

Public support for a sugar-sweetened beverage tax and pro-tax messages in a Mid-Atlantic US state

Elisabeth A Donaldson^{1,*}, Joanna E Cohen^{1,2}, Lainie Rutkow³, Andrea C Villanti^{1,4}, Norma F Kanarek⁵ and Colleen L Barry³

¹Department of Health, Behavior & Society, Johns Hopkins Bloomberg School of Public Health, 615 N. Wolfe Street, Baltimore, MD 21205, USA: ²Institute for Global Tobacco Control, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA: ³Department of Health Policy & Management, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA: ⁴Schroeder Institute for Tobacco Research and Policy Studies, Washington, DC, USA: ⁵Department of Environmental Health Sciences, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

Submitted 19 June 2014: Final revision received 10 October 2014: Accepted 16 October 2014: First published online 28 November 2014

Abstract

Objective: To examine the characteristics of supporters and opponents of a sugar-sweetened beverage (SSB) tax and to identify pro-tax messages that resonate with the public.

Design: A survey was administered by telephone in February 2013 to assess public opinion about a penny-per-ounce tax on SSB. Support was also examined for SSB consumption reduction and pro-tax messages. Individual characteristics including sociodemographics, political affiliation, SSB consumption behaviours and beliefs were explored as predictors of support using logistic regression.

Setting: A representative sample of voters was recruited from a Mid-Atlantic US state.

Subjects: The sample included 1000 registered voters.

Results: Findings indicate considerable support (50 %) for an SSB tax. Support was stronger among Democrats, those who believe SSB are a major cause of childhood obesity and those who believe childhood obesity warrants a societal intervention. Belief that a tax would be effective in lowering obesity rates was associated with support for the tax and pro-tax messages. Respondents reporting that a health-care provider had recommended they lose weight were less convinced by pro-tax messages. Women, Independents and those concerned about childhood obesity were more convinced by the SSB reduction messages. Overall, the most popular messages focused on the importance of reducing consumption among children without mentioning the tax.

Conclusions: Understanding who supports and opposes SSB tax measures can assist advocates in developing strategies to maximize support for this type of intervention. Messages that focus on the effect of consumption on children may be useful in framing the discussion around SSB tax proposals.

Keywords

Obesity
Paediatric obesity
Nutrition policy
Health policy
Carbonated beverages

In the USA, obesity has emerged as a critical public health issue over the past three decades as its prevalence has more than doubled in adults and tripled in children^(1,2). Sugar-sweetened beverage (SSB) consumption is considered an important driver of the obesity epidemic⁽³⁾ as intake leads to weight gain^(4–6) and as consumption rates in children and adults have almost tripled since the 1970s⁽⁷⁾. Many US states and localities have sought to reduce SSB consumption by increasing taxes on these beverages; however, to date, no US jurisdiction has successfully enacted a tax. Numerous studies have estimated

the potential effect of a tax on SSB consumption and the prevalence of obesity, primarily for taxes that would be higher than the current state sales tax on these beverages in the range of a penny-per-ounce or more^(8–12).

While studies have examined the potential effect of an SSB tax^(8–12), few studies have explored public knowledge and attitudes towards an SSB tax^(13–15). Although several public opinion polls have been conducted and published in the grey literature, their findings on overall support were mixed^(16–20). A Pew Research Center report polled Americans in October 2013 and found that 63 % believed

*Corresponding author: Email edonalds@jhsph.edu

obesity has societal consequences; however, only 35 % of respondents favoured an SSB tax⁽¹⁶⁾. Among the few peer-reviewed studies, a 2013 article by Barry *et al.* examined the SSB tax arguments that resonated with US adults, finding greater agreement with anti-tax compared with pro-tax arguments overall⁽¹³⁾. Gollust *et al.* conducted a national survey in 2012, finding that 22 % of respondents supported SSB taxes⁽¹⁴⁾. The authors found that Democrats, young adults (18–29 years), individuals with a college education and those who have a negative opinion towards the beverage industry had higher levels of support⁽¹⁴⁾. Rivard *et al.* studied consumption patterns, knowledge of SSB harms and public support for an SSB tax across the USA in 2012 and found that 36 % of adults supported SSB taxes⁽¹⁵⁾. Young adults (18–25 years), those with at least some college and non-obese individuals (BMI < 30.0 kg/m²) were more likely to support the tax⁽¹⁵⁾.

Prior studies focused on SSB taxes and tax messages in national samples and found limited support. Public opinion surveys can contribute to public health practice and advocacy around policy making, including SSB taxes⁽²¹⁾. However, the current literature may be limited by its national focus because studies are unable to explore more nuanced characteristics of supporters and opponents within particular regions or states. The present study builds on the existing literature by examining a comprehensive set of characteristics of supporters of an SSB tax, pro-tax messages and SSB consumption reduction messages.

The study addressed three research questions: (i) What are the characteristics of supporters and opponents of a state-level SSB tax? (ii) What are the characteristics of individuals persuaded and not persuaded by messages about reducing SSB consumption? (iii) What are the characteristics of supporters and opponents of pro-SSB tax messages? We hypothesized that individuals who believe SSB are associated with obesity, believe that an SSB tax will be effective at reducing consumption or are concerned with childhood obesity will be more likely to support the SSB tax, and that Republicans and SSB consumers will be less likely to support the tax. Second, we hypothesized that adults with higher education or those who believe SSB are associated with obesity will be more likely to favour one or more of the SSB consumption or pro-SSB tax messages.

Methods

Sample

A survey was conducted in February 2013 using a randomly selected sample of voters in a Mid-Atlantic state based on voter records obtained from the State Board of Elections in October 2012. The Mid-Atlantic region includes states in the north-eastern USA including Delaware, Maryland, Pennsylvania, Washington DC, Virginia and West Virginia⁽²²⁾. Survey questions were

developed based on a review of a national survey⁽¹³⁾. The survey was piloted for length. A stratified sampling strategy, stratified by geographic location and political party, identified a representative sample of voter records that reflected the proportionality of these characteristics in the entire state voter population. Telephone numbers for the selected voter records were obtained by linking voter registration information to landline and cellular telephone databases using a commercial provider⁽²³⁾. The survey was administered by landline or cellular telephone to individuals who provided verbal consent to participate upon answering the phone. A total of 25 000 voter records were obtained through the stratified sample. Cellular and landline telephone numbers were dialled until the final desired sample size (n 1000) was obtained. A description of the weighted and unweighted sample characteristics as compared with overall state demographics is provided in the online supplementary material, Supplemental Table 1. The response rate was not collected by the contractor administering the survey. However, in comparing the sample participants with the overall state characteristics, respondents are similar to the state in terms of gender and political party as illustrated in Supplemental Table 1.

Outcome measures

Three dependent variables were examined in the analysis: (i) SSB tax support; (ii) support for SSB consumption reduction messages; and (iii) support for pro-SSB tax messages. Support for an SSB tax was measured by asking: 'If health experts proposed adding a tax of one penny-per-ounce to the price of regular soda and other drinks with added sugar for the purpose of reducing teen consumption and preventing childhood obesity, would you favour or oppose that?' Response options were 'oppose' or 'favour'.

Two additional dependent variables were examined: whether messages regarding SSB consumption were convincing and whether pro-SSB tax messages were convincing (Table 1). A random sample of half of the respondents rated the three messages in Panel A based on whether each was a convincing reason to consume fewer sugary drinks. The other half of respondents rated the four messages in Panel B based on whether each offered a convincing reason to favour an SSB tax. Support for each message was assessed on a five-point Likert scale from 'not convincing at all' to 'very convincing'. Responses were collapsed, with responses of 4 or 5 considered 'convincing' and responses of 1 to 3 coded as 'not convincing'. Table 1 provides the messages and the proportion who found the messages convincing in each Panel. In the multivariable analysis, the messages in each Panel were combined to create a dichotomous outcome that examined support for one or more of the messages as compared with not supporting at least one of the messages in the Panel. The Cronbach's α coefficient evaluating

Table 1 Sugar-sweetened beverage (SSB) consumption messages and pro-SSB tax messages

		<i>n</i>	% Convinced	95% CI weighted
Panel A: SSB consumption messages				
Experts link weight and SSB	'Experts say that 20 % of our nation's weight problems have been caused by sugary drinks alone'	486	41.2	36.6, 45.9
SSB and child weight	'Eliminating just one sugary drink a day from a child's life could help them lose 10–15 pounds in one year'	474	57.5	52.6, 62.2
Healthy habits learned in childhood	'Healthy habits are learned when children are young. It is important to reduce sugary drink consumption so that children do not continue unhealthy habits into adulthood'	490	76.9	72.7, 80.6
Panel B: pro-SSB tax messages				
Tax is a tool for parents	'Making sugary drinks more expensive gives parents a tool they can use to help discourage their kids' unhealthy habits outside the home'	494	30.4	26.3, 34.9
Tax counteracts industry	'The soft drink industry unfairly targets children with their advertising. Money from a tax on sugary drinks could be used to counteract these ads and educate parents and children about the link between sugary drinks and obesity'	488	37.6	33.1, 42.3
Tax reduces consumption	'Experts say a tax on sugary drinks is the most effective thing you can do to reduce teen and adult consumption'	492	21.6	17.9, 25.8
Tax revenue for obesity prevention	'A penny-per-ounce tax on sugary drinks in the state could raise almost half a billion dollars over the next two years to fund obesity prevention efforts in our schools and community'	482	35.9	31.5, 40.7

internal consistency of the items in each panel was 0.53 for the Panel A messages and 0.76 for the Panel B messages. An exploratory factor analysis was also conducted to identify if the messages within each Panel grouped together. The factor analysis revealed that a one-factor solution worked best for both Panel A and Panel B. These findings support the grouping of messages within each Panel.

The main independent variables were grouped in three categories: (i) respondent sociodemographic characteristics; (ii) respondent SSB consumption and health behaviours; and (iii) respondent beliefs. Sociodemographic characteristics included: age, gender, race, political affiliation, education and annual 2012 income before taxes. All characteristics were assessed through self-report except for age and political affiliation, which were identified from the respondent's voter registration.

Self-reported daily SSB consumption was assessed. The SSB definition included soda, sugar-sweetened iced tea, sports drinks, energy drinks and fruit drinks. This definition did not include 100 % fruit juice and diet drinks. Daily consumption was structured as a dichotomous variable to compare those drinking at least one SSB each day with those drinking less than daily, including weekly and never consumers. SSB availability at home was assessed by asking respondents to report whether they had one or more SSB types at home. Respondents were also asked about their perception of the addictiveness of SSB. Response choices were 'not addictive or habit forming', 'addictive' or 'habit forming'. Lastly, respondents were asked if a health-care provider had ever recommended weight loss.

The final group of independent variables captured respondent beliefs. To assess their belief in the effectiveness of SSB taxes, respondents were asked, 'In general, do

you think that making sugary drinks more expensive would help cut down on their consumption?' In exploring their belief regarding SSB and the childhood obesity epidemic, respondents were asked, 'Do you think there is a connection between children drinking sugary drinks – like soda – and childhood obesity?' Respondents were also asked if a health expert's opinion would motivate them to reduce consumption: 'If health experts said sugary drinks are a major cause of obesity or weight gain, would that strongly motivate you to drink fewer sugary drinks, motivate you a little bit, or not really motivate you?' In addition, respondents were asked whether they considered childhood obesity a concern on a four-point scale from 1 = 'very important' to 4 = 'not at all important'. Their responses were dichotomized, with responses of 1 or 2 indicating 'concern' and responses of 3 or 4 indicating 'no or little concern'. Lastly, respondents were asked about their perspective on whether obesity warrants a parental or societal solution with the following question: 'Which of these is closer to your own view?' Response options included: 'More needs to be done by society to reduce or prevent childhood obesity in the state' or 'Reducing childhood obesity is mainly a parent's concern'. The online supplementary material, Supplemental Table 2 provides a summary of the survey instrument and variables included in the current analysis.

Statistical analysis

The svy procedures in the statistical software package Stata version 11 were used to account for the sampling design. Pearson's χ^2 tests, adjusted to account for the sampling design, were conducted to determine whether opinion on the tax differed by respondent characteristics. Three multivariable logistic regression models were used

to examine support for the tax. The first model included sociodemographic variables including political affiliation, race/ethnicity, education, income, age and gender. The second model expanded the first model and included SSB consumption and availability, perception of SSB addictiveness, as well as health-care provider suggested weight loss. The third and final model extended the previous two models to include beliefs regarding the effectiveness of SSB taxes, the relationship between SSB and childhood obesity, concern for childhood obesity, the perceived solution for childhood obesity, as well as self-reported motivation to reduce consumption in response to health experts linking SSB to obesity. Beliefs were included in the extended model because we hypothesized *a priori* that they would be important for explaining SSB tax and message support. In examining the outcome of being convinced by the Panel A (SSB consumption) messages and the outcome of finding Panel B (pro-SSB tax) messages convincing, multivariable logistic regression models were estimated that included all of the independent variables.

All models were weighted to account for the sampling design. Post-stratification weights were developed based on race (White, African American or Other), gender and age (18 to 65 years) of residents in the state and registered voters from the 2012 US Census^(24,25). In addition, two of the most densely populated counties in the state were weighted to account for their over-representation in the sample population. Akaike's Information Criterion and the Hosmer–Lemeshow goodness-of-fit test were used to assess each model's fit without accounting for the survey sampling design^(26,27). The *F*-adjusted mean residual goodness-of-fit test was also applied to assess model fit while taking the sampling design into account⁽²⁷⁾.

Results

The final study sample included 1000 registered voters from a Mid-Atlantic state (Table 2). Fifty-two per cent was female and a majority was White (62%) and affiliated with the Democratic Party (56%). A majority (84%) were 35 years of age or older. Fifty-one per cent had a bachelor's degree or postgraduate education and a majority (75%) made more than \$US 50 000 in annual income. Twenty-seven per cent consumed one or more SSB daily and 46% had SSB available at home. Sixty-one per cent of respondents did not believe that a tax would be effective in reducing consumption but a majority believed that SSB were either addictive (61%) or habit forming (22%). Most respondents also believed that SSB are a major (52%) or minor (37%) cause of childhood obesity. Similarly, most respondents (85%) reported a belief that childhood obesity is an important concern. Only 38% believed that a societal intervention was warranted as an obesity solution. Almost two-thirds (65%) reported being motivated to reduce SSB consumption if a health expert links SSB with

obesity. Lastly, 42% had been told by a provider to lose weight. In comparison to the state as a whole, the race/ethnicity of the sample included slightly more White respondents (62% *v.* 60%; see online supplementary material, Supplemental Table 1). Furthermore, the current sample was more educated (51% *v.* 30% with bachelor's degree or higher) and had a higher annual income (75% *v.* 68% with \$US 50 000 or more) relative to the state.

Overall, 50% of respondents supported a state SSB tax (Table 2). Gender, race/ethnicity and political party were associated with support (*P* values < 0.05). A significantly greater proportion of females, Democrats and individuals who identified with a race/ethnicity other than White supported the tax. Daily consumption of SSB and having them at home were associated with reduced support for the tax (41% daily *v.* 54% non-daily; 43% at home *v.* 56% not at home, respectively; *P* values < 0.05). Respondents who considered childhood obesity an important problem, as well as those who viewed the problem as a societal concern rather than a parental issue, supported the state tax (54% concern *v.* 29% not a concern; 74% societal *v.* 36% parental, respectively; *P* values < 0.05).

Table 3 illustrates the multivariable logistic regression models examining supporters of the SSB tax. In Model 1, gender, political party and education were associated with support. The odds of support were one-third lower among males compared with females (OR = 0.68; *P* < 0.05). Republicans and Independents had 50–60% lower odds of supporting the tax compared with Democrats (OR = 0.35; *P* < 0.001 for Republicans; OR = 0.49; *P* < 0.05 for Independents). In addition, respondents with some college education or more had over 1.5 times the odds of supporting the tax compared with those with a high-school education or less.

When the model was extended to include SSB consumption and health behaviours (see Model 2), Democrats and those with a postgraduate education remained more likely to support the tax. The odds of support were 47% lower among daily SSB consumers (OR = 0.53; *P* < 0.05). Individuals who perceived SSB as habit forming or addictive had twice the odds or more of supporting the tax compared with respondents not holding those views (OR = 1.97; *P* < 0.05 for habit forming; OR = 2.27; *P* < 0.05 for addictive). Lastly, respondents who were told by a health-care provider to lose weight had 36% lower odds of supporting the SSB tax compared with those not receiving this recommendation (OR = 0.64; *P* < 0.05).

The final model was extended to further include respondent beliefs while adjusting for all of the variables examined in the previous two models (see Model 3). Among the sociodemographic characteristics, Republicans and Independents continued to have lower odds of supporting the tax compared with Democrats after adjustment for all of the covariates (OR = 0.55; *P* < 0.05 for Republicans; OR = 0.45; *P* < 0.05 for Independents). Respondents had over 2.5 times the odds of supporting the

Table 2 Sugar-sweetened beverage (SSB) tax support by respondent characteristics: a US Mid-Atlantic state registered voter sample (*n* 1000), February 2013

Characteristic	Overall weighted %	Support SSB tax (weighted %)	<i>P</i> value*
Opinion of SSB tax			
Support	50.2	–	–
Age (years)			
≥35	83.7	50.4	0.91
18–34	16.3	49.7	
Gender			
Female	52.4	55.3	<0.05
Male	47.6	44.9	
Race/ethnicity			
White	62.4	46.1	<0.05
African American/Black	25.5	60.1	
Other (Hispanic, Asian, Multiracial)	12.1	55.9	
Political party			
Democrat	55.6	60.6	<0.001
Republican	24.9	30.2	
Independent or other	19.5	46.9	
Education			
High school or less	24.7	45.2	0.45
Some college/associate's degree	24.8	51.9	
4-year college/bachelor's degree	27.7	52.2	
Postgraduate	22.8	51.3	
Income, annual before taxes			
≥\$US 100 000	35.6	52.7	0.63
\$US 50 000–<100 000	39.7	50.9	
<\$US 50 000	24.7	56.0	
Childhood obesity important concern			
Yes	84.9	54.1	<0.001
No	15.0	29.0	
Childhood obesity solution			
Parental concern	62.2	36.0	<0.001
Societal concern	37.8	73.6	
Daily SSB consumption			
Yes	27.2	41.2	<0.05
No	72.8	53.7	
SSB at home			
Yes	45.8	43.1	<0.05
No	54.2	56.4	
Health-care provider suggested weight loss			
Yes	42.3	46.6	0.06
No	57.7	53.3	
Belief that SSB tax will be effective			
Yes	39.4	68.3	<0.001
No	60.6	38.1	
SSB are habit forming or addictive			
Neither	16.5	31.2	<0.001
Addictive	61.3	57.2	
Habit forming	22.2	47.1	
Belief in SSB and obesity relationship in children			
No, do not contribute	11.1	24.2	<0.001
Yes, only minor cause	36.9	39.9	
Yes, major cause	51.9	64.8	
Motivation among SSB drinkers to reduce consumption after health expert links SSB with obesity			
Yes	64.9	59.1	<0.001
No	35.1	34.7	

**P* values based on Pearson's χ^2 statistics to test the association between respondent characteristics and attitudes towards a state SSB tax, adjusting for the sampling design for all characteristics.

tax if they believed that SSB are a major cause of obesity in children, that a tax will be effective at reducing consumption or that obesity is a problem best solved by a societal solution *v.* a parental solution (OR = 2.80; *P* < 0.05 for SSB a major cause; OR = 2.78; *P* < 0.001 for tax is effective; OR = 2.84; *P* < 0.001 for societal concern). The model fit statistics illustrated that all three models fit

according to the Akaike's Information Criterion and Hosmer–Lemeshow goodness-of-fit test. The final model did not fit after taking the survey design into account in the goodness-of-fit test.

In exploring agreement with the SSB consumption reduction messages in Panel A, the message on SSB and child weight, as well as the message about learning healthy

Table 3 Odds of supporting a state tax on sugar-sweetened beverages (SSB): a US Mid-Atlantic state registered voter sample (*n* 1000), February 2013

Characteristic	<i>n</i>	Model 1		Model 2		Model 3	
		Adjusted OR	95 % CI	Adjusted OR	95 % CI	Adjusted OR	95 % CI
Age (years)							
18–34 <i>v.</i> ≥35	946	1.30	0.75, 2.25	1.34	0.74, 2.44	1.27	0.62, 2.60
Gender							
Male <i>v.</i> female	946	0.68*	0.48, 0.98	0.73	0.50, 1.06	0.70	0.43, 1.13
Race/ethnicity							
White	618	Ref.		Ref.		Ref.	
African American/Black	196	1.09	0.70, 1.70	1.15	0.70, 1.87	1.50	0.82, 2.75
Other	87	1.15	0.66, 2.01	1.05	0.57, 1.94	1.20	0.55, 2.61
Political party							
Democrat	530	Ref.		Ref.		Ref.	
Republican	256	0.35*	0.22, 0.56	0.35*	0.22, 0.57	0.55*	0.30, 0.99
Independent or other	160	0.49*	0.30, 0.79	0.45*	0.27, 0.75	0.45*	0.23, 0.89
Education							
High school or less	241	Ref.		Ref.		Ref.	
Some college/associate's degree	218	1.69*	1.02, 2.80	1.62	0.96, 2.71	1.69	0.89, 3.21
4-year college/bachelor's degree	247	1.68*	1.01, 2.78	1.60	0.95, 2.71	1.35	0.70, 2.61
Postgraduate	206	2.05*	1.17, 3.59	1.88*	1.05, 3.37	1.50	0.71, 3.16
Income, annual before taxes							
≥\$US 100 000	218	Ref.		Ref.		Ref.	
\$US 50 000–<100 000	260	0.88	0.58, 1.36	0.94	0.60, 1.47	0.98	0.56, 1.73
<\$US 50 000	180	1.14	0.68, 1.92	1.10	0.64, 1.89	1.36	0.68, 2.72
Daily SSB consumption							
Yes <i>v.</i> no	946	–		0.53*	0.34, 0.84	0.64	0.38, 1.07
SSBs at home							
Yes <i>v.</i> no	946	–		0.73	0.50, 1.09	0.71	0.44, 1.14
Health-care provider suggested weight loss							
Yes <i>v.</i> no	911	–		0.64*	0.44, 0.92	0.79	0.50, 1.25
SSB are habit forming or addictive							
Neither	151	–		Ref.		Ref.	
Addictive	562	–		2.27*	1.38, 3.73	0.96	0.48, 1.95
Habit forming	188	–		1.97*	1.09, 3.56	1.32	0.62, 2.81
Belief that SSB tax will be effective							
Yes <i>v.</i> no	890	–		–		2.78*	1.69, 4.57
Belief in SSB and obesity relationship in children							
No, do not contribute	97	–		–		Ref.	
Yes, only minor cause	316	–		–		1.44	0.61, 3.36
Yes, major cause	464	–		–		2.80*	1.14, 6.79
Motivation among SSB drinkers to reduce consumption after health expert links SSB with obesity							
Yes <i>v.</i> no	799	–		–		1.31	0.78, 2.21
Childhood obesity concern							
Yes <i>v.</i> no	946	–		–		1.09	0.56, 2.13
Childhood obesity solution							
Societal concern <i>v.</i> parental concern	912	–		–		2.84*	1.74, 4.64
Model fit statistics							
Akaike's Information Criterion			871.3		817.5		568.6
Hosmer–Lemeshow, <i>P</i> value			0.21		0.45		0.20
<i>F</i> -adjusted mean residual goodness-of-fit test, <i>P</i> value			0.43		0.62		0.01

Ref., referent category.

*Indicates a *P* value <0.05.

habits in childhood were convincing to a majority of the random half of respondents receiving them (Table 1). Less than half (41.2%) reported being convinced to reduce consumption of SSB by the message conveying expert opinion of the contribution of sugary drinks to the obesity epidemic. None of the pro-tax messages in Panel B were convincing to a majority of respondents. Among the four pro-tax messages, the message that received the most support (37.6%) focused on using tax revenue to create a counter marketing and education strategy about the beverage industry.

The analyses presented in Table 4 show the characteristics of individuals who reported being convinced by at

least one of the messages in the panel they received (i.e. either Panel A's messages about SSB consumption reduction or Panel B's pro-SSB tax messages). In Panel A's multivariable model including all covariates, males were less likely than females to find one or more of the messages convincing (OR = 0.34; *P* < 0.05). Individuals earning an income between \$US 50 000 and \$US 100 000 had lower odds of being convinced by the messages compared with the highest income group earning more than \$US 100 000 (OR = 0.25; *P* = 0.05). Independents had higher odds of being convinced by the consumption reduction messages relative to Democrats (OR = 18.3; *P* < 0.05).

Table 4 Odds of finding any sugar-sweetened beverage (SSB) consumption or pro-SSB tax message convincing: a US Mid-Atlantic state registered voter sample (*n* 1000), February 2013

Characteristic	Panel A: convinced by any SSB consumption message (<i>n</i> 500)			Panel B: convinced by any pro-SSB tax message (<i>n</i> 500)		
	<i>n</i>	Adjusted OR	95 % CI	<i>n</i>	Adjusted OR	95 % CI
Age (years)						
18–34 <i>v.</i> ≥35	486	3.27	0.43, 25.0	494	2.17	0.77, 6.09
Gender						
Male <i>v.</i> female	486	0.34*	0.13, 0.91	494	1.97	0.95, 4.09
Race/ethnicity						
White	310	Ref.		325	Ref.	
African American/Black	101	3.48	0.93, 13.1	99	1.60	0.63, 4.05
Other	50	1.34	0.23, 7.72	44	1.18	0.40, 3.47
Political party						
Democrat	273	Ref.		276	Ref.	
Republican	133	3.58	0.93, 13.82	129	0.80	0.30, 2.13
Independent or other	80	18.3*	1.45, 230.9	89	0.63	0.26, 1.52
Education						
High school or less	121	Ref.		128	Ref.	
Some college/associate's degree	121	0.86	0.27, 2.72	107	0.72	0.29, 1.83
4-year college/bachelor's degree	116	3.00	0.36, 25.0	138	1.03	0.37, 2.84
Postgraduate	110	1.41	0.33, 6.1	103	1.11	0.36, 3.49
Income, annual before taxes						
≥\$US 100 000	102	Ref.		122	Ref.	
\$US 50 000–<100 000	136	0.25*	0.06, 0.99	134	0.79	0.34, 1.84
<\$US 50 000	91	0.49	0.09, 2.59	94	1.12	0.40, 3.13
Daily SSB consumption						
Yes <i>v.</i> no	486	1.33	0.44, 4.07	494	0.69	0.32, 1.48
SSB at home						
Yes <i>v.</i> no	486	0.54	0.19, 1.53	494	0.99	0.51, 1.95
Health-care provider suggested weight loss						
Yes <i>v.</i> no	467	1.11	0.42, 2.92	476	0.51*	0.26, 0.99
SSB are habit forming or addictive						
Neither	80	Ref.		75	Ref.	
Addictive	292	1.69	0.56, 5.12	291	1.99	0.71, 5.60
Habit forming	95	2.71	0.54, 13.5	102	1.49	0.50, 4.50
Belief that SSB tax will be effective						
Yes <i>v.</i> no	457	3.98	0.84, 18.8	465	6.21*	2.95, 13.1
Belief in SSB and obesity relationship in children						
No, do not contribute	49	Ref.		52	Ref.	
Yes, only minor cause	170	1.09	0.23, 5.15	163	1.01	0.35, 2.96
Yes, major cause	236	0.96	0.16, 5.59	240	0.92	0.31, 2.72
Motivation among SSB drinkers to reduce consumption after health expert links SSB with obesity						
Yes <i>v.</i> no	420	3.13*	1.29, 7.56	404	1.99	0.91, 4.39
Childhood obesity concern						
Yes <i>v.</i> no	486	4.50*	1.62, 12.53	494	1.38	0.91, 4.39
Childhood obesity solution						
Societal concern <i>v.</i> parental concern	466	1.39	0.33, 5.85	475	1.80	0.88, 3.71
Model fit statistics						
Akaike's Information Criterion		178.3			299.1	
Hosmer–Lemeshow, <i>P</i> value		0.31			0.47	
<i>F</i> -adjusted mean residual goodness-of-fit test, <i>P</i> value		0.00			0.09	

Ref., referent category.
*Indicates a *P* value < 0.05.

In addition, SSB consumers who reported being motivated to reduce their intake were more likely to be convinced by one or more of the messages compared with less motivated drinkers (OR = 3.13; *P* < 0.05). Lastly, individuals who believed childhood obesity is a problem had over four times the odds of being convinced by the messages compared with those not concerned about childhood obesity (OR = 4.50; *P* < 0.05).

In the multivariable model examining respondents convinced by one or more pro-SSB tax messages (Panel B), only two characteristics remained significant after

adjustment for the covariates. Respondents who reported having a health-care provider suggest weight loss had 49% lower odds of finding one or more of the pro-tax messages convincing (OR = 0.51; *P* < 0.05). Individuals who believed that an SSB tax will be effective at reducing consumption had over six times the odds of being convinced by one or more of the pro-tax messages (OR = 6.21; *P* < 0.001). Models for both message Panel A and message Panel B fit according to all of the fit statistics with the exception of Panel A's model fit when the goodness-of-fit test took survey design into account.

Discussion

As states across the USA consider policy interventions to address the obesity epidemic, the present survey of voters in a Mid-Atlantic state found that 50% support a state penny-per-ounce tax on SSB. Compared with previous polls and studies, the current study observed a higher level of support for an SSB tax (50% in the current state in February 2013 *v.* 22% to 36% in previous national studies conducted in 2009–2010, 2012 and 2013)^(13,15,16). Diffusion of Innovations theory would suggest that a majority of voters may soon be in support of this issue based on the swift rise in support across polls over the past four years⁽²⁸⁾.

In this sample of state-registered voters, SSB consumption levels are lower than national estimates with 27% of respondents self-reporting daily consumption compared with 51% of adults over 20 years of age who consumed one or more SSB daily through dietary recall in the 2009–2010 National Health and Nutrition Examination Survey⁽²⁹⁾. Despite the lower SSB consumption prevalence in the state, daily drinkers were still less supportive of the tax. Similar to findings in tobacco control where smokers do not often favour increases in tobacco taxes⁽³⁰⁾, the present study observed that daily SSB drinkers were less likely to support the tax than consumers who drank SSB less than daily. Also, as hypothesized and similar to previous studies, Democrats were more supportive of the SSB tax compared with Republicans and Independents^(14,16). However, unlike previous opinion surveys, age was not associated with support in the current study^(14,15). Income was also not associated with support. Given that over a quarter of the sample had an annual income over \$US 100 000 and half had more than a 4-year college education, it may be that the current sample of registered voters did not include enough low socio-economic respondents to identify differences in support as compared with the studies with national samples. Education, however, was associated with support after belief variables were included in the fully adjusted model. Similar to previous studies, the current analysis found that those with a college education were more supportive of the tax^(14,15,31).

The hypotheses regarding a belief that childhood obesity is a problem caused by SSB and a belief that a tax will be effective in reducing consumption were borne out in these data. Both beliefs were associated with SSB tax support after adjusting for sociodemographic characteristics and SSB consumption behaviours. Additionally, respondents who believed childhood obesity warrants a societal intervention were more supportive of the tax even after adjustment for other covariates. While 85% of respondents in the current analysis believed that childhood obesity was an important concern, only 38% agreed with a societal intervention for the problem. Other studies have observed that even if American respondents agree that obesity has societal consequences, they have

higher support for individual-level solutions over societal options^(16,31–36). For example, a Pew Research Center report observed that a majority (63%) of Americans view obesity as having consequences for society but, as supported by the present study, comparatively few agree with societal-level solutions such as taxes⁽¹⁶⁾. Additionally, several studies have observed a rise in concern for obesity as a national health issue without an increase in support for government intervention largely due to perceptions that obesity is an individual's responsibility^(31–36). Niederdeppe *et al.* (2011) used the theory of perceived responsibility and social motivation⁽³⁷⁾ to explore beliefs about the causes of obesity as a means to understand support for obesity policies⁽³⁸⁾. The authors found that many respondents believed that individuals should be responsible for solutions to the obesity epidemic because obesity is associated with a lack of will-power⁽³⁸⁾. Similar to the present study, other studies have observed that those who believe someone other than the individual should address the obesity problem have greater support for interventions such as raising taxes^(38,39).

Similar to those who reported support for the SSB tax, respondents who found one or more of the SSB consumption reduction messages convincing were more likely to be female. In addition, a positive association was observed between SSB drinker motivation to reduce consumption and support for the consumption messages. Furthermore, concern for childhood obesity was also positively associated with support for the messages. Lastly, a majority of voters perceived SSB as addictive or habit forming (83%) and evidence suggests that the sugar in these drinks has addictive properties, such as inducing cravings⁽⁴⁰⁾. As most respondents (77%) supported the SSB consumption message about reducing unhealthy habits during childhood, the perception of sugar's addictiveness may be an important consideration for future message development even though it did not predict support for the group of consumption messages in the present analysis.

Overall, a majority of respondents were convinced by two of the SSB consumption reduction messages, with less than 40% of respondents convinced by any of the pro-SSB tax messages. Similarly, Barry *et al.* (2013) found in a national sample that none of the pro-tax messages were supported by a majority of the participants⁽¹³⁾. In the present study, the two messages that had the most agreement focused generally on the importance of reducing SSB consumption among children without mentioning the tax. The two pro-tax messages that received the least support from respondents emphasized the benefits of taxing SSB for the purpose of reducing consumption among teens and adults, as well as in helping parents modify child drink choices. Therefore, it may be important for advocates of SSB taxes to frame the discussion around the potential effect of a state tax on consumption in children as opposed to a strategy that targets adolescents and

adult consumption. Jou *et al.* (2014) assessed the perceived effectiveness of SSB tax messages through stakeholder interviews and found that messages emphasizing the relationship between SSB consumption and health outcomes, as well as those that noted using the tax revenue for health programmes, were perceived as effective⁽⁴¹⁾. Similar to the current study, which found the highest support among the pro-tax messages for the message on counteracting industry advertising, Jou *et al.* observed support for messages that focused on the effect of the beverage industry on children⁽⁴¹⁾.

Limitations

The current analysis is based on a survey of registered voters in a single Mid-Atlantic US state. Sample weights were incorporated in the analysis based on the race/ethnicity, gender and age distribution of the state's US Census data. However, the weighting did not take into account non-response or different response rates for landline and cell phone respondents. In addition, the sample was obtained from voter records and not necessarily voters in the last election. Therefore, although the sample strives to be representative of a single Mid-Atlantic state, the results cannot be generalized to other states.

Additionally, the response or cooperation rates were not collected by the contractor administering the telephone survey. Potential reasons why individuals in the selected 25 000 voter records might not have responded could include household inaccessibility due to limited landline phone numbers and individuals not responding on their cell phones⁽⁴²⁾. Therefore, an important limitation is that it is unknown how many individuals were contacted. Moreover, it is not known what proportion of individuals in the voter record sample or of those contacted agreed to participate in the survey. The importance of ascertaining and evaluating response rate has been widely studied (see, for example, reference 43). We do not know the scope of non-response in the sample and therefore cannot compare the response rate in the current survey to similar studies. Furthermore, we cannot assess whether respondents and non-responders differed substantially in terms of their demographic characteristics or in their support for an SSB tax. If responding to the survey is correlated with opinion of the SSB tax, it could bias the study findings. For example, if non-responders were more likely to oppose the tax then the analysis would overestimate support in the state's voter population. Also, the estimates made in the analysis are intended to represent the state's population but if respondents differ from non-responders, this would affect the external validity or generalizability of the study findings to the underlying population of interest. Although the response or cooperation rate is an important piece of information to report, the American Association for Public Opinion Research notes that the response rate is not the only method of assessing survey quality⁽⁴⁴⁾. The Association recommends that additional survey information,

including the amount of missing data and comparability with other research, should be evaluated to assess quality as well⁽⁴⁴⁾. The limited missing data and comparability of the findings in the current study to previous research are strengths^(14–16,31). Furthermore, the weighted final sample is similar in regard to gender and political party compared with the state as a whole. Finally, despite the important limitation of not having a response rate, the current analysis included both cell phone and landline telephone numbers to contact voters, and respondents were not initially aware that they would be asked about a tax.

Another limitation is that two of the three fully adjusted models did not fit according to the *F*-adjusted goodness-of-fit test. However, the models likely have sufficient fit based on results of the other tests.

Lastly, respondents received one of two message groups. Panel A assessed messages about reducing SSB consumption whereas Panel B assessed pro-SSB tax messages. The messages within each Panel were read to each respondent in a random order; therefore, priming of respondents in terms of the order of the messages received would have been minimized. However, the question assessing SSB tax support may have primed respondents and biased our analysis towards higher levels of support because it noted the purpose of the tax. Additionally, priming could have occurred if respondents were exposed to other messages within the state as some localities and organizations were promoting SSB policy interventions around the time the survey was fielded. Given that the current study was not designed to test messages and the full sample was not exposed to all messages, these findings offer a snapshot of message support and cannot be used to evaluate the relative salience of one message over another.

Conclusions

The present study examined supporter characteristics of a state SSB tax. In regard to the potential effect of an SSB tax on consumption, modelling studies suggest that a penny-per-ounce excise tax (a 20 % increase in SSB price) would reduce consumption by 15 % to 24 % and reduce weight by approximately 0.7 lb (1.5 kg) per year, preventing over 20 000 premature deaths by 2020^(8–10). The potential revenue from an SSB tax in the Mid-Atlantic state in the present study would be over \$US 200 million each year⁽⁴⁵⁾. The findings of the current study, as well as knowing the anticipated effect of the tax, could help advocates and policy makers identify potential coalition members and organizations for campaigns. The findings could inform advocates and policy makers regarding the characteristics of supporters and opponents of an SSB tax as a way to assess political feasibility. Although only half of respondents in this Mid-Atlantic state supported the SSB tax, this level of support is higher than in previous

national surveys. Therefore, perhaps this intervention may be more politically feasible in specific states or after mobilizing certain population subgroups, such as Democrats and females who reported support for the measure.

By exploring messages that resonate with specific voter groups, the findings could assist advocates in framing the discussion around this type of policy proposal to build coalition support. These findings suggest that advocates should focus on disseminating and promoting messages around: (i) a societal solution to obesity that balances messages focused on individual change alone; (ii) the potential effectiveness of SSB taxes in reducing consumption and generating revenue for childhood obesity programmes; and (iii) the relationship between obesity and SSB to enhance the public's understanding of the effect of SSB on health outcomes.

Acknowledgements

Financial support: E.A.D. received support for her doctoral training from a National Cancer Institute grant (T32 CA009314) and the Center for a Livable Future-Lerner Fellowship. These funding sources were not involved in the study design, data collection, analysis, interpretation or writing of the manuscript. **Conflict of interest:** None. **Authorship:** E.A.D. conceptualized the study, carried out the data analysis, interpreted the results and wrote the article. J.E.C., C.L.B., L.R., A.C.V. and N.F.K. supervised the analysis, participated in data interpretation, assisted in writing the article and critically reviewed the article. **Ethics of human subject participation:** This study was determined to be exempt by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board (#00000287).

Supplementary material

To view supplementary material for this article, please visit <http://dx.doi.org/10.1017/S1368980014002699>

References

1. Flegal KM, Carroll MD, Ogden CL *et al.* (2000) Prevalence and trends in obesity among US adults, 1999–2000. *JAMA* **288**, 1723–1727.
2. Ogden CL, Flegal KM, Carroll MD *et al.* (2002) Prevalence and trends in overweight among US children and adolescents, 1999–2000. *JAMA* **288**, 1728–1732.
3. Woodward-Lopez G, Kao J & Ritchie L (2011) To what extent have sweetened beverages contributed to the obesity epidemic? *Public Health Nutr* **14**, 499–509.
4. Mozaffarian D, Hao T, Rimm EB *et al.* (2011) Changes in diet and lifestyle and long-term weight gain in women and men. *N Engl J Med* **364**, 2392–2404.
5. Ebbeling CB, Feldman HA, Chomitz VR *et al.* (2012) A randomized trial of sugar-sweetened beverages and adolescent body weight. *N Engl J Med* **367**, 1407–1416.
6. de Ruyter JC, Olthof MR, Seidell JC *et al.* (2012) A trial of sugar-free or sugar-sweetened beverages and body weight in children. *N Engl J Med* **367**, 1397–1406.
7. Nielsen SJ & Popkin BM (2004) Changes in beverage intake between 1977 and 2001. *Am J Prev Med* **27**, 205–210.
8. Powell LM, Chiqui JF, Khan T *et al.* (2013) Assessing the potential effectiveness of food and beverage taxes and subsidies for improving public health: a systematic review of prices, demand and body weight outcomes. *Obes Rev* **14**, 110–128.
9. Wang YC, Coxson P, Shen YM *et al.* (2012) A penny-per-ounce tax on sugar-sweetened beverages would cut health and cost burdens of diabetes. *Health Aff (Millwood)* **31**, 199–207.
10. Finkelstein EA, Zhen C, Nonnemaker J *et al.* (2010) Impact of targeted beverage taxes on higher- and lower-income households. *Arch Intern Med* **170**, 2028–2034.
11. Chiqui JF, Chaloupka FJ, Powell LM *et al.* (2013) A typology of beverage taxation: multiple approaches for obesity prevention and obesity prevention-related revenue generation. *J Public Health Policy* **34**, 403–423.
12. Eyles H, Ni Mhurchu C, Nghiem N *et al.* (2012) Food pricing strategies, population diets, and non-communicable disease: a systematic review of simulation studies. *PLoS Med* **9**, e1001353.
13. Barry CL, Niederdeppe J & Gollust SE (2013) Taxes on sugar-sweetened beverages: results from a 2011 national public opinion survey. *Am J Prev Med* **44**, 158–163.
14. Gollust SE, Niederdeppe J & Barry CL (2014) Americans' opinions about policies to reduce children's consumption of sugar-sweetened beverages. *Prev Med* **63**, 52–57.
15. Rivard C, Smith D, McCann SE *et al.* (2013) Taxing sugar-sweetened beverages: a survey of knowledge, attitudes and behaviours. *Public Health Nutr* **15**, 1355–1361.
16. Pew Research Center (2013) Public Agrees on Obesity's Impact, Not Government's Role. <http://www.people-press.org/2013/11/12/public-agrees-on-obesitys-impact-not-governments-role/> (accessed January 2014).
17. Field Research Corporation (2012) Unhealthy eating, lack of physical activity seen as greatest health risk facing California kids. Voters believe obesity prevention efforts should involve the community as well as kids and their families. http://www.yaleruddcenter.org/resources/upload/docs/what/policy/SSBTaxes/CA_Field_Poll_4.12.pdf (accessed January 2014).
18. Quinnipiac University Poll Institute & Rubenstein Associates, Inc. (2008) New Yorkers, even diet drinkers, oppose fat tax, Quinnipiac University poll finds; voters back millionaire's tax 6 – 1. <http://www.yaleruddcenter.org/resources/upload/docs/what/policy/SSBTaxes/QuinnipiacPollFatTaxes12.08.pdf> (accessed January 2014).
19. Global Strategy Group (2010) 1662 STC MS Statewide Soda Tax. http://www.yaleruddcenter.org/resources/upload/docs/what/policy/SSBTaxes/Mississippi_SodaTaxPoll_1.10.pdf (accessed January 2014).
20. Center for Rural Studies, University of Vermont (2011) 2011 Vermont Sugar-Sweetened Beverage Tax Study. http://www.yaleruddcenter.org/resources/upload/docs/what/policy/SSBTaxes/VT_SSB_Poll_2011.pdf (accessed January 2014).
21. Turner S, O'Connor P & Rademacher E (2009) Inform, influence, evaluate: the power of state public opinion polls. *Health Aff (Millwood)* **28**, 273–276.
22. US Environmental Protection Agency (2014) Region 3 (Mid-Atlantic). <http://www2.epa.gov/aboutepa/epa-region-3-mid-atlantic> (accessed October 2014).
23. CSS Direct (2013) *Information Appending and Database Marketing*. Omaha, NE: CSS Direct.
24. US Census Bureau (2013) Current Population Survey, Annual Social and Economic Supplement. <https://www.census.gov/cps/data/cpstablecreator.html> (accessed March 2014).
25. US Census Bureau (2012) Current Population Survey, Voter and Registration Supplement. <https://www.census.gov/hhes/www/socdemo/voting/index.html> (accessed March 2014).
26. Bozdogan H (1987) Model selection and Akaike's Information Criterion (AIC): the general theory and its analytical extensions. *Psychometrika* **52**, 345–370.

27. Archer KJ & Lemeshow S (2006) Goodness-of-fit test for a logistic regression model fitted using survey sample data. *Stata J* **6**, 97–105.
28. Rogers EM (1983) *Diffusion of Innovations*. New York: Free Press.
29. Kit BK, Fakhouri THI, Park S *et al.* (2013) Trends in sugar-sweetened beverage consumption among youth and adults in the United States: 1999–2010. *Am J Clin Nutr* **91**, 180–188.
30. Hamilton WL, Biener L & Rodger CN (2005) Who supports tobacco excises taxes? Factors associated with towns' and individuals' support in Massachusetts. *J Public Health Manag Pract* **11**, 333–340.
31. Oliver JE & Lee T (2005) Public opinion and the politics of obesity in America. *J Health Polit Policy Law* **30**, 923–954.
32. Olds T, Thomas S, Lewis S *et al.* (2013) Clustering of attitudes towards obesity: a mixed methods study of Australian parents and children. *Int J Behav Nutr Phys Act* **10**, 117.
33. Hilbert A, Rief W & Braehler E (2007) What determines public support of obesity prevention? *J Epidemiol Community Health* **61**, 585–590.
34. Lund TB, Sandoe P & Lassen J (2011) Attitudes to publicly funded obesity treatment and prevention. *Obesity (Silver Spring)* **19**, 1580–1585.
35. Covic T, Roufeil L & Dziurawiec S (2007) Community beliefs about childhood obesity: its causes, consequences and potential solutions. *J Public Health* **29**, 123–131.
36. Sikorski C, Lupp M, Schomerus G *et al.* (2012) Public attitudes towards prevention of obesity. *PLoS One* **7**, e39325.
37. Weiner B (1993) On sin versus sickness: a theory of perceived responsibility and social motivation. *Am Psychol* **48**, 957–965.
38. Niderdeppe J, Porticella N & Shapiro MA (2012) Using theory to identify beliefs associated with support for policies to raise the price of high-fat and high-sugar foods. *J Health Commun* **17**, 90–104.
39. Barry CL, Brescoll VL, Brownell KD *et al.* (2009) Obesity metaphors: how beliefs about the causes of obesity affect support for public policy. *Milbank Q* **87**, 7–47.
40. Ahmed SH, Guillem K & Vandaele Y (2013) Sugar addiction: pushing the drug–sugar analogy to the limit. *Curr Opin Clin Nutr Metab Care* **16**, 434–439.
41. Jou J, Niederdeppe J, Barry CL *et al.* (2014) Strategic messaging to promote taxation of sugar-sweetened beverages: lessons from recent political campaigns. *Am J Public Health* **104**, 847–853.
42. Brick JM, Dipko S, Presser S *et al.* (2006) Nonresponse bias in a dual frame sample of cell and landline numbers. *Public Opin Q* **70**, 780–793.
43. Singer E (editor) (2006) Special Issue: Nonresponse Bias in Household Surveys. *Public Opin Q* **70**, issue 5.
44. American Association for Public Opinion Research (2014) Response Rate – An Overview. http://www.aapor.org/Response_Rates_An_Overview1.htm#.Uy8xtGfeOUI (accessed March 2014).
45. Yale Rudd Center for Food Policy and Obesity (2014) Revenue Calculator for Sugar-Sweetened Beverage Taxes. <http://www.yaleruddcenter.org/sodatax.aspx> (accessed January 2014).