soda taxes, which are generally low compared with tobacco taxes, were created with the goal of revenue generation rather than to change behaviour, and with one exception (tax on vending machine soda sales) have not been generally associated with adolescents' soda consumption or BMI[4–8]. Still, data suggest that SSB taxes may be quite effective if they were increased to greater than 6%, such as a penny-per-ounce excise tax[9], or if generated revenue was appropriated for obesity prevention efforts[4,5,10]. The most recent data indicate that the price elasticity of SSB, which has a mean of −1·21 (−0·13 to −3·18), would decrease SSB consumption by 24% if price increased by 20%[5,11]. Similarly, laws targeting competitive foods and beverages in schools appear to have had mixed success. For example, recent longitudinal studies have reported both mitigating and null effects of competitive food and beverage laws on schoolchildren's weight status[12,13].

Heretofore, previous empirical research has associated children's weight status or soda consumption with either the magnitude of soda taxes or the strength of competitive food laws singularly, rather than in combination.

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A review of SSB consumption intervention policy further indicated that complementary school nutrition and price policies may decrease consumption of SSB, as opposed to the tax-only solution that has shown to be insufficient to affect obesity[14]. Together, these data may suggest that concomitantly strong taxation and competitive food policy that influences the environment outside and inside schools, respectively, may be more effective in reducing consumption of SSB and favourably altering weight status. However, the degree to which state soda taxes and competitive beverage laws exist in a complementary manner at each grade level and across the USA is unknown. The purpose of the present study was to assess the association of state soda taxes with the strength of state laws governing competitive beverages in schools by grade level and to determine if this association changed over time.

Methods

Soda sales taxes

Soda sales tax data from 2003 to 2010 were extracted from the Robert Wood Johnson Foundation-supported Bridging the Gap (BTG) project at the University of Illinois at Chicago. BTG is a nationally recognized research initiative created to improve the understanding of how policies and environmental factors affect diet, physical activity and obesity among youth. The BTG database lists soda sales tax on items sold through grocery stores and vending machines in each of the fifty US states and the District of Columbia as of 1 January of each year (http://www.bridgingthegapresearch.org/research/sodasnack_taxes/)[15]. In order to account for states that tax soda at a higher rate than food, we created a measure of the 'disfavoured' tax (i.e. the difference between the soda sales tax and the tax on food products generally) variable, described elsewhere[15], as our independent predictor. Soda sales tax ranged from 0 to 7·5 % and three categories of disfavoured soda tax were constructed (0 %, >0–5 %, >5 %) based on the distribution of the data.

Competitive beverage laws

The Child Nutrition and WIC Reauthorization Act of 2004 required US school districts participating in federal school meals programmes to adopt and implement wellness policies for physical education and nutrition[16]. In response, states independently adopted laws to guide school policy, but the strength of laws varied from state to state and has varied over time[17,18]. The National Cancer Institute created the Classification of Laws Associated with School Students (CLASS) scoring system and database (http://.class.cancer.gov/index.aspx) to capture variation in the strength of these state laws[17,18]. The data sources for CLASS are the actual policies affecting schools that have been codified into state law (e.g. state statutes, regulations and executive orders). The CLASS nutrition database contains independent empirical coding for the strength of school nutrition laws, derived from LexisNexis and Westlaw searches (providers of computer-assisted legal research databases and services), in comparison to national standards and recommendations for the nutrient content of foods and beverages sold in schools, which have been summarized in reports by the US Department of Agriculture (2009), the Institute of Medicine (2009) and the Centers for Disease Control and Prevention (2011)[19–21]. For example, the Institute of Medicine recommends that vending machine beverages not contain added sugar or non-caloric sweeteners. Scores for seventeen school nutrition content areas are available from 2003 to 2010 (except 2009) by grade level (elementary school, kindergarten through grade 5; middle school, grades 6 through 8; high school, grades 9 through 12) for all fifty US states and the District of Columbia. Inter-rater agreement and reliability of CLASS nutrition coding is high (agreement = 74·5–88·8 %; average intra-class correlation = 0·90). An in-depth description of the CLASS methodology and documentation is available elsewhere[18]. The present analysis used the ratings for state laws governing nutrition content of competitive beverages available for sale in four venues: cafeterias (à la carte), vending machines, at fundraisers and other venues (e.g. school stores). CLASS competitive beverage scores for each venue range from 0 to 6, with higher scores reflecting a stronger match with Institute of Medicine standards relative to the nutrient content of beverages.

To generate a yearly aggregate competitive beverage score for each state, the four categories of laws were collapsed into a summary score by creating a value for each competitive beverage category (0 = no law (CLASS score = 0); 1 and 2 = weak law (CLASS score = 1–2); and 3 = strong law (CLASS score ≥3)) and summing these values for each competitive beverage category. For the analysis we tested the association using both the score by grade level and as a total summary score after collapsing all grades into one score. These overall state aggregate scores were stratified into three levels: 0 (no law); >0–<10 (weak law); and >10 (strong law).

Statistical analysis

The independent variables in the present analysis were state disfavoured soda tax rates from 2003 to 2010 and the dependent variable was the states' aggregate competitive beverage summary score assessed between 2003 and 2010, separately for each year. A univariate analysis was conducted first using linear regression keeping sales tax as a continuous variable, and next as ordered logistic regression stratifying sales tax into three categories. This was followed by multivariate/adjusted models controlling for year and state clustering. Collinearity and parsimony of each model were also assessed. For analysis of change in competitive food law stringency (i.e. competitive beverage score) and disfavoured soda sales tax from 2003 to 2010, a general

linear model was applied to log-transformed competitive beverage scores. This analysis was run using both the univariate and multivariate models adjusting for state. We used a mixed-effects model with repeated measures by year (continuous) to assess whether disfavoured soda taxes (categorical) was associated with the strength of competitive beverage laws over time (continuous).

Results

Table 1 presents descriptive information regarding the stringency of competitive beverage laws affecting schools across levels of disfavoured soda sales tax in 2003 and 2010 by grade level. Between 2003 and 2010, there was a significant increase in the strength of competitive beverage laws ($\chi^2 = 8{\cdot}408$, $P = 0{\cdot}015$) and states with relatively higher disfavoured soda sales tax (>5 %) in 2003 showed the greatest increase in competitive beverage law strength over this period (see Fig. 1). There was no significant change in state disfavoured soda taxes over time.

A test of the association between state disfavoured sales tax on soda and strength of competitive beverage laws revealed that when taxes were assessed on a continuum, higher disfavoured soda sales tax was associated with significantly higher odds of having strong competitive

Table 1 Summary statistics for state-level soda tax and competitive beverage laws by grade, 2003 and 2010

	Soda sales tax, 2003							Soda sales tax, 2010						
	0 %		>0–5 %		>5 %			0 %		>0–5 %		>5 %		
States	%	*n*	%	*n*	%	*n*	Total	%	*n*	%	*n*	%	*n*	Total
Competitive beverage laws														
Elementary school level														
None	16	8	31	16	20	10	34	11	6	15	8	6	3	17
Weak	2	1	6	3	4	2	6	1	1	4	2	6	3	6
Strong	6	3	9	4	9	4	11	9	5	15	8	29	15	28
Total no. of states	12		23		16		51	12		18		21		51
Middle school level														
None	16	8	31	16	20	10	34	11	6	20	10	6	3	17
Weak	2	1	9	4	6	3	8	4	2	4	2	8	4	10
Strong	6	3	6	3	6	3	9	8	4	11	6	27	14	24
Total no. of states	12		23		16		51	12		18		21		51
High school level														
None	16	8	33	17	24	12	37	11	6	21	11	9	5	22
Weak	2	1	9	4	2	1	6	6	3	4	2	15	7	12
Strong	6	3	4	2	6	3	8	6	3	9	5	18	9	17
Total no. of states	12		23		16		51	12		18		21		51

Note: overall state aggregate scores were stratified into three levels: 0 (no law); >0–<10 (weak law); and >10 (strong law).

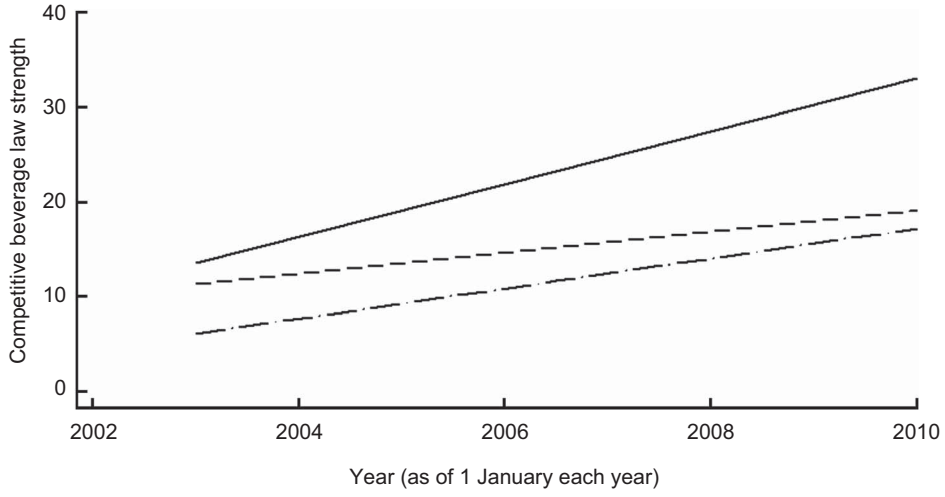

Fig. 1 Longitudinal analysis of competitive beverage laws as a function of state disfavoured soda tax. Competitive beverage law strength summary score as a continuous measure was compared with tertiles of state disfavoured soda tax over the 2003–2010 time period. The *y*-axis denotes the strength of competitive beverage laws as a continuous measure; the *x*-axis is time in years; each sloped line is a category of disfavoured soda tax (– – – – –, 0 % state disfavoured soda tax; — · — · —, 0–5 % state disfavoured soda tax; ———, 5 % state disfavoured soda tax)

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Table 2 Odds of strong competitive beverage laws by level of state disfavoured soda sales tax

	Unadjusted model				Adjusted model*			
	OR	SE	*P* value	95 % CI	OR	SE	*P* value	95 % CI
All grades								
Disfavoured soda sales tax (0–7·5 %)	1·52	0·17	**<0·0001**	1·22, 1·90	1·53	0·18	**<0·0001**	1·22, 1·92
Disfavoured soda sales tax tertiles								
0 %	Referent				Referent			
>0–5 %	1·44	0·46	0·252	0·77, 2·70	1·69	0·56	0·111	0·89, 3·22
>5 %	2·33	0·53	**<0·0001**	1·49, 3·64	2·32	0·54	**<0·0001**	1·47, 3·65
Elementary school level								
Disfavoured soda sales tax (0–7·5 %)	1·40	0·16	**0·003**	1·12, 1·76	1·41	0·16	**0·003**	1·12, 1·77
Disfavoured soda tax tertiles								
0 %	Referent				Referent			
>0–5 %	1·16	0·37	0·638	0·63, 2·15	1·35	0·44	0·352	0·72, 2·56
>5 %	2·01	0·46	**0·002**	1·28, 3·15	1·99	0·47	**0·003**	1·26, 3·15
Middle school level								
Disfavoured soda sales tax (0–7·5 %)	1·43	0·16	**0·001**	1·15, 1·79	1·45	0·17	**0·001**	1·16, 1·81
Disfavoured soda tax tertiles								
0 %	Referent				Referent			
>0–5 %	1·35	0·43	0·339	0·73, 2·54	1·61	0·53	0·145	0·85, 3·07
>5 %	2·07	0·47	**0·001**	1·33, 3·23	2·09	0·49	**0·001**	1·33, 3·28
High school level								
Disfavoured soda sales tax (0–7·5 %)	1·57	0·18	**<0·001**	1·25, 1·98	1·58	0·19	**<0·001**	1·26, 1·99
Disfavoured soda tax tertiles								
0 %	Referent				Referent			
>0–5 %	1·79	0·57	0·064	0·97, 3·34	2·12	0·69	**0·021**	1·12, 4·03
>5 %	2·45	0·57	**<0·001**	1·55, 3·85	2·46	0·58	**<0·001**	1·54, 3·91

Significant *P* values are indicated in bold font.
*OR adjusted for state and year by ordered logistic regression.

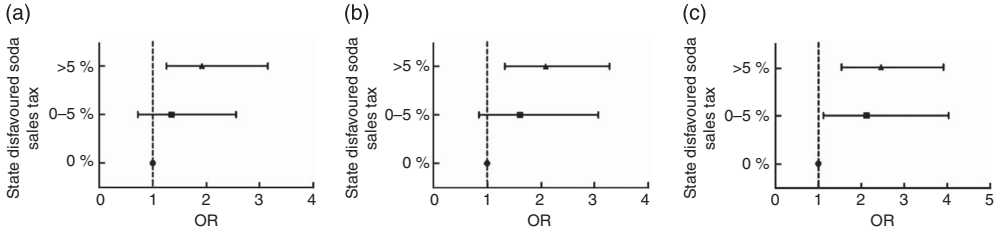

Fig. 2 Odds of strong competitive beverage laws by grade level, stratified by state disfavoured soda tax. Separately for US elementary school (a), middle school (b) and high school (c) levels, competitive beverage law summary scores were used to determine the association with state disfavoured soda taxes, which were stratified into three categories. Ordered logistic regression was used to determine the odds ratio (●, ■, ▲) and 95 % confidence interval (represented by horizontal bars), adjusted for state and year (– – – – –, OR = 1·0, referent category)

beverage laws in both models (adjusted OR = 1·53; 95 % CI 1·22, 1·92; $P < 0·0001$; Table 2). We next determined if a threshold existed at which disfavoured soda sales tax was associated with strong competitive beverage laws. Stratifying the soda sales tax into three categories, 0 %, >0–5 % and >5 %, we found that states with the highest level of soda sales tax (>5 %) also had the strongest competitive beverage laws in both models (adjusted OR = 2·32; 95 % CI 1·47, 3·65; $P < 0·0001$). Together these data demonstrate that states with higher disfavoured soda sales taxes are more likely to have stronger competitive beverage laws, with the strongest effect occurring in those states with a disfavoured soda sales tax >5 %.

Because competitive beverage laws are weaker at higher grade levels, we analysed the association between soda sales tax and strength of competitive beverage laws by school level. Across all grade levels in both the unadjusted and adjusted models, the odds of strong competitive beverage laws were greater in states with higher disfavoured soda tax when assessed continuously (see Table 2). Stratifying by soda tax (0 %, >0–5 %, >5 %) for each grade level, only states with high disfavoured soda taxes (>5 %) had significantly higher odds of having a strong beverage law in the adjusted models at the elementary (OR = 1·99; 95 % CI 1·26, 3·15; $P = 0·003$) and middle (OR = 2·09; 95 % CI 1·33, 3·28; $P = 0·001$) school levels, with the high school (OR = 2·46; 95 % CI 1·54, 3·91; $P < 0·001$) level surprisingly having the highest odds (see Fig. 2 and Table 2). Additionally, at the high school level, states with disfavoured soda taxes above 0 % to <5 % remained significantly associated with stronger beverage laws (OR = 2·12; 95 % CI 1·12, 4·03; $P = 0·021$).

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Discussion

Concomitant execution of strong state-level soda taxation policy and school beverage laws has been proffered as a potential approach to reduce consumption of SSB among children, and possibly childhood obesity, either directly by limiting energy consumption or by providing resources to promote child health[3,4,14]. However, the degree to which these state-level policies complement each other was unknown. Our study found a positive association between disfavoured soda tax rate and strength of competitive beverage laws between 2003 and 2010. While the strength of competitive beverage laws increased generally over this period, they increased most among states with the highest disfavoured soda taxes, whereas there was no significant increase in soda tax rates over this period. These data suggest that while state-level soda taxes are generally low and few states have strong competitive beverage laws across grade levels, complementary state-level soda taxation and competitive beverage policies exist and provide opportunity for further research.

Examining the interplay between soda taxation and school nutrition policy may offer insight regarding how to leverage these complementary policies. For example, combining measurements of these policies may be more highly associated with soda consumption and weight status than when policy effects are explored individually, or they may serve to clarify discrepancies in the literature regarding how policy affects these outcomes. Alternatively, the ability to detect association of these combined policy approaches with soda consumption and weight status may still be limited, since state soda taxes are relatively small in comparison to other taxes (3·54% soda sales tax *v.* 5·2% tobacco sales tax on average)[9,10,22], such as those applying to cigarettes that have been shown to influence adolescent behaviour[23]. However, since it is predicted that soda sales tax rates >6% are necessary to reduced soda consumption and SSB price elasticity is estimated to be −1·21[5], identifying complementary policies in a state that reduce SSB consumption significantly may present an opportunity to support other states in enacting similar policies.

Although beyond the scope, our study was limited by the lack of a behavioural outcome. Additionally, the CLASS data set does not distinguish between sodas and other beverages in its assessment of stringency of competitive beverage laws and we could not isolate the association of soda taxes with school nutrition laws specifically restricting sales of sodas. We also could not determine causality between soda tax and competitive food laws. It is unknown if this association is intentionally reflecting a concerted effort to change the environment or coincidental. Lastly, beyond state clustering, we did not adjust analyses for other state-level factors that may alter associations between soda taxes and strength of competitive food laws. Our study is thus silent with respect to potential factors that may causally drive the relationship between laws governing school wellness and soda taxation policy. A correlation having been established, future studies may specifically examine factors, such as median household income, state deficit or childhood obesity, which could be a mediator of this relationship.

In general, our study demonstrates a positive association between state soda taxes and strength of competitive beverage laws across all grade levels. However, the overall association between soda taxes and the strength of competitive beverage laws was driven principally by the association at the highest levels of soda tax and competitive beverage laws, whereas no and low soda taxation was not associated with competitive beverage laws, except at the high school level, which also had the highest odds of having strong beverage laws with high soda taxes. Given that laws governing competitive beverages in high schools are relatively weak, this strong association may be spurious given the small number of states with strong laws at high school level, or it may indicate that idiosyncratic factors, such as concern over the health preparedness of youth as they prepare to enter the workforce, may be governing this relationship and should be the focus of future studies. Future longitudinal studies may examine if complementary soda tax and competitive beverage laws are associated with purchasing and consumption behaviours of students and explore conditions that may improve complementarities.

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