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Original article

Associations between State-level Soda Taxes and Adolescent Body Mass Index

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Abstract

Purpose: Soft drink consumption has been linked with higher energy intake, obesity, and poorer health. Fiscal pricing policies such as soda taxes may lower soda consumption and, in turn, reduce weight among U.S. adolescents.

Methods: This study used multivariate linear regression analyses to examine the associations between state-level grocery store and vending machine soda taxes and adolescent body mass index (BMI). We used repeated cross-sections of individual-level data on adolescents drawn from the Monitoring the Future surveys combined with state-level tax data and local area contextual measures for the years 1997 through 2006.

Results: The results showed no statistically significant associations between state-level soda taxes and adolescent BMI. Only a weak economic and statistically significant effect was found between vending machine soda tax rates and BMI among teens at risk for overweight.

Conclusions: Current state-level tax rates are not found to be significantly associated with adolescent weight outcomes. It is likely that taxes would need to be raised substantially to detect significant associations between taxes and adolescent weight. © 2009 Society for Adolescent Medicine. All rights reserved.

Keywords: Adolescents; BMI; State taxes; Soda tax

Obesity (age- and gender-specific body mass index [BMI] $\geq$ 95th percentile) rates reached 17.6% among U.S. adolescents aged 12 to 19 years, in 2003–2006 [1]. Parallel to the rising obesity epidemic, data show an upward trend over the previous 2 decades in adolescents' total energy intake and, in particular, an increase in soft drink consumption [2–4]. Soft drinks are readily available to youth in homes, schools, restaurants, and vending machines, and the mean daily intake of soft drinks among youth more than doubled over the 1977–1978 to 1994–1998 period—increasing from 5 to 13 oz. among boys and 5 to 11 oz. among girls, respectively [5]. Additionally, soft drink consumption as a percent of total daily caloric intake increased over the 1977–1978 to 1999–2001 period from 3.0% to 6.9% for children aged 2 to 18 and 4.1% to 9.8% for young adults [3]. Soda was found to contribute approximately 67% of all sugar-sweetened beverage calories among adolescents [4]. In addition, soft drink consumption has been shown to be the single greatest contributor to the intake of total added sweeteners making up 37.1% and 40.7%, respectively, among female and male adolescents [6]. Recent comprehensive reviews show that soft drink consumption has been associated with higher energy intake, lower nutrient intake, and obesity [7,8].

It is not surprising then that reducing soft drink consumption is considered a key target for public health officials and policymakers as a potential means of reducing weight, particularly among children and adolescents, because soft drinks offer no nutritional value. Recently, the beverage industry has entered into a voluntary agreement with the Clinton Foundation and the Alliance for a Healthier Generation to adopt school beverage guidelines that restrict the sale of soft drinks in schools [9]. Additionally, given the broad reach

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of schools, policymakers have begun to ban or limit soft drink sales in schools [10,11]. In addition, at the school district level, wellness policies mandated by Congress for districts participating in the National School Lunch Program (P.L. 108-265) as well as other policies developed at the district level are increasingly including restrictions on the availability of and access to soft drinks by students [12]. There are also significant public health concerns about the extent of advertising directed at children [13]; advertisements for regular soft drinks are the fourth most frequent category of food and beverage television advertisements seen by adolescents aged 12 through 17 [14]. In addition, given the success in other public health areas such as tobacco, there has been much discussion on implementing fiscal tax policies (such as soda and ''fat'' taxes) to change relative prices of healthy versus unhealthy food and beverages as a means of improving individuals' diet with the aim of reducing obesity and improving health outcomes [15–19]. Whereas the implementation of food and beverage taxes as instruments aimed at reducing obesity has been called for on the basis of food nutrient content, it is recognized that from a legislative vantage it is likely easier to tax specific categories of food, in particular, those with low nutritional value such as soft drinks [15,18]. Indeed, just rcently, as a public health measure, some states have proposed introducing or increasing soda taxes [20,21].

To date, however, fiscal policies such as state-level food and beverage taxes have not been implemented with the primary goal of changing consumption behavior. These taxes are applied primarily for revenue generation and, for the most part, revenue of the limited food and beverage taxes that are in place go to the general treasury or to other nonhealth-related purposes [22]. State-level soda taxes currently exist in 34 states on soda sold in grocery stores and 39 states on soda sold through vending machines with mean tax rates of 3.43% and 4.02%, respectively [22]. Evidence on the extent to which such taxes are associated with weight is limited and not available for children or adolescents. A study [19] of associations between taxes and state-level aggregate adult obesity rates found no statistically significant differences in obesity prevalence between states without taxes and those with taxes or those with at least a 5% tax. The study did reveal a weak statistically significant (p value $= .09$) association where when compared with states with taxes, states that had repealed a soft drink or snack-food tax were 13 times more likely to have had a high ($\geq$75 percentile in the relative increase) relative increase in obesity prevalence.

A limited number of existing studies using individual-level data, however, have found statistically significant associations between food prices and children's weight, suggesting that fiscal pricing policies may affect weight outcomes. Lower fruit and vegetable prices have been statistically significantly associated with lower weight outcomes among children and adolescents [23–26], and higher fast food prices have been statistically significantly associated with lower weight outcomes among adolescents [14,25–28]. No studies to date that we are aware of, however, have linked soft drink prices or state-level taxes to individual-level data to assess price/tax sensitivity of weight outcomes. Given the combined evidence on increasing soft drink consumption among youths and the associations between soda consumption and obesity, developing an evidence base on the potential price/tax sensitivity is important.

This study examines the associations between state-level grocery store and vending machine soda tax rates and adolescents' BMI. We use repeated cross sections over the 1997 through 2006 period of individual-level data on adolescents drawn from the Monitoring the Future (MTF) study combined with external data from multiple sources. Multivariate regression analyses control for individual- and household-level sociodemographic characteristics, local area food store and restaurant availability, local area socioeconomic status (SES), and year effects. We also examine whether the associations differ by gender, grade, parents' SES or adolescents at risk for overweight.

Methods

Data

This study drew on individual-level national data for 8th, 10th, and 12th grade students from the MTF study, combined with external data on state-level soda grocery store and vending machine sales tax rates over the 10-year period from 1997 through 2006. We also included several contextual control measures. We controlled for local area food store and restaurant availability using data drawn from business lists developed by Dun and Bradstreet (D&B). We also controlled for local area SES using data on per capita income drawn from the Census 2000. The external soda sales tax data were matched to the individual-level data at the state level, and the outlet density and per capita income controls were matched at the school zip code level for each year 1997 through 2006.

State-level soda tax data: independent predictors

Data on state-level sales tax rates for soda purchased through grocery stores as well as through vending machines, for the years 1997 through 2006, inclusive (using a January 1 annual reference date) were obtained from data compiled by The MayaTech Corporation for the Robert Wood Johnson Foundation-supported ImpacTeen project [22]. The sales tax rates were compiled from state statutory and administrative law via primary legal research [29] and were verified by the states. Hence, in this study, the state-level sales tax rates imposed on soda sold in grocery stores and through vending machines were our key independent variables of interest. Additionally, we examined dichotomous indicators for the presence of each state tax. Also, we assessed the effect of whether the grocery store soda sales tax rate was ''disfavored,'' that is, whether the soda sales tax rate was higher than the tax rate for food generally [22,30]. We assessed

the disfavored status using a dichotomous indicator for disfavored status and a continuous measure of the amount of the disfavored tax (the soda tax rate minus the general food tax rate). Data on the general state sales tax rates for food were obtained from the Federation of Tax Administrators [31].

Monitoring the Future survey data: individual-level outcome measure and controls

Since 1975, the MTF study conducted at the University of Michigan's Institute for Social Research annually surveyed nationally representative samples of 12,000–15,000 high school seniors in the coterminous United States. Since 1991, the MTF surveys also included about 30,000 8th and 10th grade students annually. Located in approximately 420 schools, these students and schools were selected annually for the MTF survey based on a three-stage sampling procedure (see [32] for details on the sampling procedure). To cover the range of topic areas in the study, students were administered different questionnaire forms; four forms among 8th and 10th grade students and six forms among 12th grade students. This occurred in an ordered sequence ensuring virtually identical subsamples for each form. Approximately one-third of the questions on each form were common to all forms, including the demographic variables used in this study. Questions on height and weight were form specific. Over the 10 years of data from 1997 through 2006 for 8th, 10th, and 12th grade students 13 through 19 years of age, our sample had a total of 153,673 observations for which we had information on height and weight and nonmissing information on our covariates.

Our BMI outcome measure was calculated based on the self-reported anthropometric information (height and weight) available in the MTF survey. We calculated BMI as equal to weight(kilogram)/height(meter)-squared. In sensitivity analyses and our analyses by subpopulations, we assessed students at risk for overweight that was defined as adolescents whose BMI was equal to or greater than age–gender-specific 85th percentile based on the Center for Disease Control and Prevention growth charts [33].

We controlled for demographic measures available in the student surveys including: gender, grade, age, race/ethnicity, highest level of schooling completed by father, highest level of schooling completed by mother, a rural/urban area neighborhood designation, total student income (earned and unearned, such as allowance) in real dollars (CPI base $82–$84); weekly hours of work by the student, and whether the mother works part time or full time.

Outlet density and income data: contextual controls

The local area food environment was controlled for using data on food store and restaurant outlets obtained from a business list developed by D&B (these data are described in detail elsewhere [14]). Information on food store and restaurant outlets available in the D&B data set was pulled by zip code for the years 1997 through 2006, and the data were linked to the individual-level data by year and by the students' school zip code. Information was included on the total number of grocery food stores classified into four subcategories: (a) chain supermarkets, (b) nonchain supermarkets, (c) convenience stores, and (d) grocery stores. Restaurant outlet data were classified as fast food restaurants and full-service restaurants. Outlet availability was defined by the number of outlet counts per 10,000 capita using Census data population estimates [34]. Local area socioeconomic status was controlled for using local area per capita income at the zip code level obtained from the Census 2000 [34].

Empirical analyses

This study used multivariate linear regression analyses to examine the associations between state-level soda taxes and adolescent BMI. We estimated separate regressions to examine six different soda tax exposure measures which included: (a) a continuous measure of the state-level grocery soda sales tax rate; (b) a dichotomous measure of the presence of a state-level grocery soda tax; (c) a dichotomous measure of whether the state-level grocery soda tax was disfavored (i.e., whether the soda tax rate was greater than the general food tax rate); (d) a continuous measure of the amount by which the soda tax rate was disfavored (i.e., the soda tax rate minus the general food tax rate); (e) a continuous measure of the state-level vending machine soda tax rate; and, (f) a dichotomous measure of the presence of a state-level vending machine soda tax. We also examined whether the associations differed by gender, grade, parents' SES, or adolescents at risk for overweight.

All regressions controlled for individual- and family-level sociodemographic characteristics based on the variables shown in Table 1. We included complete sets of gender-specific age dummy variables to remove gender-specific differences in BMI growth. These dummies implicitly

Table 1
Summary statistics: state-level soda sales tax measures

	Mean/ frequency	SD	Minimum	Maximum
Grocery store soda tax rate (%)	4.25	2.47	0	7
Presence of grocery store soda tax	0.79	0.41	0	1
Disfavored grocery store soda tax status	0.60	0.49	0	1
Disfavored grocery store soda tax amount	3.42	2.84	0	7
Vending machine soda tax rate (%)	4.51	2.28	0	8
Presence of vending machine soda tax	0.83	0.37	0	1

Notes: Summary statistics are weighted using Monitoring the Future (MTF) sampling weights.

included both a constant and a gender dummy. The coefficients on other covariates may then be interpreted as reflecting variation around arbitrary gender-specific growth curves. We also controlled for year effects. The inclusion of the year dummy variables in the model was equivalent to nonparametrically detrending each variable in the analysis such that the estimates do not reflect common trends. Therefore, we identified the associations with taxes using state-level cross-sectional variation within and across years. We also controlled for local area contextual factors such as the availability of food stores and restaurants and local area per capita income. We used a Huber-white covariance matrix estimate robust to clustering at the state level and heteroskedasticity of unknown form [35].

Results

Summary statistics

Table 1 shows that 79% and 83% of students lived in states that imposed state-level grocery and vending machine soda sales taxes, respectively. The mean (standard deviation [SD]; range) state-level soda tax rates were 4.25% (SD = 2.47; range = 0%–7%) and 4.51% (SD = 2.28; range = 0%–8%), respectively, in grocery stores and vending machines. Sixty percent of students lived in states where the grocery soda sales tax rate was higher than the general food sales tax rate; and, it was higher, on average, by 3.42 percentage points.

Table 2 presents the summary statistics for our individual outcome measure and control variables and the contextual control variables. The table shows that the average BMI for the full sample of students was 22.13. With regard to our control variables, the summary statistics show that just under half of the sample was male and that approximately 70% of the students were white, 10% were African American, 10% were Hispanic, and 10% were of other (or mixed) racial/ethnic backgrounds. The average age of the sample was 15, and 41% were in 8th grade, 45% in 10th grade, and 13% in 12th grade. The majority of students' parents had at least some college education (58% of fathers and 62% of mothers). Most (79%) students lived with both of their parents and just under one-quarter lived in a rural area. Students worked on average 4.7 hours per week. Average students' weekly real ($82–$84) income was about $24. Approximately 63% of students' mothers worked full time and 19% worked part time. As indicated in the latter part of Table 2, the local area per 10,000 capita number of available food stores and restaurants was: 3.15 grocery stores, 2.16 convenience stores, 0.32 chain supermarkets, 0.26 nonchain supermarkets, 3.19 fast-food restaurants, and 11.09 full-service restaurants. Local area per capita income was, on average, $22,300.

Regression results

Table 3 reports the results on the associations between state-level grocery store and vending machine soda tax measures and adolescent BMI. The table also reports results for four additional model specifications: (a) no year effects, (b) no local area food store and restaurant outlet control variables, (c) no local area income control, and (d) no local area food store and restaurant and no local area income control variables. The results from our full model specification including all control variables (Model 1) revealed no statistically significant association between any of the state-level grocery store or vending machine tax measures and adolescent BMI. This null result was robust to the exclusion of year effects (Model 2) and the exclusion of controls for local area food store and restaurant availability and SES (Models 3–5).

In Table 4, we present estimates by weight status, grade, gender, and parents' education levels to assess potential differences in the associations between soda taxes and weight across these subpopulations. The results showed a small and weakly statistically significant negative association between state-level vending machine soda tax rates and adolescent BMI among those at risk of overweight. A one percentage

Table 2
Summary statistics: outcome and control variables

	Mean/frequency
Outcome variable:	
Body mass index (BMI)	22.13 (4.46)
Individual-level control variables:	
Male	48.06%
Age	15.06 (1.47)
8th Grade[a]	41.34%
10th Grade	45.29%
12th Grade	13.37%
White[a]	69.94%
African American	10.26%
Hispanic	10.10%
Other race	9.69%
Father less than high school	12.98%
Father complete high school[a]	29.27%
Father college or more	57.75%
Mother less than high school	10.53%
Mother complete high school[a]	27.00%
Mother college or more	62.47%
Live with both parents	79.03%
Live in rural area	22.77%
Students' weekly real income (in 100s)	.2360 (0.27)
Hours worked by student	4.73 (8.04)
Mother does not work[a]	17.92%
Mother works part time	18.81%
Mother works full time	63.27%
Contextual control variables:	
Per 10,000 capita number of grocery stores	3.15 (2.86)
Per 10,000 capita number of convenience stores	2.16 (2.16)
Per 10,000 capita number of chain supermarkets	0.32 (0.51)
Per 10,000 capita number of nonchain supermarkets	0.26 (0.56)
Per 10,000 capita number of fast food restaurants	3.19 (2.50)
Per 10,000 capita number of full-service restaurants	11.09 (8.46)
Per capita income (in 10,000s)	2.23 (0.94)
N	153,673

Notes: Summary statistics are weighted using Monitoring the Future (MTF) sampling weights. Standard deviations are shown in parentheses for continuous variables.

[a] Denotes omitted categories in regression models.

Table 3
Associations between soda taxes and adolescent BMI: OLS regression results

	Grocery store soda tax rate	Presence of grocery store tax	Disfavored grocery soda tax status	Disfavored grocery soda tax amount	Vending machine soda tax rate	Presence of soda vending machine tax
Model 1: full model	0.0131	0.0638	0.0735	0.0124	0.0110	0.0514
	(0.0150)	(0.0913)	(0.0700)	(0.0124)	(0.0170)	(0.1099)
Model 2:	0.0133	0.0601	0.1009	0.0168	0.0081	0.0307
Model 1 with no year effects	(0.0159)	(0.0965)	(0.0757)	(0.0135)	(0.0184)	(0.1189)
Model 3:	0.0129	0.0656	0.0592	0.0099	0.0113	0.0594
Model 1 with no outlet controls	(0.0159)	(0.0970)	(0.0752)	(0.0134)	(0.0183)	(0.1169)
Model 4:	0.0133	0.0635	0.0593	0.0107	0.0110	0.0498
Model 1 with no neighborhood income controls	(0.0147)	(0.0885)	(0.0683)	(0.0122)	(0.0166)	(0.1057)
Model 5:	0.0127	0.0665	0.0206	0.0042	0.0114	0.0644
Model 1 with no outlet controls and no neighborhood income controls	(0.0162)	(0.0962)	(0.0772)	(0.0139)	(0.0186)	(0.1159)

Notes: N = 153,673. Standard errors are shown in parentheses and are adjusted using a Huber-white covariance matrix estimate, which is robust to both clustering at the state level and heteroskedasticity of unknown form. All of the multivariate regression models include but do not report on the following control variables: gender × age, grade, race, fathers' education, mothers' education, living with both parents, living in rural areas, students' weekly real income, hours worked by students, mother works part time, mother works full time and year effects (except Model 2).

OLS = ordinary least squares.

point increase in the vending machine tax rate was associated with a 0.006 reduction in BMI among adolescents at risk of overweight (p value = .09). In fact, all of the tax measures were negatively associated with BMI among those youths at risk for overweight, but only the vending machine tax rate was statistically significant. None of the estimates across the remaining subpopulations were statistically significant.

Given the weak significant finding for BMI among those at risk for overweight, we undertook additional analyses (not shown in tables), to examine the associations between each of our tax measures and the probability of being at risk for overweight using probit models. The results revealed a negative but statistically insignificant association between each of the tax measures and the probability of the adolescents being at risk for overweight. Further, we did not find any statistically significant associations between our tax measures and the probability of being at risk for overweight in our subsample populations by grade, gender, or parents' education.

These study results are not without limitations. First, the data are cross-sectional, which limit our ability to draw conclusions about causality. Second, the height and weight measures are self-reported, which may introduce measurement error and bias our results toward the null. Third, the MTF survey data do not include information on household income. To the extent that our control variables, such as parental education, do not capture variation in income our results may be subject to omitted variables bias. Also, we were unable to assess tax sensitivity based on differences in income.

Discussion

Based on differences in state-level soda tax rates over the past decade, the results did not reveal any statistically significant associations between the tax measures and adolescent weight among the full sample. This null finding was robust to the exclusion of year effects and local area contextual controls for SES and food store and restaurant availability. Further, whereas previous research has suggested that the weight of children in low-SES families is more sensitive to food prices [23,26], the results by parent's education were not found to be statistically significant, although the presence of taxes among youths with lower educated parents was negatively associated with weight.

The study results, however, did reveal a small weakly statistically significant negative association between state-level soda vending machine tax rates and weight among heavier teens (i.e., those at risk of overweight). This result is consistent with previous research that found higher BMI fruit and vegetable and fast food price sensitivity among children at risk for overweight and adolescents at the upper end of the BMI distribution [23,25]. These results suggest that current soda taxes, in particular, vending machine soda taxes, may have some small to moderate effects in reducing soda consumption, which is translating into very small measurable reductions in BMI among those adolescents at risk for overweight.

Insignificant or small findings with regard to weight outcomes are not surprising given that the current state-level tax rates are very low and that one would expect a weaker relationship between soda taxes and BMI than with soft drink consumption measures or even energy intake. Unfortunately, the MTF individual-level survey data did not contain any measures of soda consumption or caloric intake that would help to provide evidence on the extent to which such taxes may directly effect behavior. Future research should attempt to assess the effect of soft drink taxes directly on soft drink purchases/consumption and energy intake. The former will assess the own-price effect and the latter will shed evidence on the extent to which those who face higher taxes simply substitute toward nontaxed or lower-taxed high calorie food and beverages. Indeed, even if soda consumption is price

Table 4
Associations between soda taxes and adolescent BMI: OLS regression results by subpopulations

	Tax rate	Presence of tax	Disfavored tax status	Disfavored tax amount	Vending machine soda tax rate	Presence of soda vending machine tax
By weight status						
At risk of overweight	−0.0058	−0.0252	−0.0337	−0.0054	−0.0060[a]	−0.0210
(N = 21,319)	(0.0036)	(0.0197)	(0.0226)	(0.0039)	(0.0035)	(0.0199)
Not at risk of overweight	0.0165	0.0809	0.0993	0.0166	0.0142	0.0665
(N = 132,354)	(0.0150)	(0.0920)	(0.0696)	(0.0123)	(0.0170)	(0.1099)
By grade						
8th grade	0.0031	0.0429	0.0373	0.0043	0.0070	0.0590
(N = 63,202)	(0.0183)	(0.1117)	(0.0897)	(0.0158)	(0.0209)	(0.1337)
10th grade	0.0241	0.0997	0.1117	0.0212	0.0216	0.0873
(N = 70,123)	(0.0161)	(0.1011)	(0.0785)	(0.0136)	(0.0184)	(0.1187)
12th grade	0.0075	0.0400	0.0342	0.0043	−0.0101	−0.0478
(N = 20,348)	(0.0175)	(0.0943)	(0.0923)	(0.0160)	(0.0174)	(0.0992)
By gender						
Male	0.0101	0.0389	0.0681	0.0105	0.0104	0.0438
(N = 73,242)	(0.0165)	(0.1023)	(0.0785)	(0.0137)	(0.0193)	(0.1255)
Female	0.0152	0.0828	0.0766	0.0140	0.0109	0.0545
(N = 80,431)	(0.0154)	(0.0943)	(0.0724)	(0.0130)	(0.0166)	(0.1049)
By parents' education						
Some college or more	0.0160	0.0948	0.0985	0.0156	0.0146	0.0845
(N = 114,878)	(0.0158)	(0.0984)	(0.0720)	(0.0127)	(0.0181)	(0.1177)
Less than college	0.0067	-0.0134	0.0003	0.0033	0.0017	−0.0354
(N = 38,795)	(0.0145)	(0.0822)	(0.0820)	(0.0141)	(0.0161)	(0.0990)

Note: Standard errors are shown in parentheses and are adjusted using a Huber-white covariance matrix estimate, which is robust to both clustering at the state level and heteroskedasticity of unknown form. All of the models include but do not report on the following control variables: gender × age, grade, race, fathers' education, mothers' education, living with both parents, living in rural areas, students' weekly real income, hours worked by students, mother works part-time, mother works full-time and year effects. The symbol [a] denotes statistical significance at the 10% level.

sensitive, energy intake may change very little due to cross-price effects that may result in substitution toward other high calorie beverages. Evidence of this type will have implications for the design of tax policies shedding light on the potential importance of implementing broader based taxes on sweetened beverages generally versus more narrow soda taxes.

The existing soda tax rates are relatively small resulting in fairly minimal dollar changes in prices that will likely make it difficult to observe differences in reduced form weight outcomes. The average state sales tax on a $1.00 bottle of soda is $0.0425 and $.0451 when sold through grocery stores and vending machines, respectively. In contrast, many states have aggressively used excise taxes on cigarettes in recent years so as to promote public health by reducing tobacco use. State excise taxes add as much as $2.75 (in New York) to a pack of cigarettes, with combined state and federal taxes more than doubling the retail price of cigarettes in many states [36].

Whereas public policy and voluntary initiatives increasingly have sought to limit the sale of soda in schools, these actions alone are not likely to be sufficient to substantially reduce soda consumption among youths. Recent evidence suggests that the contribution of in-school purchases to sugar sweetened beverage consumption among adolescents is relatively small [4]. In 2003–2004, for sugar-sweetened beverages consumed among adolescents, the vast majority of purchases were store based (69%); and, vending machine and restaurant purchases were a substantially greater source among adolescents compared to younger children [4]. It should be noted that grocery and vending machine sales taxes will not address the consumption of soda at restaurants because the sale of sodas in restaurants would be subject to restaurant taxes. This suggests a multipronged approach is needed to reduce soft drink consumption among youths and improve the likelihood that such reductions persist into adulthood.

Recently, a number of governments have begun to consider changes in soda taxes framed in the context public health concerns. The U.S. Congressional Budget Office, for example, has explored the revenue and public health impact of a 3 cent per 12 ounce federal excise tax on sweetened beverages, including nondiet sodas, fruit drinks, flavored teas, and flavored milks [37]. The governor of Massachusetts proposed applying the state's 5% sales tax to candy and soft drinks, both of which are currently exempted from the tax [20]. Some, however, have proposed much higher taxes that would have a greater impact on price, and hence, the potential for significantly affecting behavior and related weight outcomes. For example, the governor of New York included an 18% sales tax on nondiet sodas and other sweetened beverages in his proposed 2009 budget [21]. Additionally, dedicating a portion of the revenues from soda taxes specifically to obesity-reduction efforts could provide an additional mechanism for addressing adolescent obesity [15,22].

As state policymakers look toward using increased grocery store and vending machine soda sales taxes or soda excise taxes that would be applicable regardless of source (store, vending

machine, cafeterias, or restaurant) as potential policy instruments to reduce soda consumption, the implementation of higher tax rates will offer researchers further opportunities to assess the effects of such taxes on soft drink consumption, energy intake, and weight outcomes. Future research that links tax data to individual-level longitudinal data on consumption, caloric intake, and weight outcomes will contribute substantially to the evidence base on whether increases in soda taxes may be an effective instrument for change.

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