

bridging the gap

Research Informing Policies & Practices
for Healthy Youth

Soda Taxes and Adolescent Body Weight: Evidence from Panel Data

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Lisa M. Powell and Jamie F. Chriqui
Institute for Health Research and Policy
University of Illinois at Chicago

UIC Institute for
UNIVERSITY OF ILLINOIS
AT CHICAGO Health Research and Policy
SCHOOL OF PUBLIC HEALTH

Presentation Outline

- Objectives and Background
- Individual-level and Tax Data
- Empirical Model
- Results
- Policy Implications

Objectives and Background

Objective

- To empirically examine the associations of state-level soda taxes with adolescent body weight, using longitudinal nationally representative data (National Longitudinal Survey of Youth 1997 (NLSY97)).

Background -- Price effects:

- Numerous studies document that soda consumption is price sensitive. Recent review by Andreyeva (2010) reports mean price elasticity of -0.8.
- Studies using scanner data suggest higher prices elasticities; i.e. Smith et al. (2010) estimate a price elasticity of -1.26.
- Few studies link prices to weight outcomes due to limited data. Mixed results: No effect found by Powell and Han (2011) and sig neg effect found by Duffy et al. (2010).

Background -- Taxes and Weight Outcomes:

- Using adult cross-sectional data, Fletcher, Frisvold and Tefft (2009) find statistically significant but small associations between soda taxes and weight: 1 percentage point increase in the state soft drink tax is associated with a 0.003 unit reduction in adult BMI and a 0.01 percentage point decrease in adult obesity prevalence.
- No association with children's weight using cross-sectional NHANES data (Fletcher, Frisvold, and Tefft, 2010). Suggest due to substitution to whole milk.
- Sturm et al. (2010) find higher soda sales taxes are only statistically significantly associated with lower BMI gain among children already at risk for overweight and the effect is small: 1 percentage point increase in the soda sales tax rate is associated with a -0.033 unit change in BMI.
- Cross-sectional study of youths by Powell et al. (2009) finds a statistically significant but very small effect of state soda sales taxes applied to vending machines and BMI among teens at risk for overweight: 1 percentage point increase in the vending machine tax rate was associated with a 0.006 reduction in BMI.

Individual-level and Tax Data

National Longitudinal Survey of Youth 97

Data Description: National Longitudinal Survey of Youth 97

- Nationally representative longitudinal data on youth aged 12 to 17 in 1997; 4 waves of data including 1997, 1998, 1999 and 2000
- Estimation sample includes 18,029 person-year observations on unbalanced panel of 6734 individuals living in 49 different states across the U.S
- Information on parental characteristics available from parental questionnaire and annual household roster data
- Outcome variable: body mass index (BMI)
- Control variables: age, gender, race, ethnicity, youth income, family income, mother's education, mother's employment status
- Neighborhood controls: urbanicity, median household income

Data Description: Tax Data

- State level soda taxes from Bridging the Gap (BTG)
- Linked by state FIPS codes and year
- Measures used:
 - State-level soda tax rate
 - Disfavored tax rate (soda tax rate – general food tax rate)
 - Disfavored dichotomous indicator (indicator if disfavored tax rate >0)
 - State-level additional soda taxes/fees (dichotomous indicator)

Empirical Model: Taxes and BMI

Empirical Model

$$BMI_{icst} = \beta_0 + \beta_1 Tax1_{st} + \beta_2 Tax2_{st} + \beta_3 X_{it} + \beta_4 I_c + \beta_5 S_s + \beta_6 Y_t + v_i + w_{icst}$$

- $Tax1_{st}$ -- State-level disfavored soda tax rate
- $Tax2_{st}$ -- State-level additional soda taxes/fees
- X_{it} -- Individual/household control variables
- I_c -- County-level median household income
- S_s -- State dummy variables
- Y_t -- Year dummy variables

❖ Individual-level Random Effects Models: Assumes v_i and independent variables are not correlated

❖ Individual-level Fixed Effects Models: Difference out the constant individual-specific residual v_i and provide within person effects

Results

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Summary Statistics

| Individual, Household, and Local Characteristics | Mean/Frequency |
|--|----------------|
| Age | 15.97 |
| Male | 51.82% |
| White | 70.75% |
| Black | 13.50% |
| Hispanic | 11.18% |
| Asian | 1.93% |
| Other | 2.64% |
| Youth Lives With Single Parent | 25.32% |
| Youth Income(\$1982-1984) | 830.35 |
| Hours Worked Per Week | 13.20 |
| Parental Income (\$1982-1984) | 33,565.34 |
| Mother Not Completed High School | 15.26% |
| Mother Completed High School | 35.41% |
| Mother Completed Some College or More | 49.33% |
| Mother Doesn't Work | 20.48% |
| Mother Works Part Time | 17.22% |
| Mother Works Full Time | 62.30% |
| Household Residence Urban | 69.44% |
| Household Residence Suburban | 10.73% |
| Household Residence Rural | 19.83% |
| County-Level Median Household Income (\$2000) | 42,979.01 |

Summary Statistics: BMI and Tax Exposure Measures

| Outcome and Tax Exposure Measures | Mean/Frequency | | | | |
|--|----------------|--------|--------|--------|--------|
| | All Years | 1997 | 1998 | 1999 | 2000 |
| BMI | 22.68 | 21.64 | 22.59 | 23.10 | 23.59 |
| Continuous Disfavored Soda Tax Rate | 2.92 | 2.89 | 2.92 | 2.94 | 2.97 |
| Presence of Disfavored Soda Tax | 52.56% | 53.00% | 52.30% | 52.72% | 53.20% |
| Presence of Additional Soda Taxes/Fees | 19.17% | 24.22% | 22.90% | 15.84% | 11.41% |

Longitudinal Regression Estimates of the Determinants of Adolescent BMI

| | BMI |
|--|------------|
| Continuous disfavored state soda tax rate | -0.220** |
| Presence of additional state soda taxes/fees | -0.230*** |
| African American | 1.407*** |
| Hispanic | 0.940*** |
| Asian | -0.577* |
| Other | 0.803** |
| Youth Lives With Single Parent | 0.239*** |
| Youth Income | 0.183 |
| Hours Worked Per Week | 0.002 |
| Parental Income | -0.008 |
| Mother Completed High School | -0.162 |
| Mother Completed Some College or More | -0.224* |
| Mother Works Part Time | -0.133** |
| Mother Works Full Time | -0.045 |
| Household Residence Suburban | -0.239 |
| Household Residence Rural | 0.038 |
| County-Level Median Household Income | -0.120* |
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Longitudinal BMI Soda Tax Estimates by Alternative Specifications

| Model | State Tax/Fee | County-Level Median Household Income | Model 1 (Continuous Disfavored Soda Tax Rate) | Model 2 (Presence of Disfavored Soda Tax) |
|-------|---------------|--------------------------------------|---|---|
| RE | ✓ | ✓ | -0.220** | -0.088** |
| RE | X | ✓ | -0.190* | -0.076* |
| RE | ✓ | X | -0.216** | -0.087** |
| RE | X | X | -0.188* | -0.075* |
| FE | ✓ | ✓ | -0.235* | -0.094* |

Summary of Empirical Results

- Generally moderate associations between soda taxes and body weight based on the existing low tax rates which range up to just 7% in the study sample.
- *Substantial* increases in soda tax rates may have some measureable effects on BMI and even greater effects at the population level.
- Disfavored soda tax elasticity of BMI is estimated to be -0.029.
 - Doubling the disfavored tax rate (~3% to ~6%) is estimated to reduce BMI by 2.9%. For a 5'5" tall youth at mean BMI of 22.68 (136lbs), a 2.9% reduction in BMI corresponds to a reduction in weight of 3.9lbs.

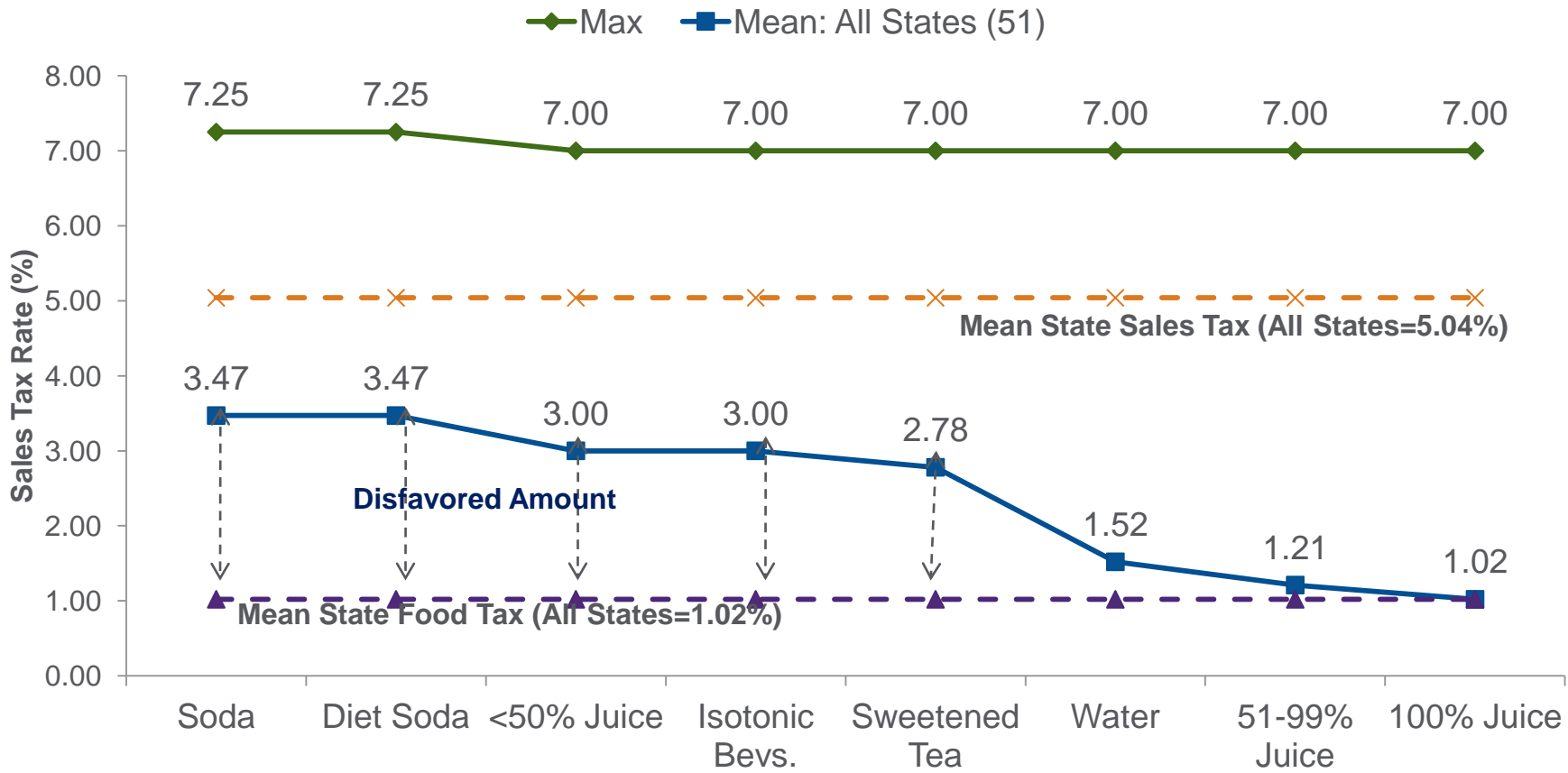
Policy Implications

Policy Landscape - Taxes

Food taxes have not generally been introduced with the aim of modifying consumption behavior as they have been used in other public health areas such as tobacco.

Food taxes are currently imposed on selected categories of food such as soft drinks, candy and snacks in grocery stores and vending machines but at quite **low tax rates**.

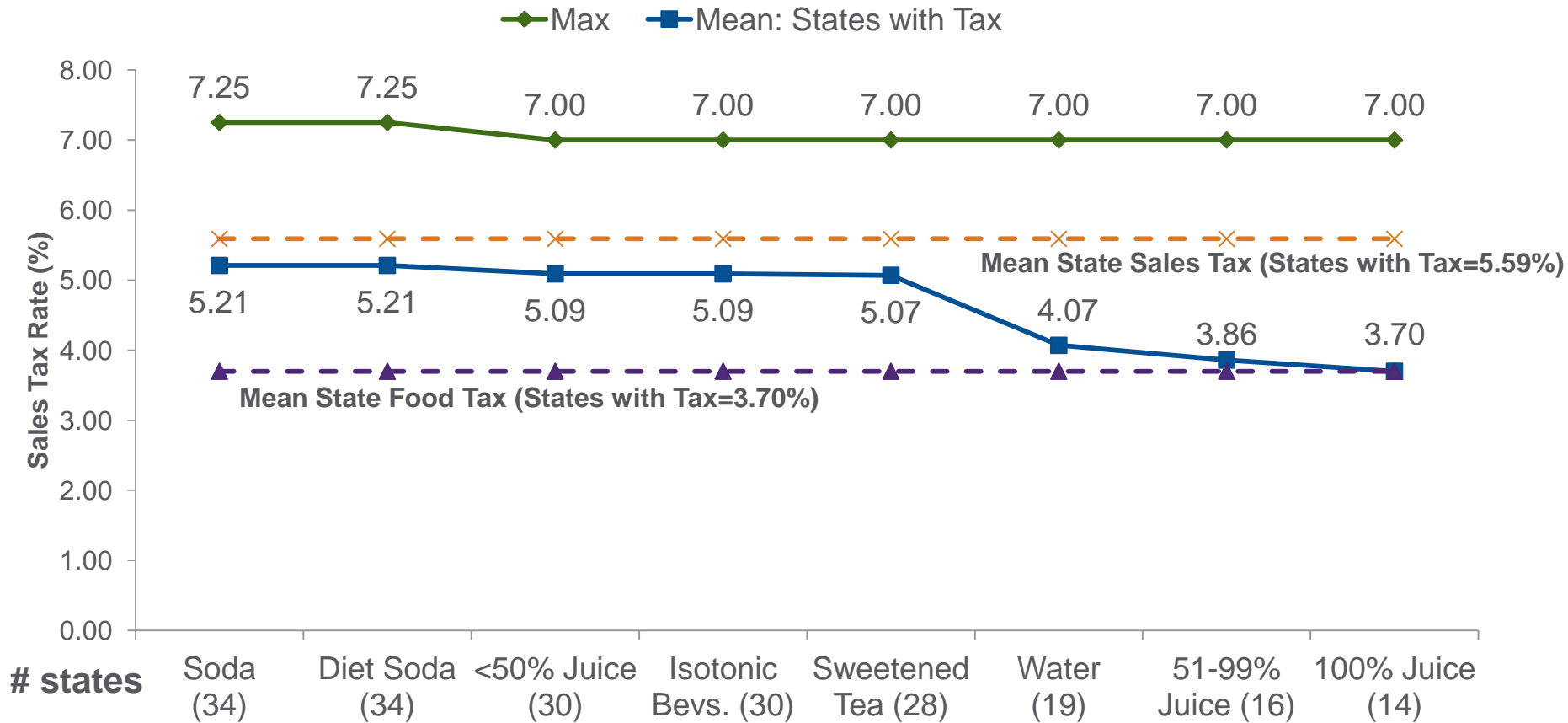
Sales Taxes on Selected Beverages, All States (as of July 1, 2010)



Note: Three states also impose a mandatory statewide local tax that is not reflected in the above data: CA (1%), UT (1.25%), VA (1%).

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Sales Taxes on Selected Beverages, Taxing States (as of July 1, 2010)



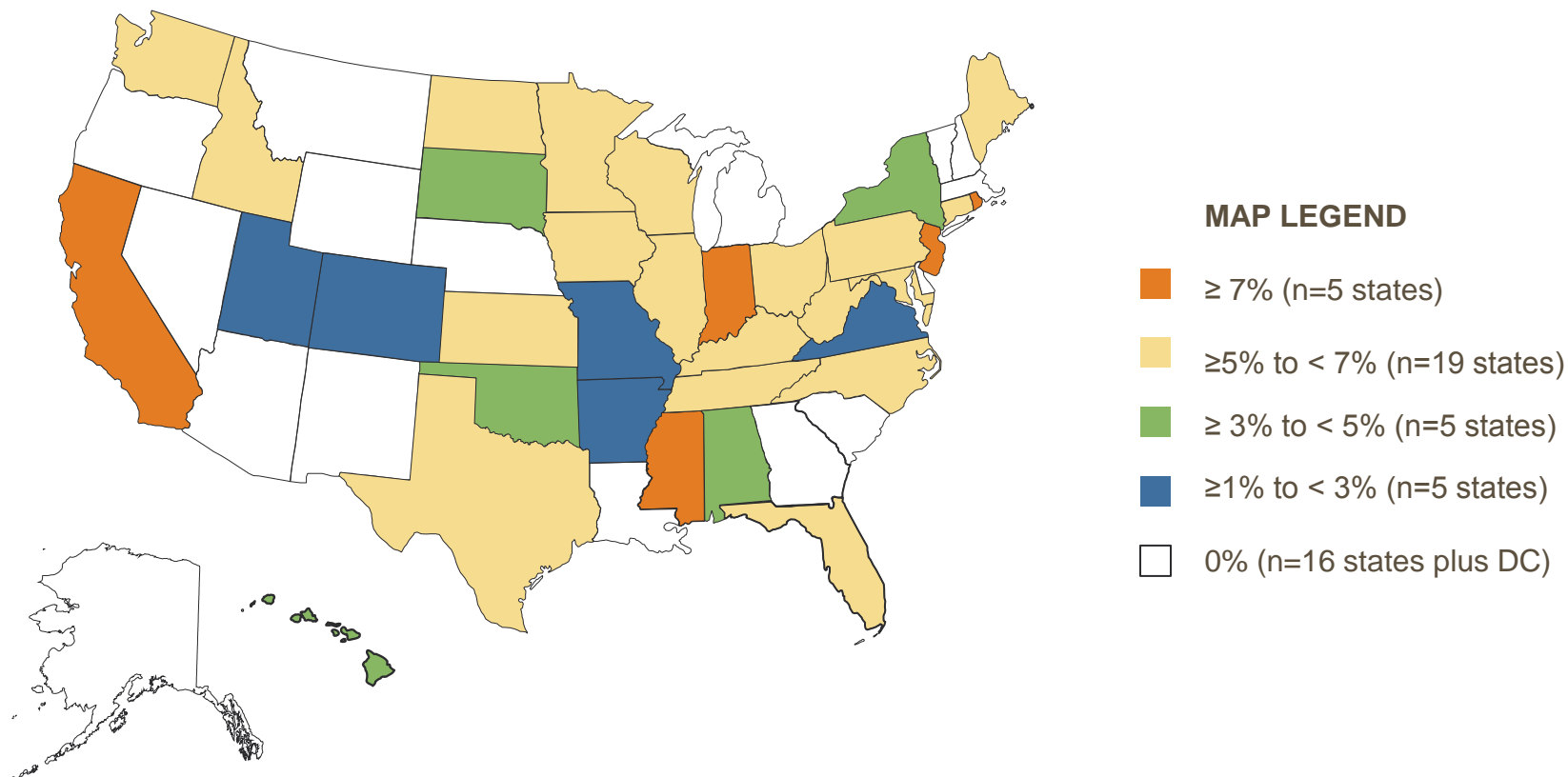
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Sales taxes applied to vending machines sales, selected beverages (as of July 1, 2010)

| | Mean all states (%) | Max (%) | N | Mean taxing states (%) |
|--|---------------------|---------|----|------------------------|
| Soda | 4.14 | 8.00 | 40 | 5.28 |
| Diet Soda | 4.14 | 8.00 | 40 | 5.28 |
| ≤ 50% fruit juice | 4.02 | 8.00 | 39 | 5.26 |
| Isotonic beverages | 4.02 | 8.00 | 39 | 5.26 |
| Sweetened teas (bottle/can) | 3.90 | 8.00 | 38 | 5.24 |
| Bottled water | 3.38 | 8.00 | 34 | 5.07 |
| >51% fruit juice, but < 100% fruit juice | 3.30 | 8.00 | 33 | 5.10 |
| 100% fruit juice | 3.30 | 8.00 | 33 | 5.10 |

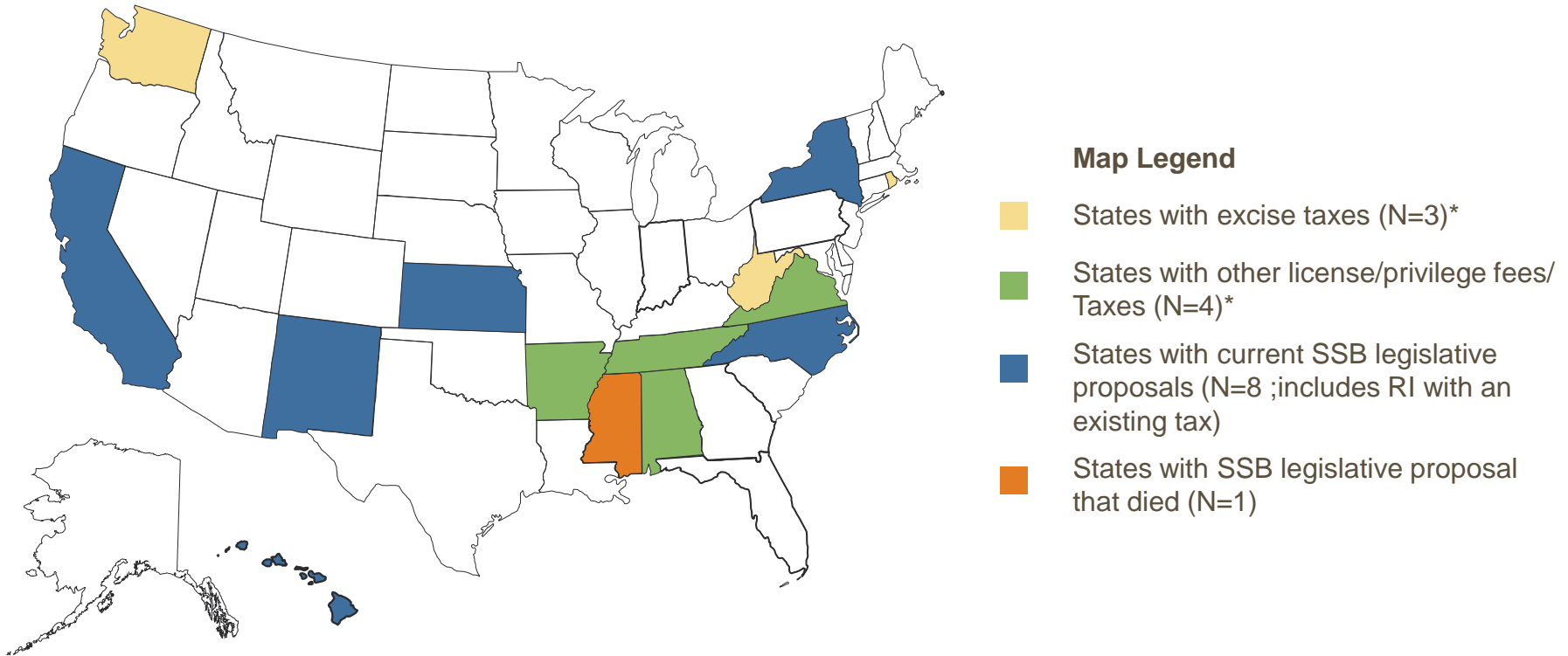
State Sales Taxes on Regular and Diet Soda as of July 1, 2010



Note: Three states also impose a mandatory statewide local tax that is not reflected in the above data: CA (1%), UT (1.25%), VA (1%).

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States with Non-Sales* Taxes on Selected Beverages (as of 7/1/10) or SSB-related Legislative Proposals in 2010



*Additional excise/ad valorem (non-sales) taxes may be applied at the manufacturer, distributor, wholesaler, and/or retailer levels and are applied to bottles, syrup, powders and/or mixes. Taxes apply to regular and diet soda, isotonic, and sweetened tea in AL, AR, RI, TN, and WV. Taxes only apply to regular and diet soda in VA and WA.

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State SSB-related Legislative Activity, 2010 Legislative Session (includes carryover)—as of 8/27/10

8 states have introduced SSB-specific excise/ privilege tax bills during the 2010 legislative session:

California and **Kansas** (tax upon sweetened beverage manufacturers at a rate of \$0.01/teaspoon sugar in SSB/concentrate)

Hawaii (1% gross proceeds on sale of SSBs)

Mississippi (\$0.02/ounce or \$2.56/gallon produced from syrup)—**Died in Committee**

New Mexico (\$0.005/ounce imposed on distributors)

New York (\$1.28/gallon bottled soft drinks; \$1.28/gallon soft drink produced from powder/mix; \$7.68/gallon of syrup)

Rhode Island (\$0.05/20 ounces or \$0.10/>20 ounces) – **in addition to existing non-sales taxes**

South Carolina (\$0.01/13.5 grams of concentrate of sugar placed into SSB concentrate imposed on manufacturers)

City-level tax proposals

Philadelphia - \$0.02/ounce – **Died in City Council**

Washington DC - \$0.01/ounce – **Died in DC Council (but did extend sales tax base to include SSBs effective 10/1/10)**

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Future Research and Tax Policy Design Implications

- Evidence as we go ... jurisdictions that adopt higher taxes on sugar sweetened beverages will provide natural experiments for researchers to examine the effectiveness of these efforts in promoting healthier dietary intake and curbing the obesity epidemic.
- Tax Policy Design: Implications for Potential Impact on Health Outcomes
 - ❖ Issues of applicability to SNAP (Food Stamp) purchases
 - ❖ Excise tax rather than a sales tax
 - Incorporated at shelf price
 - Applicable regardless of where items are sold
 - Applied on a per unit basis rather than a function of price so that quantity discounts are still taxed.
 - ❖ Dedication of tax revenue to nutrition and physical activity programs

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Institute for Health Research and Policy, UIC

<http://www.ihrp.uic.edu>

ImpacTeen

<http://www.impacteen.org>

Bridging the Gap

<http://www.bridgingthegapresearch.org>

Contact: powelll@uic.edu