# Distribution of Sugar Content in Sugary Drink Purchases in the U.S.: Implications for Tiered Taxation

Lisa M. Powell, PhD[1]
Tatiana Andreyeva, PhD[2]
Zeynep Isgor, PhD[1]

*Affiliations*: [1]Division of Health Policy and Administration, School of Public Health, University of Illinois at Chicago, Chicago, IL
[2]Department of Agricultural and Resource Economics, Rudd Center for Food Policy & Obesity, University of Connecticut, Hartford, CT

*Acknowledgements/Funding*: This report is based upon work that was supported by the American Heart Association (AHA). Support for work on the sugary drink tax revenue calculator was provided by Healthy Food America.

*Conflict of Interest*: The authors have no conflicts of interest to disclose.

## INTRODUCTION

Sugary drinks (i.e., beverages with added nutritive sweeteners) are among the leading sources of empty calories for both children and adults.[1] They provide almost half of all added sugars consumed in the American diet, which makes them a rational target for strategies to reduce excessive sugar intake and improve dietary and health outcomes.[2] Less energy-dense alternatives to sugary beverages for hydration include tap water or non-caloric beverages, while more nutrient-dense options might include milk or 100% fruit juice. The negative health effects of sugary drink consumption have been extensively documented. In a variety of observational studies and randomized controlled trials, excessive consumption of sugary drinks has been linked to weight gain, increased risk of Type 2 diabetes, cardiovascular disease, dental caries, and osteoporosis.[3-6] At the same time, substituting sugary drinks with water or diet drinks (i.e., beverages with non-nutritive sweeteners) were shown to reduce body weight or slow weight gain.[7-9]

Average sugar intake has increased substantially over time and, despite a recent decline in sugary drink consumption, still exceeds dietary recommendations of limiting added sugars to less than 10% of daily calories.[10-12] For example, close to two thirds of youths aged 2-19 years consumed at least one sugary drink on a given day in 2011-14.[13] While recent sales of soda and fruit drinks have been dropping at a rate of about 1-2% per year, sales of other sugary drinks have been increasing, with annual growth rates of 3-6% depending on the category.[14] Looking for variety and novelty, consumers, and especially younger individuals, have shifted away from traditional beverages like soda towards relatively new products such as sports drinks, teas, and energy drinks. As a result, on a per capita basis, volume of sales of all sugary drinks are projected to stay flat or increase slightly over 2015-2020.[14] In terms of sugar content, some of these beverages such as energy drinks are similar to sodas, while others such as teas and sports drinks usually have less sugar per serving than soda, but still relatively high amounts of added sugar compared to dietary recommendations.

Scientific evidence on the negative health effects of excessive sugary drink consumption and economic research on pricing effects on sales and consumption have inspired many public health experts to target sugary drinks for taxation. One argument for a sugary drink tax is that it will help reduce purchases of products associated with negative health effects, such as obesity and Type 2 diabetes and related health care costs. Another justification is the potential to generate revenue to fund programs that prevent obesity and chronic disease and reduce health disparities. Most states already have small (under 10%) general sales taxes on sugary drinks as well as restaurant food and sometimes snack foods.[15] State sales taxes were introduced for general revenue purposes and do not distinguish sugary drinks from lower-calorie alternatives, such as diet beverages and seltzer. Many states apply these taxes only to carbonated beverages while excluding an important fast-growing market of noncarbonated beverages, such as sports drinks and teas. Only a handful of states have volume-specific excise taxes on sugary drinks, which are very low and do not substantially affect affordability of sugary drinks.[15]

Not surprisingly, evidence of the impact of the low sales taxes on beverage consumption is generally weak, with most studies failing to demonstrate a measurable impact on beverage consumption and dietary and weight outcomes.[16] The current sales tax is, on average, about 5%,[17] with some consumers not realizing that soda purchases are subject to a sales tax (because the tax is not reflected in the shelf price) and others not paying it at all (e.g., participants in the Supplemental Nutrition Assistance Program when using their benefits to purchase soda). It is expected that a price increase of at least 20% will work differently from the scenarios seen with the sales tax, leading to a measurable reduction in consumption up to 20–25%.[18-19] The most commonly advocated excise tax in the U.S., a penny-per-ounce tax, is

equivalent to approximately a 20% price increase for major beverage categories (e.g., soda), if fully passed on to retail prices.[20] A price increase of this magnitude may reduce sugary drink sales by a margin large enough to result in meaningful public health benefits.

Berkeley, CA, introduced a penny-per-ounce excise tax on sugary drinks in 2015. Since then, Philadelphia, PA, Cook County, IL, Boulder, CO, Seattle, WA, and three other California cities - Oakland, Albany, and San Francisco - have adopted excise taxes on sugary drinks, with rates varying from one to two cents per fluid ounce and two jurisdictions (Philadelphia, PA, and Cook County, IL, included diet beverages in their tax bases).[21] Early evaluation data from Mexico's nationwide 2014 beverage tax shows a significant decrease in sugary drink consumption, particularly among at-risk lower-income populations.[22-23] Similar promising results are seen in Berkeley, CA,[24-25] and multiple evaluations are ongoing in other locations to evaluate the effect of the sugary drink tax.

All excise beverage taxes to date have used a simple per volume design, imposing a tax of 1-2 cent(s) per fluid ounce in the U.S. and a peso per liter in Mexico. With this approach all beverage products are subject to the same specific tax rate, irrespective of their sugar content or energy density per serving. For example, lightly sweetened teas and sodas are taxed equally on a per ounce basis, even though added sugar and calories from sugar from a soda serving are usually considerably higher than from a serving of tea. While the volume-based approach has important advantages of simplicity in implementation, it does not provide incentives for consumers to switch to less-sweetened beverages or for the beverage industry to reformulate products and reduce added sugar content per serving.

Therefore, alternative tax designs have been proposed, including a tiered tax approach where sugary drinks are taxed at different rates depending on sugar content (i.e., grams of sugar per serving). The United Kingdom will apply a tiered SSB tax starting in 2018 using a three-tier system: beverages with less than 5g of sugar per 100 ml will not be taxed; beverages with 5–8g of sugar per 100ml will be taxed at a rate of 18p/liter; and, beverages with more than 8g sugar per 100ml will be taxed at the highest rate of 24p/liter. Beverages are categorized by sugar content for the tax rate determination, while the tax is levied on a volume basis, so producers might be encouraged to reduce both beverage size and added sugar content.[26]

The tiered tax approach has drawn growing interest in the U.S., but questions remain about the optimal thresholds to determine the tax tiers. The approach should be evidence based, with tiers reflecting the actual distribution of current beverage consumption in the U.S. along the sugar spectrum of various beverages. Understanding where the beverage market is in terms of sugar content of commonly consumed products will guide the choice of thresholds to induce meaningful reformulation and shifts by consumers to less-sweetened lower-taxed beverages. This study is the first to our knowledge to describe the distribution of sugary drink sales along the sugar spectrum of most beverage brands, including differences across beverage categories and by state. This analysis will provide an assessment of the distribution of the volume of sugary drink sales by sugar content to help inform policymakers on potential cut points for a sugary drink tiered tax structure.

## DATA AND METHODS

We used proprietary industry data from the Beverage Marketing Corporation (BMC) on total sales of packaged and fountain sugary drinks sold across all retail channels in the U.S. in 2016.[27] The data were based on annual gallonage (volume of gallons sold) for each beverage category, including carbonated soft drinks (CSDs) or sodas, fruit drinks, sports drinks, ready-to-drink (RTD) tea, value-added or enhanced water, energy drinks, and RTD coffee. Note that

powders (e.g., fruit drink powder mixes) were not included. Beverage sales were assumed to represent beverage consumption.

Within each beverage category, brand-level data for 2016 on volume sold were provided for each product with added sugars in the top segment of the corresponding beverage market. Only products/brands with added nutritive sweeteners were included. The top segment coverage in volume sold varied from 78% for sweetened RTD teas to 91% for sodas to 98% for energy drinks. In addition to sales volume (in millions of gallons), we received data on the market share of each beverage brand, brand's sugar content per 8-ounce serving, sugar content per gallon, and total sugar content per brand (all in grams of sugar). Brands with very small market shares outside of the top 78-98% range were assumed to have a similar distribution of grams of sugar per 8-ounce as other named brands within the corresponding beverage category.

Whenever possible, the proprietary BMC data were verified against data from other sources, including online searches for nutritional information on sugar content per serving of randomly selected brands, industry sales data from Beverage-Digest Fact Book 2017,[28] previously purchased BMC data (e.g., 2015 sales and projections through 2020[29]). No reason for concern was identified. For example, the match with 2016 data in Beverage-Digest was 98.7% for CSD category totals and within 95-99% for major CSD brands (e.g., Coke, Sprite).

To describe the distribution of sugar content in sugary drinks by state, we used data available from the UConn Rudd Center Sugary Drink Tax Calculator on 2015 beverage sales by beverage category in each state. The state-level sales are derived from regional sales data and are further adjusted for each state based on its socio-demographic composition (age, race/ethnicity and education) using National Health and Nutrition Examination Survey (NHANES) 2013-2014 and US Census data. Detailed methods for estimating state-level beverage sales are available elsewhere.[30] The distribution of grams of sugar per 8-ounce serving across beverage brands for each beverage category was applied to the state-level data by beverage category and then aggregated across the beverage categories for the given states.

Finally, to produce per capita estimates for sales of sugary drinks by sugar content, we used the 2016 American Community Survey (ACS) 1-year data file from the US Census Bureau[31] and for the state per-capita estimates, we used state-level population estimates from the U.S. Census Bureau for 2015.[32]

In this report, we describe the distribution of the volume of sugary drink sales by sugar content, grams of sugar per 8-ounce serving, for the following:

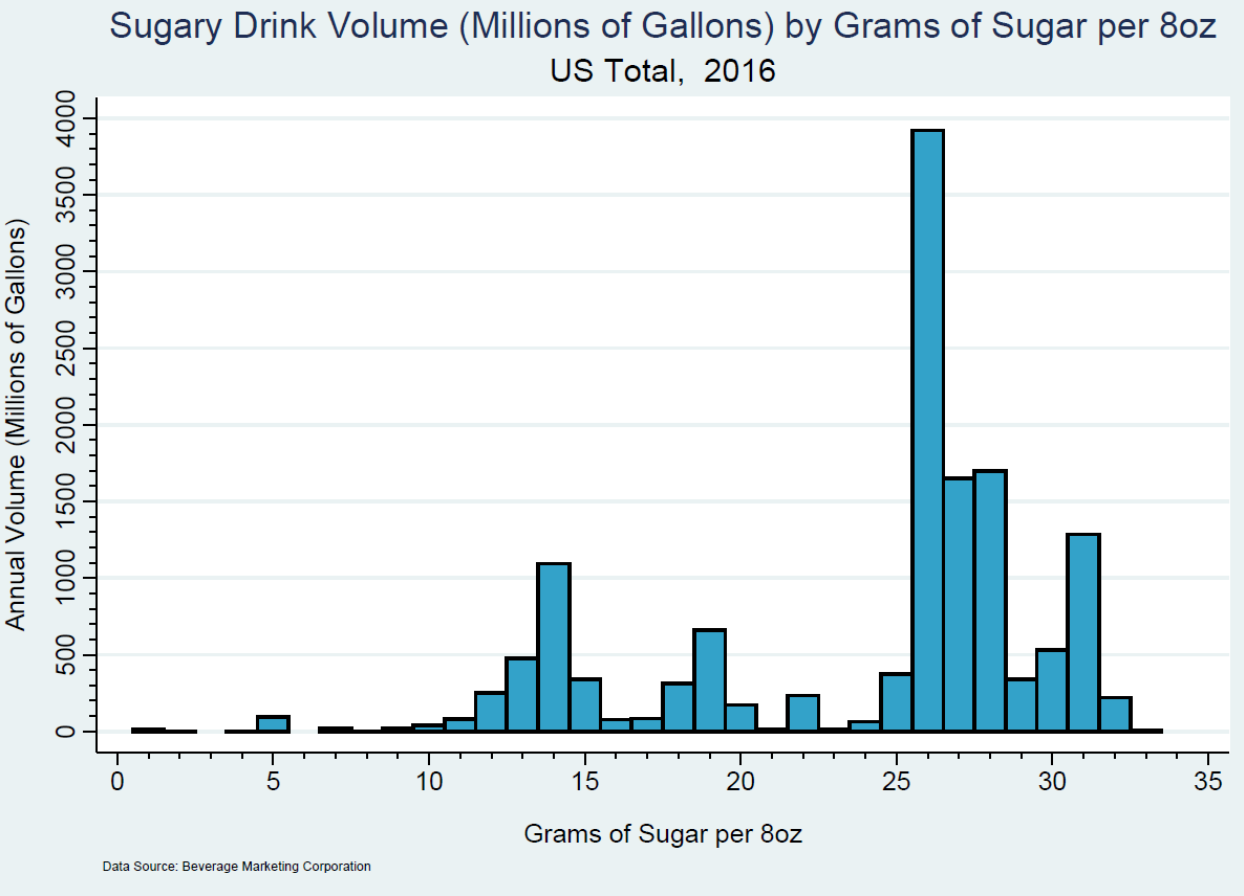
1. Total volume and per capita volume of all sugary drinks for the U.S.;
2. Total volume of sugary drinks by drink category, including CSDs/sodas, fruit drinks, RTD teas, RTD coffee, energy drinks, sports drinks, and value-added water for the U.S.; and,
3. Per capita volume of all sugary drinks by state.

Data for all sugary drinks were aggregated from data on sugary drink categories. For all sugary drinks and by category, we compiled and presented data on beverage volume sold (in millions of gallons per year) by grams of sugar per 8-ounce serving. We presented data on a per capita basis to adjust for population size for each state, providing per capita volume sold (in gallons per year) by grams of sugar per 8-ounce serving. We also provided the per capita estimate for all sugary drinks for the U.S. overall. The 8-ounce serving is used as a standard industry measure of a typical beverage serving. Figures are presented in this report with grams of sugar per 8-ounce serving reported on the x-axis and annual volume sold in millions of gallons per year (and, annual per capita volume in gallons per year) on the y-axis.

## RESULTS

The analysis of the overall U.S. sugary drink market revealed a number of "spikes" in the sales volume distribution of beverages by sugar content per serving. **Figure 1** shows that by far the largest single portion of beverages sold by sugar content were for those with 26 grams of sugar per 8-ounce serving (almost 4 billion gallons), such as sodas and energy drinks. A distant second at just over 1.5 billion gallons in sales were beverages with 27 and 28 grams of sugar per 8-ounce serving, again made up mainly from sodas and energy drinks. The next largest concentration of sales by sugar content, also at the top end of the sugar spectrum, were for beverages with 31 grams of sugar per 8-ounce serving, again made up mostly of sodas. Overall, the vast majority of sugary drink sales were in the high-sugar per serving range of 26 to 31 grams per 8-ounce serving (i.e., ≥25 grams of sugar per 8-ounce serving). The next cluster of sales by sugar content was observed in the range around 14 grams of sugar per 8-ounce serving, which included mostly sports drinks, fruit drinks and RTD teas. A third but slightly smaller cluster in the distribution was observed around 19 grams of sugar per 8-ounce serving, including mostly RTD teas and fruit drinks. Sales were generally very low for sugary drinks with less than 10 grams of sugar per 8-ounce serving. The distribution of the per capita volume of sugary drink sales by sugar content is shown in Appendix A.

**FIGURE 1**



As shown in the figures in Appendix B, there were considerable differences in the volume distribution of sugary drink sales by sugar content across beverage categories. Almost the entire volume of sales for sodas and energy drinks were for high-sugar products with over 25 grams of sugar per 8-ounce serving. There was considerable variation, however, for fruit drinks where the most common volume of sales were for fruit drinks with 18-19 grams of sugar per 8-ounce serving and for those in the 13-15 grams range; yet at the same time, fruit drink sales were also represented in the high-sugar segment (≥25 grams of sugar per 8-ounce serving), particularly with a large volume at 32 grams of sugar per 8-ounce serving. The volume of RTD coffee beverages, although small, also varied across the sugar content spectrum with a significant volume at 26 grams per 8-ounce serving. The volume of RTD tea beverage sales were mostly distributed within the10-20 grams range, but more so at the higher end of the intermediate segment (19-20 grams of sugar per 8-ounce serving). Sales volume of sports drinks and value-added waters were mostly in the lower end of the intermediate group at 10-15 grams of sugar per 8-ounce serving.

The per capita volume of sugary drink sales by sugar content for each state is depicted in Appendix C. The figures show that there were differences across states in both the absolute per capita sugary drink volume of sales and the proportionate distribution of sales by sugar content. Separate analyses by state on the per capita volume distribution of sugary drink sales by sugar content will inform state-level policymakers who may be considering a tiered-tax approach and allow them to tailor their cut-points and/or tax rates in the context of their population's sugary drink patterns.

**DISCUSSION**

This study provided current data on the distribution of sugary drink sales along the sugar content spectrum for the U.S. overall and across beverage categories and by states. The analysis revealed three significant clusters of beverage sales by sugar content in the range of 25-32 grams, 12-15 grams and 18-20 grams per 8-ounce serving. The latter two clusters can be considered to fall into the broader range of 12-20 grams. The observance of these clusters serves as useful evidence for the development of tiers in a tiered tax approach. In order to discourage consumption of high-sugar drinks and incentivize industry reformulation, cut-points for differential tax rates could be implemented at a distance of approximately 5-6 grams below the dominant cluster areas – with cut points for tax rates at <20 grams of sugar per 8-ounce serving and <10 grams per 8-ounce serving in order to incentivize meaningful reductions in consumption of high-sugar sugary drink and meaningful reformulation. This would thus suggest three sugary drink tax brackets based on sugar content as follows: 1) *Low tax bracket*: sugary drinks with sugar content less than 10 grams per 8-ounce serving; 2) *Middle tax bracket:* sugary drinks with sugar content greater than or equal to 10 grams but less than 20 grams per 8-ounce serving; and, 3) *High tax bracket*: sugary drinks with 20 grams or more of sugar per 8-ounce serving. Particularly strong disincentives in the top bracket would yield strong behavioral changes, particularly among at-risk populations who are heavy consumers of high-sugar content sugary drinks. Additionally, given that the overwhelming majority of sugary drinks contain 26-31 grams of sugar per 8-ounce serving, any reformulation that reduces added sugar in these drinks to under 20 grams per 8-ounce serving would represent a 25-35% reduction in sugar content and would allow manufacturers to "move" their products out of the "high" tax bracket. Differences in sugary drink purchases by sugar content across states should receive careful consideration in the design of a tiered beverage tax. Finally, a tiered tax approach may yield the same, if not more, tax revenue as compared to a constant tax rate depending on the variable tax rates implemented across the tiers. Future work on the sugary drink tax calculator will allow policymakers to estimate tax revenue from a tiered tax approach including customized options for different levels of tax rates across the tiers.

## References


1. Reedy J, Krebs-Smith SM. Dietary sources of energy, solid fats, and added sugars among children and adolescents in the United States. *J Am Diet Assoc*. 2010; 110:1477-84.
2. US Department of Health and Human Services, U.S. Department of Agriculture. 2015-2020 Dietary Guidelines for Americans, Eighth Edition. Washington D.C.: U.S. Government Printing Office; 2015.
3. Schulze MB, Manson JE, Ludwig DS, et al. Sugar-sweetened beverages, weight gain, and incidence of type 2 diabetes in young and middle-aged women. *JAMA* 2004;292:927-34.
4. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr*. 2006;84:274-88.
5. Malik VS, Hu FB. Sugar-sweetened beverages and health: where does the evidence stand? Am J Clin Nutr. 2011;94: 1161-2.
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 Oct;98(4):1084-102.
7. Ebbeling CB, Feldman HA, Chomitz VR, Antonelli TA, Gortmaker SL, Osganian SK, Ludwig DS. A randomized trial of sugar-sweetened beverages and adolescent body weight. *N Engl J Med.* 2012 Oct 11;367(15):1407-16.
8. Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in diet and lifestyle and long-term weight gain in women and men. *N Engl J Med*. 2011;364:2392-404.
9. Pan A, Malik VS, Hao T, Willett WC, Mozaffarian D, Hu FB. Changes in water and beverage intake and long-term weight changes: results from three prospective cohort studies. *Int J Obes (Lond)*. 2013 Oct;37(10):1378-85.
10. Mesirow MS, Welsh JA. Changing beverage consumption patterns have resulted in fewer liquid calories in the diets of US children: National Health and Nutrition Examination Survey 2001-2010. *J Acad Nutr Diet*. 2015 Apr;115(4):559-66
11. Powell ES, Smith-Taillie LP, Popkin BM. Added sugars intake across the distribution of US children and adult consumers: 1977-2012. *J Acad Nutr Diet*. 2016;116:1543-50.
12. Bleich SN, Vercammen KA, Koma JW, Li Z.Trends in Beverage Consumption Among Children and Adults, 2003-2014. *Obesity* (Silver Spring). 2017 Nov 14.
13. Rosinger A, Herrick K, Gahche J, Park S. Sugar-sweetened beverage consumption among U.S. youth, 2011–2014. NCHS data brief, no 271. Hyattsville, MD2017.
14. Proprietary data from the Beverage Marketing Corporation, 2016. New York, NY: Beverage Marketing Corporation of New York, 850 Third Avenue, New York, New York 10022.
15. Chriqui JF, Chaloupka FJ, Powell LM, Eidson SS. A typology of beverage taxation: multiple approaches for obesity prevention and obesity prevention-related revenue generation. *J Public Health Policy*. 2013 May 23. Aug;34(3):403-23.
16. Powell LM, Chaloupka FJ. Food prices and obesity: evidence and policy implications for taxes and subsidies. *Milbank Q*. 2009 Mar;87(1):229-57.
17. Chriqui JF, Eidson SS, Chaloupka FJ. State Sales Taxes on Regular Soda (as of January 1, 2014) - BTG Fact Sheet. Chicago, IL: Bridging the Gap Program, Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago; 2014.
18. World Health Organization. Fiscal policies for diet and prevention of noncommunicable diseases: technical meeting report, 5-6 May 2015, Geneva, Switzerland. WHO 2016.
19. Powell LM, Chriqui JF, Khan T, Wada R, Chaloupka FJ. 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*. 2013;14(2):110-128.
20. Powell LM, Isgor Z, Rimkus L, and Chaloupka FJ. Sugar-Sweetened Beverage Prices: Estimates from a National Sample of Food Outlets. Chicago, IL: Bridging the Gap Program,

Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago, 2014.
21. Healthy Food America. Locally Sugary Drink Taxes Passed in the US as of 10/19/2017. http://www.healthyfoodamerica.org/map
22. Colchero MA, Guerrero-López CM, Molina M, Rivera JA. Beverages sales in Mexico before and after implementation of a sugar sweetened beverage tax. *PLoS One.* 2016 Sep 26;11(9).
23. Colchero MA, Rivera-Dommarco J, Popkin BM, Ng SW. In Mexico, evidence of sustained consumer response two years after implementing a sugar-sweetened beverage tax. *Health Aff (Millwood)*. 2017 Mar 1;36(3):564-571.
24. Silver LD, Ng SW, Ryan-Ibarra S, Taillie LS, Induni M, Miles DR, Poti JM, Popkin BM. 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 Apr 18;14(4).
25. 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 Oct;106(10):1865-71.
26. American Heart Association (AHA). Reducing Sugar-Sweetened Beverage Consumption: A Focus on Sugar-Sweetened Beverage Taxes, June 2016.
27. Proprietary data from the Beverage Marketing Corporation, 2017. New York, NY: Beverage Marketing Corporation of New York, 850 Third Avenue, New York, New York 10022.
28. Beverage-Digest. Statistical Yearbook of Non-Alcoholic Beverages for 2016. Fact Book Twenty-Second Edition, May 2017.
29. Proprietary data from the Beverage Marketing Corporation, 2016. New York, NY: Beverage Marketing Corporation of New York, 850 Third Avenue, New York, New York 10022.
30. Revenue Calculator for Sugary Drink Taxes. Help using the calculator. Available at: http://www.uconnruddcenter.org/revenue-calculator-more-information
31. US Census Bureau, 2016. American Community Survey 1-Year Estimates.
32. US Census Bureau, 2015. Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico.