

Intervention Strategy Description

Implementation of a state excise tax of either \$0.02/ounce or \$0.01/ounce of sugar-sweetened beverages (SSBs), administered by the New Hampshire Department of Revenue Administration (DORA) and based on proposals considered by federal, state, and local governments.¹⁻⁴

Background

SSBs include all beverages with added caloric sweeteners. The modeled excise tax does not apply to 100% juice, milk products, or artificially-sweetened beverages. Although sugary drinks consumption has declined in recent years, adolescents and young adults in the United States consume more sugary drinks than the Dietary Guidelines for Americans recommends, with persistent racial/ethnic disparities.⁵⁻⁸ Randomized trials and longitudinal studies have linked SSB consumption to excess weight gain, diabetes, and cardiovascular disease. Consumption of SSBs increases the risk of chronic diseases through its impact on BMI and other mechanisms.^{9,10} The *Dietary Guidelines for Americans, 2015*¹¹ recommends that individuals reduce SSB intake in order to manage their body weight. Drawing on the success of tobacco taxation and decades of economic research, public health experts have called for higher taxes on SSBs and documented their likely impact.¹²⁻¹⁵ In 2009, the IOM recommended that local governments implement tax strategies to reduce consumption of “calorie-dense, nutrient-poor foods,” emphasizing SSBs as an apt target for taxation.¹⁶

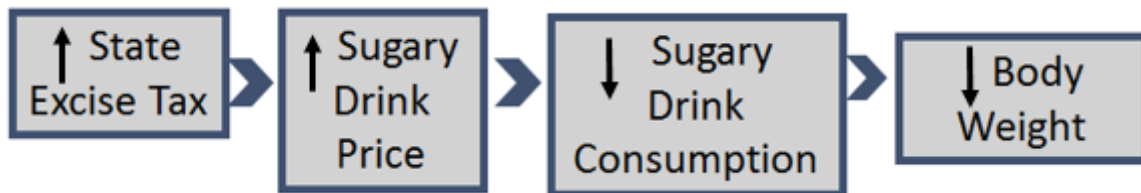
Summary Results 2015-2025

	\$0.02/oz	\$0.01/oz
# of Cases of Obesity Prevented	17,400	8,880
Health Care Cost Savings per \$1 Invested	\$19.80	\$10.00
Cost per Case of Obesity Prevented	Cost-saving	Cost-saving
Net Cost (negative means savings) [†]	-\$128 million	-\$61.7 million

[†] These costs include the difference between the cost to implement the intervention and the healthcare cost savings produced over 10 years.

Modeling Framework

Increased state excise tax linked to change in BMI through change in SSB price and consumption.



Impact of Tax on Price to Consumers

We assume 100% pass through of the tax over the ten years. Empirical studies in Mexico and France indicate that approximately the full amount of the excise tax is passed on to consumers.¹⁷ Short term studies for the local tax in Berkeley indicate less than complete pass-through.^{3,18,19} The expected percent increase in SSB price was estimated based on the average \$0.059/ounce reported in a review of beverage demand elasticity (inflated to \$0.0612 in 2014

dollars).²⁰ The price per ounce in this study was based on a weighted average across stores, restaurants and other sources proportional to the source of consumed SSBs in NHANES 2009-2010. The price per ounce of SSBs purchased in stores was calculated using weighted averages of two-liter bottles, 12-can cases, and single-serve bottles or cans based on the distribution of package sizes estimated from 2010 Nielsen Homescan data. The \$0.02/ounce increased excise tax would result in a 32.7% price increase; the \$0.01/ounce increased excise tax in a 16.3% price increase. We assumed that the tax rate would be adjusted annually for inflation to maintain the 32.7% or 16.3% price increase throughout the ten-year modeling time frame.

SSB Consumption and Price Elasticity of Demand

We used regionally-adjusted estimates of total SSB consumption in 2015 published in the UCONN Rudd Center Revenue Calculator for Sugar-Sweetened Beverage Taxes to adjust national age, sex, and race/ethnicity-specific consumption data from NHANES 2005-2010 to estimate current SSB consumption levels in New Hampshire.²¹ Powell et al reviewed studies published 2007-2012 and estimated a mean own-price elasticity of demand for SSBs weighted by SSB category consumption shares of -1.21, ranging from -3.87 to -0.69.²² Recent research concerning the Berkeley tax indicates a 21% reduction in SSB intake among low income populations.¹⁸

Direct effect of change in SSB consumption on change in BMI

We conducted evidence reviews for impact of change in SSB intake on BMI, taking into account any dietary compensation.¹⁵ Four large longitudinal studies in adults²³⁻²⁶ of sufficient duration were identified. The relationship was modeled using a uniform distribution based on the range of the estimates of the effect of a one serving reduction on BMI (from 0.21 to 0.57). Among youth, a double-blind randomized controlled trial conducted over 18 months found that an additional 8 oz serving of SSBs led to a 1 kg greater weight gain.²⁷

Reach

The intervention reaches all youth and adults ages 2 years and older in New Hampshire.

Costs

The policy change will involve start up and ongoing labor costs for state tax department administrators. To implement the intervention, the state government will need to process tax statements and conduct audits. Businesses will also need to prepare tax statements and participate in audits, which will require labor from private tax accountants. Cost information was drawn states and localities with planned or implemented excise taxes on sugary drinks.¹⁵ *The cost and benefit estimates do not include expected tax revenue.*

CHOICES Microsimulation Model

The CHOICES microsimulation model for New Hampshire was used to calculate the costs and effectiveness over ten years (2015–25). This is a stochastic, discrete-time, individual-level microsimulation model designed to simulate the experience of the state population from 2015 to 2025. Cases of obesity prevented were calculated at the end of the model in 2025. The model uses data from: US Census, American Community Survey, Behavioral Risk Factor Surveillance System²⁸, NHANES, National Survey of Children’s Health²⁹, the Medical Expenditure Panel Survey, and multiple national longitudinal studies.³⁰ We calculated uncertainty intervals using Monte Carlo simulations programmed in Java over one thousand iterations of the model for a population of one million simulated individuals for a population of one million simulated individuals scaled to the state population size.¹⁵

Results

Metric	\$0.02/ounce Results	\$0.01/ounce Results
Cost/Effect		
Cost per Year with Obesity Prevented	Cost-saving	Cost-saving
Cost per Quality Adjusted Life Year (QALY) Gained	Cost-saving	Cost-saving
Cost per Case of Obesity Prevented	Cost-saving	Cost-saving
QALYs Gained	5,670 (1,770; 14,500)	2,880 (874; 7,500)
Reach		
First Year Population Reach*	1,310,000	1,310,000
Effect		
Decrease in 12-oz Serving of SSBs per Person in the First Year*	158 (92.2; 317)	78.6 (45.8; 157)
Cases of Obesity Prevented*	17,400 (5,560; 44,000)	8,880 (2,770; 22,900)
Years with Obesity Prevented	124,000 (39,700; 313,000)	63,500 (19,800; 163,000)
Life Years Gained	1,580 (480; 3,880)	808 (233; 2,170)
Deaths Averted*	464 (143; 1,160)	238 (68; 601)
Cost		
Annual Intervention Cost	\$686,000	\$686,000
Net Cost (negative means savings)+	-\$129mill (-\$342mill; -\$35.1mill)	-\$61.7mill (-\$171mill; -\$14.3mill)
Health Care Cost Savings per \$1 Invested	\$19.80 (\$6.12; \$50.80)	\$10.00 (\$3.09; \$26.00)

All metrics reported for the population over a 10-year period and discounted at 3% per year, unless otherwise noted.

*Not discounted.

+ These costs include the difference between the cost to implement the intervention and the healthcare cost savings produced over 10 years.

Impact on Diabetes

We estimated the impact of the tax-induced reduction in SSB intake on diabetes incidence for adults ages 18-79 years using a published meta-analysis of the relative risk of developing diabetes due to a one-serving change in SSB consumption³¹ as well as local estimates of diabetes. On average, each 8.5 oz serving of SSBs per day increases the risk of diabetes by 18%. In New Hampshire, we estimated that the \$0.02/ounce SSB increased excise tax would lead to a reduction in diabetes incidence- an estimated 817 cases of diabetes prevented- over a one-year period once the tax reaches its full effect; the \$0.01/ounce SSB increased excise tax would lead to an estimated 423 cases of diabetes prevented.

Impact on Tooth Decay

We estimated the impact of a sugar sweetened beverage (SSB) excise tax on tooth decay cost for the state using a longitudinal analysis of the relationship between intake of sugars and tooth decay in adults. On average, for every 10 grams higher intake of sugar per day, there is an increase in DMFT of approximately 0.10 over 10 years.³² As described above, we assume that the excise tax will result in a reduction in SSB intake. There are many studies showing a similar relationship between higher intake of sugars and tooth decay in children and youth³³ and thus we assume the same relationship as found in adults. We used 2018 New Hampshire Medicaid Management Information System (NH MMIS) procedure code data to estimate the average Medicaid cost of treating decayed, missing and filled teeth (DMFT):

\$173 for a permanent crown and \$89 for a filling.³⁴ These codes reflect treatment for one surface and do not reflect higher reimbursement rates for multi-surface treatment, temporary crowns, or potential flat fee schedules. Based on analysis of data on tooth decay, fillings and crowns for the US population from NHANES 1988-1994 (the last year crowns and fillings were separately reported) (personal communication Zachary Ward, April 2018)³⁵, we estimate that 78.9% of tooth decay in children and 43.5% of tooth decay in adults is treated. Using this same data set, we estimate that 97% of treatment for children is fillings and 82.5% of treatment for adults is fillings. To estimate Medicaid-specific dental caries cost savings, we used local estimates of the numbers of people enrolled in Medicaid and the proportion receiving Medicaid dental services. Because of limited Medicaid dental coverage for adults in New Hampshire, only children are included in the Medicaid-specific calculations. In New Hampshire, we estimated that the \$0.02/ounce tax over a period of 10 years would lead to a total saving in DMFT of \$3.62 million and \$695,000 in Medicaid savings. The \$0.01/ounce tax would lead to a total over a period of 10 years in DMFT savings of \$1.33 million and \$255,000 in Medicaid savings. The Medicaid reimbursement fee estimates may underestimate the total cost savings of tooth decay treatment projected here as dental providers may charge higher amounts to patients.

Expected Yearly SSB Tax Revenue

The annual revenue from a city excise tax on sugary beverages is likely to be substantial. According to the Rudd Center Revenue Calculator for Sugar Sweetened Beverage,²¹ a \$0.02/ounce excise tax in New Hampshire could raise as much as \$78 million and a \$0.01/ounce excise tax as much as \$54 million in 2017. Actual tax revenue may be lower than these projected estimates due to several factors. The Rudd Center Revenue estimates are based on regional sales data adjusted for state or city specific demographics³⁶; sales data for specific states and/or cities within those regions may vary from the regional average. Retailers may have inventories of sugary drinks obtained before the tax was implemented. Residents living close to city, county and/or state borders may also purchase sugary drinks in neighboring communities without such a tax. Finally, there may be some distributors/manufacturers that are non-compliant with the tax. The Rudd Center notes that their revenue projections “should be considered optimistic...and adjusted downward by 10-30%.”²¹

Equity and Implementation Considerations

Concerns have been raised regarding the impact of the tax on households with low incomes. Because of the elasticity of -1.21, our analyses clearly indicate that households will spend less on SSBs after the tax goes into effect, providing disposable income for other purchases. In addition, we project that greater health benefits will accrue to low-income consumers who on average consume more SSBs than higher income consumers; the same is true for a number of racial and ethnic groups. Disparities in obesity outcomes should thus decrease following implementation of the proposed tax. In addition, revenue raised from an SSB tax can be reinvested in low income communities; for instance, in Berkeley, CA SSB tax revenue has been allocated for spending on school and community programs, several with a focus on low income or minority populations, to promote healthy eating, diabetes and obesity prevention.^{37,38}

There is opposition from the beverage industry, which spends over \$4 billion/year nationwide on marketing.³⁹ Public support for such taxes generally increases with earmarking for prevention activities.⁴⁰ Relatively small beverage excise taxes are currently applied across many states. The proposed tax is likely to be sustainable if implemented based on the history of tobacco excise taxes. There is potential for a shift in social norms of SSB consumption based on evidence from tobacco control tax and regulatory efforts.⁴¹

Discussion

We project that the proposed SSB excise tax policy of \$0.02/ounce will prevent thousands of cases of childhood and adult obesity, prevent new cases of diabetes, increase healthy life years and save more in future health care costs

than it costs to implement, with a lower impact for an increase of \$0.01/ounce tax. Revenue from the tax can be used for education and health promotion efforts. Implementing the tax could also serve as a powerful social signal to reduce sugar consumption.

Results prepared by the CHOICES Project at the Harvard T.H. Chan School of Public Health: Gortmaker SL, Long MW, Ward ZJ, Giles CM, Barrett JL, Resch SC, Cradock AL and the New Hampshire Division of Public Health Services, Department of Health and Human Services: Foster SJ and Hammond WC. Funded by The JPB Foundation. Results are those of the authors and not the funders. For further information: contact cgiles@hsph.harvard.edu. Visit www.ChoicesProject.org

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