

# A Review of the Effects of U.S. Local Sugar-Sweetened Beverage Taxes on Substitution to Untaxed Beverages and Food Items

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## Key Findings

- **Evaluations of U.S. local sugar-sweetened beverage taxes across five taxing jurisdictions have found mixed results on whether these taxes lead to substitution to untaxed beverages.**
- **Substitution to food items has only been evaluated empirically in two taxing jurisdictions: Philadelphia, Pennsylvania, and Seattle, Washington. Evaluations in Philadelphia found no evidence of substitution to sweets or salty snacks. Evaluations in Seattle found evidence of substitution to sweets but not salty snacks.**
- **One study in Philadelphia and another in Seattle found post-tax decreases in grams of sugar purchased/sold after accounting for potential substitution to other sources of sugar.**

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## Introduction

A majority of U.S. adults and children exceed the Dietary Guidelines for consumption of added sugars,<sup>1-3</sup> an excess of which contributes to adverse health outcomes, including obesity, type 2 diabetes, cardiovascular disease, and dental caries.<sup>4-7</sup> Sugar-sweetened beverages (SSBs) are the largest source of added sugars intake in the American diet.<sup>1,2</sup> As such, reducing SSB consumption is an important public health goal.

SSB taxes are a promising policy tool aimed at reducing consumption and have been implemented in eight local U.S. jurisdictions (Albany, Berkeley, Oakland, and San Francisco, California; Boulder, Colorado; Cook County, Illinois [subsequently repealed]; Philadelphia, Pennsylvania; and Seattle, Washington). These taxes, which range in magnitude from 1 to 2 cents per ounce, typically apply to beverages with added sweeteners and no nutrients (e.g., soda, fruit, energy, and sports drinks) and exclude sweetened/flavored milk; while most have not applied to artificially sweetened beverages (ASBs) with the exception of the Philadelphia and Cook County taxes. Prior studies have shown that SSB taxes in the U.S. (hereafter referring to taxes on SSBs alone and both SSBs and ASBs) reduce the demand for taxed beverages.<sup>8</sup> However, these taxes may not only affect the demand for the taxed beverages themselves, but also the demand for substitute beverages and foods.

Substitution to untaxed beverages with no added sugars (e.g., water) is an intended goal of SSB taxes. However, substitution to unhealthful products is a possible unintended consequence. For example, a tax on SSBs may induce substitution to sweets or salty snacks, if an individual is looking to obtain alternative high-sugar or high-calorie foods. Thus, it is important to understand the extent to which taxes may result in substitution toward untaxed food and beverage products that could undermine the intended public health goals of these taxes. This research brief summarizes findings from peer-reviewed studies and governmental reports that evaluate substitution to untaxed beverages and food items in response to local U.S. SSB taxes.

TABLE 1 Findings from U.S. Local Sugar-Sweetened Beverage Tax Evaluations on Substitution to Untaxed Beverages

Study	Jurisdiction	Data Source	Overall	Diet Drinks	Water	Milk	100% Juice
Falbe et al. (2016) <sup>9</sup>	Berkeley, CA	Consumption	--	--	Increase	--	--
Silver et al. (2017) <sup>10</sup>	Berkeley, CA	Scanner	Increase	Decrease <sup>a</sup>	Increase	Increase <sup>b</sup>	Increase <sup>c</sup>
Silver et al. (2017) <sup>10</sup>	Berkeley, CA	Consumption (volume)	No change	--	--	--	--
Silver et al. (2017) <sup>10</sup>	Berkeley, CA	Consumption (calories) <sup>d</sup>	Increase	--	--	--	--
Lee et al. (2019) <sup>11</sup>	Berkeley, CA	Consumption	--	--	Increase	--	--
Taylor et al. (2019) <sup>12</sup>	Berkeley, CA	Scanner	--	Increase	--	--	--
Rojas and Wang (2021) <sup>13</sup>	Berkeley, CA	Scanner	No change	--	--	--	--
Powell et al. (2020) <sup>14</sup>	Cook County, IL	Scanner	No change	N/A	No change	No change	No change
Powell and Leider (2020) <sup>15</sup>	Cook County, IL	Scanner	No change	N/A	--	--	--
Cawley et al. (2020) <sup>16</sup>	Oakland, CA	Purchases	Increase	No change <sup>e</sup>	No change	--	--
Cawley et al. (2020) <sup>16</sup>	Oakland, CA	Consumption (adults)	No change	No change	No change	No change	No change
Cawley et al. (2020) <sup>16</sup>	Oakland, CA	Consumption (children)	No change	No change	No change	Increase	Decrease <sup>f</sup>
Léger and Powell (2021) <sup>17</sup>	Oakland, CA	Scanner <sup>g</sup>	No change	Decrease <sup>h</sup>	No change	Increase	No change
Zhong et al. (2018) <sup>18</sup>	Philadelphia, PA	Consumption	--	N/A	Increase	--	--
Cawley et al. (2019) <sup>19</sup>	Philadelphia, PA	Purchases	No change	N/A	No change	--	--
Cawley et al. (2019) <sup>19</sup>	Philadelphia, PA	Consumption (adults)	No change	N/A	No change	No change	Increase <sup>i</sup>
Cawley et al. (2019) <sup>19</sup>	Philadelphia, PA	Consumption (children)	No change	N/A	No change	No change	No change
Roberto et al. (2019) <sup>20</sup>	Philadelphia, PA	Scanner	No change	N/A	--	--	--
Bleich et al. (2020) <sup>21</sup>	Philadelphia, PA	Purchases	No change	N/A	--	--	--
Lawman et al. (2020) <sup>22</sup>	Philadelphia, PA	Purchases	No change	N/A	--	--	--
Zhong et al. (2020) <sup>23</sup>	Philadelphia, PA	Consumption	--	N/A	No change	--	--
Bleich et al. (2021) <sup>24</sup>	Philadelphia, PA	Purchases	No change	N/A	--	--	--
Seiler et al. (2021) <sup>25</sup>	Philadelphia, PA	Scanner	No change	N/A	No change	--	Increase
Powell and Leider (2020) <sup>26</sup>	Seattle, WA	Scanner	Increase	Increase <sup>j</sup>	No change	No change	No change
Saelens et al. (2020) <sup>27</sup>	Seattle, WA	Consumption (adults)	No change	--	No change	--	--
Saelens et al. (2020) <sup>27</sup>	Seattle, WA	Consumption (children)	No change	--	No change	--	--
Powell and Leider (2021) <sup>28</sup>	Seattle, WA	Scanner	Increase	Increase <sup>k</sup>	Increase	No change	No change
Powell et al. (2021) <sup>29</sup>	Seattle, WA	Scanner	No change <sup>l</sup>	--	--	No change <sup>l</sup>	--
Cawley et al. (2020) <sup>30</sup>	Philadelphia, PA; San Francisco, CA; Seattle, WA; Oakland, CA	Purchases	No change	--	--	--	--

One row is shown per study, unless the study relied on multiple distinct data sources/ measures or reported separate estimates for adults and children. Cells with "--" indicate the given item was not assessed. Cells with "N/A" are not applicable because the given item was taxed in the study jurisdiction.

<sup>a</sup> Decrease in volume sold of diet soft/energy drinks.

<sup>b</sup> Increase in volume sold of plain milk, but decrease in volume sold of milk-based or milk substitute drinks.

<sup>c</sup> Increase in volume sold of fruit/vegetable/tea drinks (treated as a group).

<sup>d</sup> Increase in calories consumed reported to be primarily from milk and other beverages; detailed results by beverage type not reported.

<sup>e</sup> No change for diet soda; no other diet drinks examined.

<sup>f</sup> Decrease in probability of consuming 100% juice; no change in primary consumption measure.

<sup>g</sup> Study found evidence of dynamic effects over the first year post-tax; summary based on overall findings across the entire time period.

<sup>h</sup> Decrease in volume sold of juice drinks.

<sup>i</sup> Increase in the probability of consuming 100% juice; no change in primary consumption measure.

<sup>j</sup> Increase in volume sold of untaxed soda and tea/coffee.

<sup>k</sup> Increase in volume sold of untaxed juice drinks and soda.

<sup>l</sup> Increase in sugar sold from untaxed beverages at one-year but not two-years post-tax, driven by increase in sugar sold from sweetened milk at one-year but not two-years post-tax. No change in sugar sold from untaxed SSBs.

## Substitution to Untaxed Beverages

- As shown in Table 1, a number of studies did not assess substitution to untaxed beverages broadly and others that provided broad measures did not assess beverage types. For example, four studies only assessed substitution to water, and one study only assessed substitution to diet drinks. Seven studies only assessed substitution to untaxed beverages overall and did not assess changes by untaxed beverage type.
- Evaluations of U.S. local SSB taxes have found mixed results on whether these taxes lead to substitution to untaxed beverages both across and within taxing jurisdictions.
- No U.S. local SSB tax has applied to 100%/unsweetened juice, although there have been recommendations that it be taxed as a source of free sugars.<sup>31</sup> Of studies that evaluated substitution to juice, while some have found substitution,<sup>10,19,25</sup> the majority have not.<sup>14,16,17,26,28</sup>
- No U.S. local SSB tax has applied to calorically flavored/sweetened milk. Only two studies have specifically examined substitution to this, both in Seattle, with one finding no change in volume sold of sweetened milk at two-years post-tax,<sup>28</sup> and the other finding an increase in sugar sold from sweetened milk at one-year but not two-years post-tax.<sup>29</sup> Of studies that have examined substitution to milk more broadly, there have been mixed results with some studies finding evidence of substitution<sup>10,16,17</sup> and others not.<sup>14,19,26</sup>
- Research on substitution to beverage concentrates is limited (and not reported in the table above). One study found increases in volume sales in grams of beverage concentrates (which were untaxed) in supermarkets but not other store types,<sup>32</sup> while another study in the same jurisdiction found no change in unit sales of beverage concentrates.<sup>20</sup>

TABLE 2 Findings from U.S. Local Sugar-Sweetened Beverage Tax Evaluations on Substitution to Food Items

Study	Taxing Jurisdiction	Key Findings
Gibson et al. (2021) <sup>32</sup>	Philadelphia, PA	Declines in volume sales in grams of candy, sweet snacks, and salty snacks in supermarkets; no changes for any of these in mass merchandisers or pharmacies.
Bleich et al. (2021) <sup>24</sup>	Philadelphia, PA	In a study of small independent stores, no change in calories or sugar purchased from high-sugar foods (including candy, sweets, and pure sugar). Overall reduction in total calories purchased from sweetened beverages and high-sugar foods of 21-23% and in total sugar purchased of 34% up to two-years post-tax.
Saelens et al. (2020) <sup>27</sup>	Seattle, WA	No change in children's consumption of foods with added sugars.
Oddo et al. (2021) <sup>33</sup>	Seattle, WA	3-6% increase in sales and calories sold of sweets; no change in sales of salty snacks.
Powell et al. (2021) <sup>29</sup>	Seattle, WA	Increase in sugar sold from sweets at both one-year and two-years post-tax; no change in standalone sugar sold. Net reduction in sugar sold from taxed SSBs of 18% at one-year and 19% at two-years post-tax after accounting for substitution to untaxed beverages, sweets, and standalone sugar.

## Substitution to Food Items

- Substitution to food items in response to U.S. local SSB taxes has only been evaluated empirically in Philadelphia and Seattle.
- In Philadelphia, no substitution was found to sweets or salty snacks, and an overall reduction in calories and sugar purchased from sweetened beverages and high-sugar foods was found up to two-years post-tax.
- In Seattle, there was evidence of substitution to sweets but not salty snacks. A net reduction was found in sugar sold from taxed SSBs after accounting for substitution to sweets as well as standalone sugar and untaxed beverages.
- Different findings in Philadelphia and Seattle may be explained by differences in sociodemographic and socioeconomic characteristics, tax base (the Philadelphia tax applied to both SSBs and ASBs while the Seattle tax only applied to SSBs), and other tax avoidance behaviors such as cross-border shopping (evaluations have found cross-border shopping in response to the Philadelphia tax<sup>20,25</sup> but no evidence of cross-border shopping has been found in response to the Seattle tax<sup>26,28</sup>).

## Conclusions

Evaluations of local U.S. SSB taxes have found mixed results on whether taxes lead to substitution to untaxed beverages or food items. Results show limited evidence of substitution to untaxed beverages that are likely to be important sources of added or free sugars. While there is some evidence of substitution to sweets, results still show reductions in sugar purchased or sold from taxed beverages after accounting for this. These findings support the ability of SSB taxes to lead to reductions in added sugars consumption and associated chronic diseases.

## References

1. Bowman S, Clemens J, Friday J, LaComb R, Paudel D, Shimizu M. *Added sugars in adults' diet: What We Eat in America, NHANES 2015-2016*. Food Surveys Research Group (USDA-ARS); 2019. Dietary Data Brief No. 24.
2. Bowman S, Clemens J, Friday J, Schroeder N, LaComb R. *Added sugars in American children's diet: What We Eat in America, NHANES 2015-2016*. Food Surveys Research Group (USDA-ARS); 2019. Dietary Data Brief No. 26.
3. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2020-2025*. 2020. [https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary\\_Guidelines\\_for\\_Americans-2020-2025.pdf](https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary_Guidelines_for_Americans-2020-2025.pdf). Accessed June 9, 2021.
4. Yang Q, Zhang Z, Gregg EW, Flanders W, Merritt R, Hu FB. Added sugar intake and cardiovascular diseases mortality among US adults. *JAMA Intern Med*. 2014;174(4):516-524.
5. Malik VS, Popkin BM, Bray GA, Després J-P, Hu FB. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. *Circ*. 2010;121(11):1356-1364.
6. Malik VS, Pan A, Willett WC, Hu FB. Sugar-sweetened beverages and weight gain in children and adults: A systematic review and meta-analysis. *Am J Clin Nutr*. 2013;98(4):1084-1102.
7. Vartanian LR, Schwartz MB, Brownell KD. Effects of soft drink consumption on nutrition and health: A systematic review and meta-analysis. *Am J Public Health*. 2007;97(4):667-675.
8. Powell LM, Marinello S, Leider J, Andreyeva T. *A review and meta-analysis of the impact of local U.S. sugar-sweetened beverage taxes on demand*. Chicago, IL: Policy, Practice and Prevention Research Center: University of Illinois Chicago; August 2021. Research Brief No. 121.
9. Falbe J, Thompson HR, Becker CM, Rojas N, McCulloch CE, Madsen KA. Impact of the Berkeley excise tax on sugar-sweetened beverage consumption. *Am J Public Health*. 2016;106(10):1865-1871.
10. Silver LD, Ng SW, Ryan-Ibarra S, et al. Changes in prices, sales, consumer spending, and beverage consumption one year after a tax on sugar-sweetened beverages in Berkeley, California, US: A before-and-after study. *PLoS Med*. 2017;14(4):e1002283.
11. Lee M, Falbe J, Schilling D, Basu S, McCulloch C, Madsen K. Sugar-sweetened beverage consumption 3 years after the Berkeley, California, sugar-sweetened beverage tax. *Am J Public Health*. 2019;109(4):637-639.
12. Taylor RLC, Kaplan S, Villas-Boas SB, Jung K. Soda wars: The effect of a soda tax election on university beverage sales. *Econ Inq*. 2019;57(3):1480-1496.
13. Rojas C, Wang E. Do taxes on soda and sugary drinks work? Scanner data evidence from Berkeley and Washington state. *Econ Inq*. 2021;59(1):95-118.
14. Powell LM, Leider J, Léger PT. The impact of a sweetened beverage tax on beverage volume sold in Cook County, IL, and its border area. *Ann Intern Med*. 2020;172(6):390-397.
15. Powell LM, Leider J. Evaluation of changes in beverage prices and volume sold following the implementation and repeal of a sweetened beverage tax in Cook County, Illinois. *JAMA Netw Open*. 2020;3(12):e2031083-e2031083.
16. Cawley J, Frisvold D, Hill A, Jones D. Oakland's sugar-sweetened beverage tax: impacts on prices, purchases and consumption by adults and children. *Econ Hum Biol*. 2020;37:100865.
17. Léger PT, Powell LM. The impact of the Oakland SSB tax on prices and volume sold: A study of intended and unintended consequences. *Health Econ*. 2021;30(8):1745-1771.
18. Zhong Y, Auchincloss A, Lee B, Kanter G. The short-term impacts of the Philadelphia beverage tax on beverage consumption. *Am J Prev Med*. 2018;55(1):26-34.
19. Cawley J, Frisvold D, Hill A, Jones D. The impact of the Philadelphia beverage tax on purchases and consumption by adults and children. *J Health Econ*. 2019;67:102225.
20. Roberto CA, Lawman HG, LeVasseur MT, et al. Association of a beverage tax on sugar-sweetened and artificially sweetened beverages with changes in beverage prices and sales at chain retailers in a large urban setting. *JAMA*. 2019;321(18):1799-1810.
21. Bleich SN, Lawman HG, LeVasseur MT, et al. The association of a sweetened beverage tax with changes in beverage prices and purchases at independent stores. *Health Aff (Millwood)*. 2020;39(7):1130-1139.
22. Lawman HG, Bleich SN, Yan J, et al. One-year changes in sugar-sweetened beverage consumers' purchases following implementation of a beverage tax: a longitudinal quasi-experiment. *Am J Clin Nutr*. 2020;112(3):644-651.
23. Zhong Y, Auchincloss AH, Lee BK, McKenna RM, Langellier BA. Sugar-sweetened and diet beverage consumption in Philadelphia one year after the beverage tax. *Int J Environ Res Public Health*. 2020;17(4):1336.
24. Bleich SN, Dunn CG, Soto MJ, et al. Association of a sweetened beverage tax with purchases of beverages and high-sugar foods at independent stores in Philadelphia. *JAMA Netw Open*. 2021;4(6):e2113527-e2113527.
25. Seiler S, Tuchman A, Yao S. The impact of soda taxes: pass-through, tax avoidance, and nutritional effects. *J Mark Res*. 2021;58(1):22-49.
26. Powell LM, Leider J. The impact of Seattle's sweetened beverage tax on beverage prices and volume sold. *Econ Hum Biol*. 2020;37:100856.
27. Saelens BE, Rowland M, Qu P, et al. *Twelve Month Report: Store Audits & Child Cohort - The Evaluation of Seattle's Sweetened Beverage Tax*. Public Health-Seattle and King County; 2020.
28. Powell LM, Leider J. Impact of a sugar-sweetened beverage tax two-year post-tax implementation in Seattle, Washington, United States. *J Public Health Policy*. 2021. <https://doi.org/10.1057/s41271-021-00308-8>
29. Powell LM, Leider J, Oddo VM. Evaluation of changes in grams of sugar sold after the implementation of the Seattle Sweetened Beverage Tax. *JAMA Netw Open*. 2021;4(11):e2132271-e2132271.
30. Cawley J, Frisvold D, Jones D. The impact of sugar-sweetened beverage taxes on purchases: Evidence from four city-level taxes in the United States. *Health Econ*. 2020;29(10):1289-1306.
31. *Sugar-sweetened beverage taxation in the Region of the Americas*. Washington, DC: Pan American Health Organization; 2020.
32. Gibson L, Lawman H, Bleich S, et al. No evidence of food or alcohol substitution in response to a sweetened beverage tax. *Am J Prev Med*. 2021;60(2):e49-e57.
33. Oddo VM, Leider J, Powell LM. The impact of Seattle's sugar-sweetened beverage tax on substitution to sweets and salty snacks. *J Nutr*. 2021;151(10):3232-3239.

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