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Regular Soda Policies, School Availability, and High School Student Consumption

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Abstract

Background—Beginning in the 2014–2015 school year, all U.S. schools participating in federally reimbursable meal programs are required to implement new nutrition standards for items sold in competitive venues. Multilevel mediation modeling examining direct, mediated, and indirect pathways between policy, availability, and student consumption might provide insight into possible outcomes of implementing aspects of the new standards.

Purpose—To employ multilevel mediation modeling using state- and school district–level policies mandating school soda bans, school soda availability, and student soda consumption.

Methods—The 2010–2012 Monitoring the Future surveys obtained nationally representative data on high school student soda consumption; school administrators provided school soda availability data. State laws and district policies were compiled and coded. Analyses conducted in 2014 controlled for state-, school-, and student-level characteristics.

Results—State–district–school models found that state bans were associated with significantly lower school soda availability (*c*, $p<0.05$) but district bans showed no significant associations. No significant direct, mediated, or indirect associations between state policy and student consumption were observed for the overall sample. Among African American high school students, state policy was associated directly with significantly lower school soda availability (*a*, $p<0.01$), and—indirectly through lower school availability—with significantly lower soda consumption (*a*b*, $p<0.05$).

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Conclusions—These analyses indicate state policy focused on regular soda strongly affected school soda availability, and worked through changes in school availability to decrease soda consumption among African American students, but not the overall population.

Introduction

In 2011, 25% of U.S. public high school students attended schools where regular soda was available through competitive venues (à la carte cafeteria sales, vending machines, and stores/snack bars/carts that compete with school meal programs).[1] Competitive venues also make available other non-soda sugar-sweetened beverages (SSBs) such as high-sugar fruit drinks, energy drinks, and sports drinks. At least one type of competitive venue SSB was available for 88% of public high school students in 2011.[1] Starting in the 2014–2015 school year, U.S. high schools participating in federally reimbursable meal programs are required to remove virtually all competitive venue SSBs under implementation of the U.S. Department of Agriculture (USDA) nutrition standards for foods and beverages sold in school competitive venues (hereafter referred to as USDA standards).[2]

Previous efforts to improve school competitive venue nutrition have occurred at state, district, and school levels. Research evaluating school SSB availability/consumption policy has been mixed. State policy generally has been associated significantly with school SSB availability, especially at lower grade levels.[3–5] Results have been mixed for policy and school availability associations with student consumption.[3,4,6–11] Some studies have shown that school beverage availability is associated with overall student SSB consumption.[10,12] Other research examining only regular soda has indicated that state policy and school availability are associated with consumption among African American students, but not the general student population.[7,13]

The USDA standards are a national policy effort. Is it likely that nutrition policy at such a distal level from a specific school's environment (as compared with, for example, more proximal district policies) will have a significant association with school practices, which might then be associated with student outcomes? Analyses utilizing multilevel mediation to examine direct, mediated, and indirect pathways in the current policy environment between policy, availability, and student consumption might provide insight into possible outcomes of USDA standard implementation. Mediation analyses allow identification of variable(s) intermediate in the causal sequence between independent and outcome variables[14]; such identification is important in understanding connections among beverage policy at multiple levels, school beverage availability, and student beverage consumption. This paper uses multilevel mediation, state and district policy, school-level competitive venue beverage availability data, and data from nationally representative samples of high school students to examine the following research questions: (1) Are state and district policy associated significantly with school soda availability? (2) If significant associations are observed, are the associations direct, mediated, or indirect, and does one level of policy appear to be the primary driver of school availability? (3) Is there a mediation pathway from the primary policy lever identified in Research Question 2 through school soda availability to student soda consumption (either overall or only for specific subgroups such as African American students)?

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Methods

The Appendix provides detailed information on study samples. Briefly, nationally representative data from three annual cross-sectional samples of tenth and twelfth grade students were obtained from the 2010–2012 school-based Monitoring the Future (MTF) studies, which utilize a multistage stratified random sampling procedure (Stage 1, geographic area selection based on population density; Stage 2, selection of schools within geographic areas; Stage 3, selection of students within school).[15] School administrator data were collected from the half sample of schools cycling out of the MTF study in 2010–2012 through the Youth, Education, and Society (YES) study using mailed questionnaires.[16] Ethical approval for both studies was obtained from the University of Michigan Behavioral Sciences IRB. Policy data were collected through the Bridging the Gap research initiative (approved by the University of Illinois at Chicago IRB). State laws, effective the day after Labor Day of each year (proxy for the first day of each school year), were compiled using codified state statutory and administrative (regulatory) law databases (hereafter collectively referred to as "state policies").[11] "On-the-books" policies were gathered for school districts including MTF study schools through Internet research with telephone and email follow-up.[17]

Measures

Students were asked: *Regular (non-diet) soft drinks include Coke, Pepsi, Mountain Dew, Dr. Pepper, etc. How many (if any) 12-ounce cans or bottles (or the equivalent) of regular (non-diet) soft drinks do you drink PER DAY, on average?* Responses included *none, less than one, one, two, three, four, five or six,* or *seven or more*. "Any daily consumption" (one or more versus none or less than one) was coded for analyses. See the Appendix for further discussion.

Administrators reported if students had access to "regular soft drinks (such as Coke, Pepsi, or Dr. Pepper)" in each of the following venues: à la carte cafeteria lines, vending machines, and stores/snack bars/carts. A dichotomous indicator of soda availability in any competitive venue was created.

Codified, on-the-books state and district policies specifically mandating regular soda bans in schools were obtained and analyzed. Separate dichotomous measures were created for each jurisdictional level (i.e., state and district) indicating a mandated regular soda ban in all of à la carte cafeteria lines, vending machines, and school stores (hereafter referred to as a "comprehensive ban").

Models included state-, school-, and student-level covariates known to be associated with the primary measures included in analyses to reduce the likelihood of spurious associations. Student-level covariates included self-reported gender, race/ethnicity, and average parental education (used as a proxy for SES).[7,12,13] School-level covariates included population density, grade level, percentage of students eligible for free and reduced price lunch, total enrollment, and student body racial/ethnic distribution.[1,3,15] State-level covariates included population density, racial/ethnic distribution, adolescent obesity rates, and region of the U.S. All models controlled for year using dummy variables.[4]

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Statistical Analysis

Analyses were conducted in 2014 using SAS, version 12.1 (SAS Institute, Inc., Cary NC) for descriptive analyses and Mplus, version 7.2 (Muthén & Muthén, Los Angeles CA) for multivariate structural equation mediation models.[18] The Appendix provides detailed analysis descriptions; in brief, descriptive analyses used survey commands to account for clustering in SE estimates and were weighted to adjust for differential selection probability. Mplus single-level mediation analyses used a design-based approach with TYPE=COMPLEX; multilevel mediation analyses used a hybrid model-/design-based approach with TYPE=COMPLEX TWOLEVEL.[19,20] Figure 1 presents the general mediation models utilized.

Policy and school availability analyses included total association models (regression models without mediation) and 1-1-1 mediation models (state policy, district policy, and school soda availability all analyzed at the same level). As noted above, the MTF sample design does not include state- or district-level stratification; thus, it was not necessary to include either state or district as separate levels in a multilevel modeling context. Policy/school availability analyses indicated state policy was associated more strongly than district policy with school availability (described in Results section). Thus, policy–school–student analyses utilized a 2-2-1 mediation model: state policy and school soda availability at Level 2, and student soda consumption at Level 1. Table 1 provides descriptions of key regression coefficients in both policy/school availability and policy/school availability/student consumption models.

Results

Policy and School Availability

The unweighted sample *n* for cases with non-missing covariates and school soda availability was 243 schools in 42 states (Table 2). From 2010 to 2012, an average of 31% of U.S. public high school students attended schools with competitive venue regular soda. Thirty-six percent of high school students attended schools in states with comprehensive regular soda bans, and 41% attended schools in districts with comprehensive bans.

Table 3 presents multivariate associations between independent variable state policy, mediator district policy, and outcome school soda availability. In non-mediation (total association) models, comprehensive state bans were associated with significantly lower school soda availability ($p<0.01$); the association for comprehensive district bans was in the same direction, but not significant ($p=0.150$). The 1-1-1 mediation analyses showed that comprehensive state bans were associated directly with a significantly higher likelihood of comprehensive district bans (*a*, $p<0.001$). Having a comprehensive state ban also was associated directly with significantly lower soda availability (*c*, $p<0.05$). In contrast, district bans were not associated significantly with school soda availability (*b*). No significant mediation or indirect effect was observed (*a***b*).

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Policy, School Availability, Student Consumption

Unweighted sample sizes for cases with non-missing covariates, school soda availability, and student soda consumption were 7,877 students in 266 high schools in 42 states (Table 4). From 2010 to 2012, an average of 46% of students reported drinking regular soda daily. Thirty-five percent attended schools in states with comprehensive soda bans, and 32% attended schools with competitive venue soda available.

Total association and 2-2-1 mediation analyses using the Level 2 independent variable state policy, Level 2 mediator school soda availability, and Level 1 outcome student soda consumption showed no significant associations other than a significant, expected negative direct association between comprehensive state bans and school competitive venue soda availability (Appendix Table 1; coefficient a= –0.208, SE=0.066, p=0.002). Because the literature indicated the likelihood of subgroup differences,[13] bivariate total association models were run, testing interactions between school soda availability and gender, SES, and race/ethnicity on student daily soda consumption. Only the interaction term with African American race/ethnicity was significant (coefficient=0.609, SE=0.177, p=0.001). Analyses were repeated for only African American students.

Unweighted sample sizes for African American subsample cases with non-missing covariates, school soda availability, and student soda consumption were 809 students in 152 high schools in 40 states (Table 4). From 2010 to 2012, an average of 54% of African American students reported drinking regular soda daily. Just over one third (35%) attended schools in states with comprehensive soda bans, and 36% attended schools with soda available in at least one competitive venue.

In non-mediation (total association) models, comprehensive state bans were not associated significantly with student soda consumption (Table 5). In contrast, total association models showed school soda availability was associated with a significantly higher likelihood of soda consumption (p<0.05). In mediation analyses, comprehensive state bans were associated with a significantly lower proportion of schools reporting competitive venue soda availability (a, p<0.01). Any school competitive venue soda was associated with significantly higher student soda consumption (b, p<0.001). No significant direct association between comprehensive state bans and student consumption was observed (c). Comprehensive state bans did show a significant indirect effect on daily soda consumption among African American students by significantly reducing school soda availability ($a*b$, p<0.05).

Discussion

Regular soda is one of many SSBs consumed by adolescents. SSB consumption is associated with higher energy intake/body weight, lower nutrient intake, and weight gain among children and adolescents.[21–23] Estimates of SSB contributions to dietary energy intake are higher for adolescents aged 12–19 years than all other age groups[24]; calls to reduce child/adolescent SSB consumption have been made by the American Academy of Pediatrics and the IOM.[25,26] This analysis used 3 years of data from nationally representative samples of high school students and the schools that they attended to examine

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associations between state policy, district policy, school availability, and student regular soda consumption.

Policy Associations (Direct, Mediated, or Indirect) with School Soda Availability

State policy mandating bans on school competitive venue regular soda was associated more strongly with reduced school soda availability than was district policy with similar mandates. Comprehensive state bans were associated significantly and directly with lower school soda availability, but district policy did not significantly mediate state policy associations with school soda availability. Previous research found district policy evidenced weaker associations than state policy with elementary and middle school unhealthy food availability[3]; the authors hypothesized the finding resulted from less rigorous district than state policy. The current study does not indicate that districts are less likely to ban soda; fewer students attended high schools in states willing to enact policy banning regular soda than attended high schools in specific districts with a similar ban (only 36% of high school students attended schools in states with comprehensive soda bans compared to 41% attending schools in districts with such bans). The current study did find that having a comprehensive state ban significantly predicted the presence of district bans, consistent with Taber and colleagues[27] who found district policies were stronger in states with strong laws.

Policy Associations (Direct, Mediated or Indirect) with Student Soda Consumption

Among the total student population, no significant direct, mediated, or indirect associations were found among policy, school availability, and student consumption. In line with previous research,[7,13] interactions indicated that school soda availability showed a significant association with consumption among African American students. No significant direct total associations were found between state policy and African American student soda consumption. Employment of a mediation approach identifying variables intermediate in the causal sequence between independent and outcome variables[14] allowed analyses to show that state policy was associated directly with significantly lower school soda availability, and—through lowered school soda availability—was indirectly associated with significantly lower African American student soda consumption. The majority of adolescent SSB consumption occurs outside of school.[12,28] African American high school students report higher SSB consumption at school than do other racial/ethnic groups,[28] are less likely than white students to report not drinking soda,[29] and have higher soda consumption frequency.[13] In the current analyses, African American high school students were significantly more likely than white students to report daily soda consumption (bivariate model coefficient=0.282, SE=0.087, p=0.001), whereas no similar differences were observed for Hispanic or “other” racial/ethnic groups. As a group, African Americans may be an especially high consumer group, and as such, may be more sensitive to changes in the school beverage environment.

This study examined policies, school availability, and student consumption of regular soda only (MTF does not collect overall SSB consumption data). The USDA standards (if implemented comprehensively) will remove virtually all SSBs from high school competitive venues. This is important because: (1) state laws are much more likely to ban soda than other SSBs[30]; and (2) high school non-soda SSBs availability is markedly higher than

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regular soda.[1] Given that the potential impact of the USDA standards on national school nutrition is much larger than single beverage state bans, the potential for impact on the general population's SSB consumption may also be greater. Indications of such impact come from secondary student studies finding: (1) improved student nutrient intake where state standards regulate the nutritional content of competitive foods and beverages[31]; and (2) significantly lower SSB consumption at school and overall for students participating in the National School Lunch Program than non-participants.[12] Improvements to school competitive venue nutrition environments frequently lead to increased participation in reimbursable meal programs.[8,32–34] One likely consequence of USDA standard implementation will be the removal of snack foods/beverages with poor nutritional content that currently provide an alternative to reimbursable meal programs—thereby not only possibly increasing reimbursable meal participation, but also removing poor competitive venue nutritional choices from students who still choose to not participate.[2] Thus, the hope is that full implementation of USDA standards will significantly affect overall SSB consumption among both the general population and high consumption groups—something that cannot be tested by the data in the current analyses. However, the current analyses do indicate that potential effectiveness of the USDA standards may be strengthened by strong ties to state-level implementation efforts (as opposed to relying on district-level efforts). State-level ties in fact are currently written into the standards, which "…requires that State agencies ensure that all schools, [school food authorities], and other food groups comply with its competitive food standards. State agencies must also retain documentation demonstrating compliance."[2] The current findings also indicate that the USDA standards may help to reduce obesity risk disparities among groups with specific food and beverage consumption patterns, such as African American youth who: (1) report high soda consumption; (2) appear to be more sensitive to changes in the school nutrition environment driven by strong policy; and (3) are at high risk of obesity.[35]

This study benefited from nationally representative samples of high school students and their respective administrators, objectively measured comprehensive state and district policy data, and multilevel mediation modeling. However, data were cross-sectional, precluding causal interpretation. Although state and district policy data were objectively measured from codified sources, school measures were based on administrator responses to self-administered questionnaires, raising the possibility of social desirability bias and reporting error. To minimize social desirability bias, schools and respondents were guaranteed they would not be identified. To minimize response error, administrator 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. Follow-up calls were made to augment incomplete or clarify inconsistent administrator questionnaires.[16] Student soda consumption data were obtained via self-report from a single food frequency questionnaire (FFQ)-type measure, and the dichotomous measure coded for analysis did not allow for models that investigated consumption shifts above any daily consumption. FFQ-type surveys have been shown to provide reasonable population estimates of habitual dietary patterns,[36] but likely result in under-reporting.[36] Because the goal of this study was not to provide national estimates of consumption, but to examine policy/environment associations

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with consumption, use of self-report data are reasonable. Data were not available documenting how frequently students consumed soda in school versus other locations, or on the source(s) of consumed beverages.

Conclusions

Previous research has not provided multilevel modeling examining how policy that is distal from an adolescent's proximal surroundings may mediate beverage consumption behavior through the school environment. The current analyses indicate that distal soda policy—in this case, state-level policy—strongly affects school soda availability, and can work through changes in the school environment indirectly to decrease soda consumption among a particular student subgroup that shows evidence of high overall consumption.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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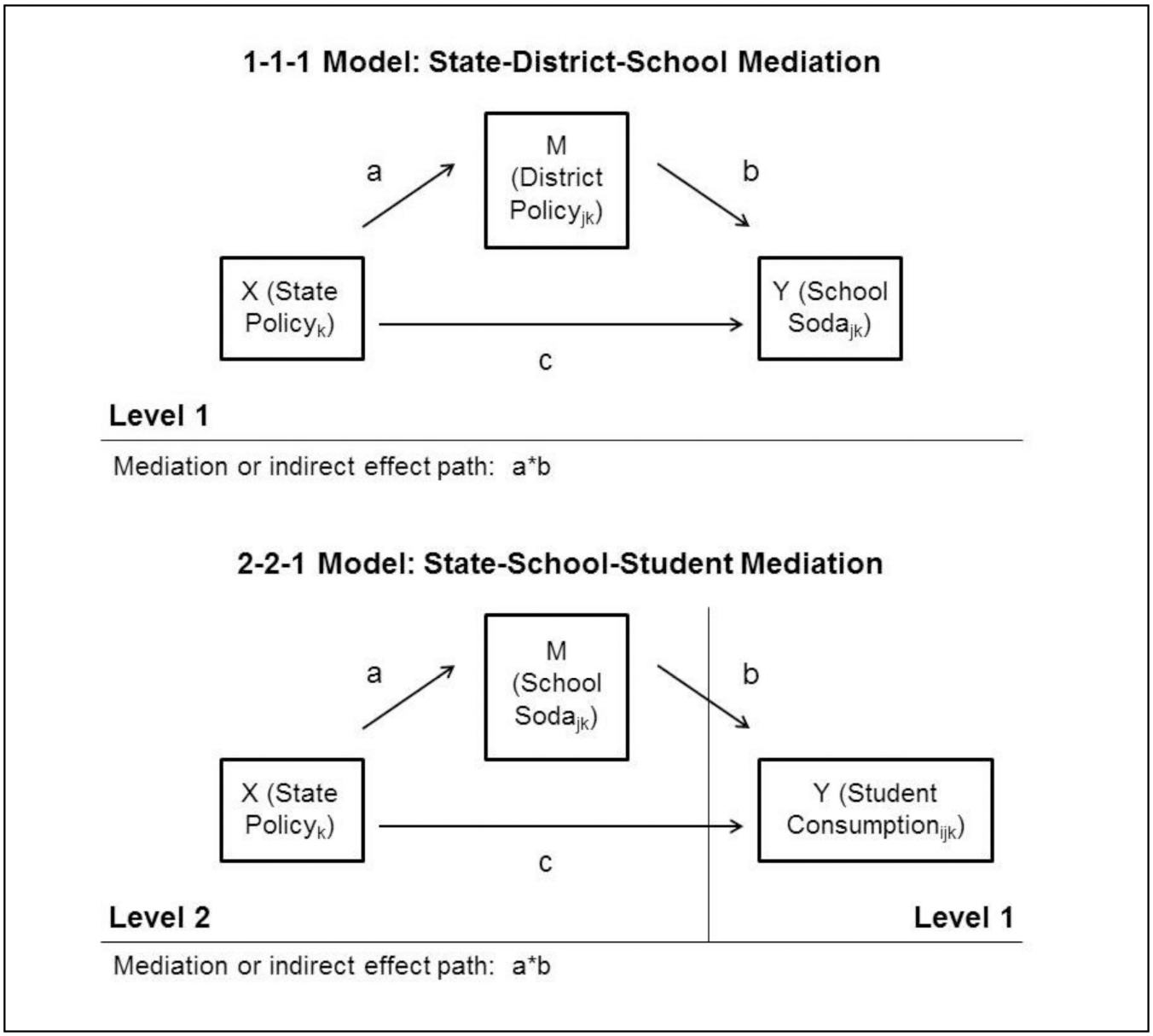

Figure 1.

Hypothesized one- and two-level mediation models

Note: X indicates the independent variable; M indicates the mediator; Y indicates the outcome variable. Subscripts indicate student *i* in district/school *j* in state *k*. Estimates a, b, and c indicate non-standardized multivariate regression coefficients.

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Table 1

Key Mediation Model Regression Coefficients

Coefficient[a]	Association	Interpretation: 1-1-1 State-District-School Models (Policy/School Availability)	2-2-1 State-School-Student Models (Policy/School Availability/Student Consumption)
A	X→M	Direct association between state policy banning school competitive venue soda (X) and the likelihood that a district has a similar ban (M)	Direct association between state policy banning school competitive venue soda (X) and the likelihood that a school has competitive venue soda available (M)
B	M→Y	Direct association between district policy banning school competitive venue soda (M) and the likelihood that a school has competitive venue soda (Y), controlling for state policy (X)	Direct association between school competitive venue soda (M) and the proportion of students in a school reporting drinking soda daily (latent school-level Y), controlling for state policy (X)
C	X→Y	Direct association between state policy banning school competitive venue soda (X) and the likelihood that a school has competitive venue soda (Y), controlling for district policy (M)	Direct association between state policy banning school competitive venue soda (X) and the proportion of students in a school reporting drinking soda daily (latent school-level Y), controlling for school availability (M)
a*b	X→M→Y	Association sequence between state policy (X) and school competitive venue soda (Y): Mediation: Significant overall association between state policy (X) and school soda (Y); district policy (M) transmits at least part of the significant association. Indirect effect: No significant overall association between state policy (X) and school soda (Y); state policy indirectly effects school soda by having a significant effect on district policy (M), which then has a significant effect on school soda (Y).	Association sequence between state policy (X) and student daily soda consumption (latent school-level Y): Mediation: Significant overall association between state policy (X) and student consumption (latent school-level Y); school availability (M) transmits at least part of the significant association. Indirect effect: No significant overall association between state policy (X) and student consumption (latent school-level Y); state policy indirectly effects student consumption by having a significant effect on school soda availability (M), which then has a significant effect on student consumption (latent school-level Y).

[a] Coefficients listed indicate non-standardized multivariate regression coefficients.

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Table 2

Descriptive Statistics for State-District-School Models, 2010–2012[a]

	% (95% CI)	Mean (95% CI)
School soda availability (any vs. none)		
Any competitive venue	30.7 (22.0, 39.4)	
State-level mandated soda ban (any vs. none)		
All competitive venues	35.8 (16.6, 55.0)	
District-level mandated soda ban (any vs. none)		
All competitive venues	41.3 (25.8, 56.8)	
School characteristics		
Grade 12 (vs. 10)	41.9 (36.5, 47.3)	
>66% White	58.9 (44.4, 73.3)	
>40% Eligible for free and reduced price lunch	47.2 (37.2, 57.2)	
1001+ students (total enrollment)	60.7 (46.9, 74.4)	
Rural	31.8 (24.4, 39.1)	
State characteristics		
South	34.9 (9.4, 60.3)	
% White		80.2 (77.8, 82.7)
% Obese (aged 10–17)		16.3 (15.2, 17.5)
Population density per square mile (in 100s)		2.4 (1.4, 3.4)

[a]Estimates obtained from models clustering by sample design strata. Data weighted to indicate the percentage of U.S. public high school students attending schools within districts or states with the specified characteristics. Unweighted n = 243 schools in 42 states.

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Table 3

Associations between State and District Regular Soda Policy and High School Regular Soda Availability, 2010–2012[a]

		Coefficient[b]	(SE)	p
Separate non-mediation multivariate total association analyses[c]				
State mandated soda ban → School soda availability		**−1.256**	(0.399)	0.002
District mandated soda ban → School soda availability		−0.808	(0.561)	0.150
1-1-1 Multivariate mediation analyses				
Level 1 State mandated soda ban				
Level 1 District mandated soda ban				
Level 1 School soda availability				
a	State ban → District ban	**0.559**	(0.068)	0.000
b	District ban → School soda availability	−0.264	(0.658)	0.689
c	State ban → School soda availability	**−1.117**	(0.557)	0.045
a*b	Mediation or indirect effect	−0.147	(0.374)	0.694

[a] Models clustered by sample design strata and were weighted to indicate the percentage of U.S. public high school students attending schools within districts or states with the specified characteristics. All models simultaneously controlled for school characteristics (grade, student body racial/ethnic distribution, percentage of student body eligible for free and reduced price lunch, school enrollment, population density), as well as state characteristics (percent White population, population density, adolescent obesity rates, region) and year. Unweighted $n = 243$.

[b] Boldface for coefficients indicates significant p values.

[c] Models examining total associations run separately for state and district bans.

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Table 4

Descriptive Statistics for State-School-Student Models, 2010–2012[a]

	% (95% CI)	Mean (95% CI)
All Students[b]		
Student daily regular soda consumption[c]	45.9 (44.1, 47.6)	
Any school competitive venue soda availability[d]	31.8 (25.3, 38.4)	
State mandated soda ban - all competitive venues[e]	35.0 (29.5, 40.5)	
Student characteristics[f]		
Race/ethnicity		
African American	10.2 (8.1, 12.3)	
Hispanic	13.9 (11.3, 16.4)	
White	59.9 (56.2, 63.7)	
Other	13.1 (11.4, 14.8)	
Missing dummy marker	2.9 (2.5, 3.4)	
Gender		
Male	48.5 (47.4, 49.6)	
Missing dummy marker	2.0 (1.6, 2.4)	
Average parental education		
Low	13.6 (12.0, 15.3)	
Missing dummy marker	5.3 (4.6, 5.9)	
School characteristics		
Grade 12 (vs. 10)	28.9 (23.1, 34.7)	
>40% Eligible for free and reduced price lunch	46.4 (39.3, 53.6)	
1001+ students (total enrollment)	60.9 (54.6, 67.2)	
Rural	31.8 (25.2, 38.3)	
State characteristics		
South	32.9 (29.4, 36.5)	
% White		80.5 (79.7, 81.4)
% Obese (aged 10–17)		16.2 (15.9, 16.6)
Population density per square mile (in 100s)		2.4 (2.2, 2.7)
African American Students[g]		
Student daily regular soda consumption	53.7 (49.9, 57.5)	
Any school competitive venue soda availability	35.6 (22.5, 48.7)	
State mandated soda ban - all competitive venues	34.6 (22.9, 46.4)	
Student characteristics		
Gender		
Male	49.4 (44.3, 54.5)	
Missing dummy marker	2.1 (0.9, 3.2)	
Average parental education		
Low	12.7 (9.2, 16.2)	
Missing dummy marker	6.0 (4.2, 7.9)	

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	% (95% CI)	Mean (95% CI)
School characteristics		
Grade 12 (vs. 10)	32.3 (21.2, 43.4)	
>40% Eligible for free and reduced price lunch	70.5 (60.4, 80.7)	
1001+ students (total enrollment)	60.4 (47.6, 73.2)	
Rural	20.6 (10.9, 30.3)	
State characteristics		
South	57.7 (46.9, 68.4)	
% White		76.4 (74.5, 78.4)
% Obese (aged 10–17)		17.7 (17.1, 18.3)
Population density per square mile (in 100s)		2.5 (2.2, 2.9)

[a] Estimates obtained from models clustering by school and sample design strata and weighted to adjust for differential selection probability.

[b] *n* (unweighted) = 7,877 students in 266 schools in 42 states.

[c] One or more regular soda daily vs. none or less than one.

[d] Any regular soda reported to be available in one or more of the following: à la carte cafeteria lines, school stores/snack bars/carts, vending machines.

[e] State policy banning regular soda in each of the following: à la carte cafeteria lines, school stores/snack bars/carts, vending machines.

[f] Missing data for these measures handled by assigning cases with missing data a value of 0 for the measure, and then coding missing data indicators and including them in all multivariate models.

[g] *n* (unweighted) = 809 students in 152 schools in 40 states.

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Table 5

State Policy, School Soda Availability and African American High School Student Soda Consumption, 2010–2012[a]

		Coefficient[b]	(SE)	p
African American High School Students				
Separate non-mediation multivariate total association analyses[c]				
State mandated ban → Student consumption		−0.077	(0.110)	0.482
School soda availability → Student consumption		**0.291**	(0.127)	0.022
2-2-1 Multivariate mediation analyses				
Level 2 State mandated soda ban				
Level 2 School soda availability				
Level 1 Student daily soda consumption				
a	State ban → School soda availability	**−0.263**	(0.077)	0.001
b	School soda availability → Student consumption	**0.326**	(0.070)	0.000
c	State ban → Student consumption	0.025	(0.140)	0.860
a*b	Mediation or indirect effect	−0.086	(0.034)	0.011

[a] Models clustered by school and sample design strata and included the sample design weight as a grand mean centered covariate. All models simultaneously controlled for Level 1 student characteristics (race/ethnicity, gender, average parental education), Level 2 school characteristics (grade, percentage of student body eligible for free and reduced price lunch, total enrollment, population density), and Level 2 state characteristics (percent White population, population density, adolescent obesity rates, region) and year.

Level 1 n = 809; Level 2 n = 152.

[b] Bold font for coefficients indicates significant p values.

[c] Models examining total associations run separately for state bans and school availability.