

## Philadelphia Beverage Tax's Impact on Beverage Ad Expenditures and Number of Ads Purchased

Sophia V. Hua, PhD, MPH,<sup>1</sup> Matthew M. Lee, MS,<sup>2</sup> Rebecca Mozaffarian, MS, MPH,<sup>2</sup> Sara N. Bleich, PhD,<sup>3</sup> Christina A. Roberto, PhD,<sup>1</sup> Frances Fleming-Milici, PhD,<sup>4</sup> Briana Stephenson, PhD,<sup>5</sup> Erica L. Kenney, ScD, MPH<sup>2</sup>

**Introduction:** On January 1, 2017, Philadelphia implemented a beverage excise tax. The study's objective was to determine whether beverage advertising expenditures and the number of beverage ads purchased changed in Philadelphia compared to Baltimore because of this tax.

**Methods:** Monthly beverage ad expenditures and the number of beverage ads purchased by brand from January 2016 through December 2019 were obtained. Ads were coded as being for taxed or not taxed beverages and analyzed in 2023. The primary outcomes were quarterly taxed beverage ad expenditures and number of ads purchased. A controlled interrupted time series design on segmented linear regression models was used. Models (aggregated and stratified by internet, spot TV, and local radio) compared whether levels and trends in the outcomes changed from pre- to post-tax in Philadelphia compared to Baltimore.

**Results:** There were no significant differences in taxed beverage advertising expenditures between Philadelphia and Baltimore for trends pretax, at implementation, or post-tax. There were 0.13 (95% CI: -0.25, -0.003) fewer quarterly taxed beverage ads purchased per 100 households in Philadelphia versus Baltimore at baseline. Among internet advertising, there were 0.42 (95% CI: -0.77, -0.06) fewer quarterly taxed beverage ads purchased per 100 households in Philadelphia versus Baltimore immediately post-tax. For spot TV ads, the percentage of taxed beverage ads purchased per quarter was greater at baseline in Philadelphia by 28.0 percentage points (95% CI: 1.9, 54.1).

**Conclusions:** This study found little evidence of changes in mass media advertising on the examined platforms between 2016 and 2019 due to the Philadelphia beverage tax.

*Am J Prev Med 2024;000(000):1-8. © 2024 Published by Elsevier Inc. on behalf of American Journal of Preventive Medicine.*

## INTRODUCTION

Sugar-sweetened beverages (SSBs) are the top source of added sugar in the American diet<sup>1</sup> and increase the risk of diet-related chronic diseases such as type 2 diabetes and obesity.<sup>2,3</sup> In part to curb SSB consumption, several U.S. cities have implemented beverage excise taxes.<sup>4</sup> The tax in Philadelphia was proposed in February 2016 after 2 previously failed attempts, passed in June 2016, and was implemented on January 1, 2017 at a rate of 1.5 cents-per-ounce. Unlike other beverage taxes in the U.S., Philadelphia's also includes beverages sweetened with non-nutritive sweeteners (i.e., diet sodas). Myriad studies have shown that these taxes, regardless of tax size, city of study, and retail

From the <sup>1</sup>Department of Medical Ethics and Health Policy, University of Pennsylvania, Perelman School of Medicine, Philadelphia, Pennsylvania; <sup>2</sup>Department of Nutrition, Harvard T.H. Chan School of Public Health, Boston, Massachusetts; <sup>3</sup>Department of Health Policy and Management, Harvard T.H. Chan School of Public Health, Boston, Massachusetts; <sup>4</sup>UConn Rudd Center for Food Policy and Health, University of Connecticut, Hartford, Connecticut; and <sup>5</sup>Department of Biostatistics, Harvard T.H. Chan School of Public Health, Boston, Massachusetts

Address correspondence to: Sophia V. Hua, PhD, MPH, Department of Medical Ethics and Health Policy, University of Pennsylvania, Perelman School of Medicine, 423 Guardian Drive, 1129 Blockley Hall, Philadelphia, PA 19104. E-mail: [sophia.hua@pennmedicine.upenn.edu](mailto:sophia.hua@pennmedicine.upenn.edu).

0749-3797/\$36.00

<https://doi.org/10.1016/j.amepre.2024.03.011>

type, have led to increased prices for taxed beverages, which have subsequently led to decreased purchasing of those same beverages.<sup>5–11</sup>

While taxes that lead to price changes are one way to alter consumer behavior, advertising can also be a powerful influence. Because advertising influences food purchasing and consumption, the food and beverage industry spends almost \$5 billion annually to promote their products.<sup>12</sup> Several studies demonstrate that exposure to unhealthy food marketing increases preference and intake of foods and beverages that are energy-dense and nutrient-poor,<sup>13–15</sup> especially among children, who are particularly susceptible to advertising given that they typically cannot recognize its persuasive intent.<sup>15–17</sup> Moreover, food and beverage advertising of sugary drinks and other less healthful foods has been shown to target Black and Hispanic youth,<sup>12,18</sup> potentially exacerbating existing health disparities.<sup>19</sup>

Given that SSB taxes reduce SSB sales, beverage companies have an incentive to counteract these effects with increased advertising to mitigate their losses by encouraging consumers to buy SSBs despite the tax. However, it is not well understood whether this is occurring. Evaluations of changes in advertising practices as a result of a beverage tax in the U.S. have focused on in-store promotions only, with mixed findings by city. One study showed that in-store marketing for taxed beverages increased in small retailers in Philadelphia compared to Baltimore after the tax,<sup>20</sup> but no changes occurred in Oakland.<sup>21,22</sup> To the authors' knowledge, no study to date has examined whether beverage advertising expenditures or number of beverage ads purchased on mass media platforms such as the internet, television, and radio have changed as a result of these taxes.

Therefore, the objective of this study was to determine whether beverage advertising expenditures and the number of beverage ads purchased on mass media changed in Philadelphia compared to Baltimore (a demographically similar city with no beverage excise tax) from before to after Philadelphia implemented a 1.5 cents-per-ounce tax for both sugar-sweetened and non-nutritive sweetened beverages on January 1, 2017. The hypothesis was that advertising expenditures and the number of ads purchased would increase for beverages subject to the tax in Philadelphia but not Baltimore.

## METHODS

### Study Sample

A controlled interrupted time series analytic approach was used to conduct a natural experiment on repeated cross-sectional advertising data from the Philadelphia and Baltimore media markets from January 2016

through December 2019. Data on monthly beverage ad expenditures and the number of beverage ads purchased by beverage brands were obtained from Kantar Inc., an advertising research firm, for ads on the internet via desktop and laptop computers (excluding social media marketing), spot TV (i.e., regional TV), local radio, national radio, newspaper, outdoors, and magazines. Data for cable TV was not included. Kantar gathers expenditure data using a mix of polls, published rates, third party reports, and audited billings. The number of ad units purchased is collected using a mix of audience impressions, bot technology, third party monitors, and internal counts. The media market is defined by media type; for example, internet uses 53 local markets to collect geo-targeted advertising, while TV uses designated market areas (DMAs) and radio uses markets delineated by Kantar's third-party data source. Information on the ad's parent company (e.g., PepsiCo), brand (e.g., Tropicana), media type (e.g., internet, radio), market (Philadelphia or Baltimore), date of ad purchase, and date of expenditure were provided for all years. For 2019, screenshots and/or videos of the content of the internet and spot TV ads were additionally provided.

### Measures

The primary outcomes were taxed beverage ad expenditures and ad units purchased per fiscal quarter. Beverage ads found in the 2016–2019 Kantar dataset was coded as either “taxed” (i.e., calorically or non-nutritively sweetened), “not taxed” (i.e., unsweetened or milk-based), or “uncategorized” based on the line of beverages offered by the brand. For example, Dr. Pepper as a brand sells only sweetened beverages, so it was considered “taxed”; on the other hand, the Deer Park brand only sells water, so it was categorized as “not taxed”; finally, the brand Honest Tea (now discontinued) sold both sweetened and unsweetened teas, so it was considered “uncategorized.” All ads for infant formula, coffee grounds, tea bags, syrups, mixes, and concentrates were excluded from the analysis because they were not candidates for potential taxation. Because it was not always possible to determine whether an advertisement was for a sweetened or unsweetened beverage from the brand information alone, taxed status was additionally determined by using the screenshot and video data provided for 2019. Three trained researchers coded those ads. While the only variables of interest to these analyses were whether the ads featured a sweetened or unsweetened beverages, the coders initially double coded 18 spot TV ads and 21 internet ads until >75% agreement was reached across *all* variables. Discrepancies were discussed as a group to reach consensus. All remaining ads were single coded (n=1,075). Ads that included both

sweetened and unsweetened beverages were coded as “taxed” ads. These data were then merged with data from 2016 to 2019 on the Kantar-provided beverage category, parent company, brand, media platform, and market city to determine the tax status of observations from those years. Using the tax status categorizations deduced from the 2016–2019 data, gaps in the tax classification that did not merge was filled. Once completed, any observations that did not have a tax status ( $n=1,553$ ; 26.2%) were coded as “uncategorized” for their tax status and excluded from the primary analyses.

Taxed, not taxed, and uncategorized advertising expenditures and number of ads shown within each quarter of the year (January–March, April–June, July–September, October–December) and for each city were summed, both overall and stratified by media type (internet, spot TV, local radio, national radio, and outdoor). Data were aggregated at the quarterly level to reduce potential noise found in a month-to-month analysis. To account for differences in the population size of Philadelphia and Baltimore, the data were standardized to a per 100 household estimate of expenditures and ad counts by dividing the quarterly expenditure/count estimates by the DMA size for each city (2,942,800 for Philadelphia<sup>23</sup> and 1,119,480 for Baltimore<sup>24</sup> in 2023) and multiplying by 100.

The secondary outcome was the proportion of taxed beverage ads out of all beverage ads. To assess whether the balance between ads for taxed versus not taxed beverages changed, the percentage of all beverage ad expenditures that were for taxed beverages was calculated by dividing taxed beverage expenditures by the sum of taxed and not taxed beverage expenditures for each quarter.

### Statistical Analysis

The primary analyses used a controlled interrupted time series design on segmented linear regression models. The models included a term for time (measured in quarters of years), which tested whether there was a difference in the existing time trend in beverage advertising expenditures or counts prior to the implementation of the tax (i.e., whether advertising had already had an increasing or decreasing trend, or whether it had stayed relatively flat in Philadelphia versus Baltimore). The models also included an interaction term between city and an indicator for the start of the sweetened beverage tax (January 2017), which tested whether advertising expenditures and counts immediately changed in Philadelphia compared to Baltimore upon tax implementation, as well as an interaction term between city, the tax start indicator, and time, to test whether there was a change in quarterly advertising trends before versus after

tax implementation in Philadelphia versus Baltimore. Models used an indicator for seasons to control for seasonality in beverage advertising (for example, regular increases during the winter holiday season). See [Appendix Figure 1](#) (available online) for the model. To assess whether trends and/or changes in trends differed by the type of media from which the ads were sourced, stratified models by whether the ads were found on internet, spot TV, or local radio were also analyzed. No other media platforms were separately analyzed due to data sparsity. Sensitivity analyses used the same models as the primary analyses but included “uncategorized” observations as not taxed or taxed, depending on which was the more conservative approach for those specific analyses. For example, in models analyzing changes in taxed ads, uncategorized beverages were included as “not taxed,” but in models analyzing changes in not taxed ads, uncategorized beverages were included as “taxed.” Exploratory analyses examined pooled data from Baltimore and Philadelphia for the 2 primary outcomes in a single-group interrupted time series analysis to determine whether there were trends at the national level that may provide context to the primary results. Analyses were conducted in Stata version 17 in 2023.

## RESULTS

There were 92 companies representing 232 brands in the data. Average baseline quarterly expenditures per 100 households for taxed beverage ads in Philadelphia was \$41.81 (SD: 25.61); in Baltimore, it was \$35.88 (SD: 22.58). Average baseline quarterly expenditures per 100 households for not taxed beverages in Philadelphia was 0.92 (SD: 1.16) and for Baltimore was 0.02 (SD: 0.02). Taxed beverage ad units purchased per 100 households in Philadelphia was 0.18 (0.07) and in Baltimore was 0.35 (SD: 0.12) in 2016. See [Table 1](#) (aggregated across all media types), [Appendix Table 1](#) (available online) (stratified by media types), and [Appendix Figure 2](#) (available online) (plot of outcomes).

When examining advertising expenditures for taxed beverages across media types, there were no significant differences between Philadelphia and Baltimore for trends pre-2017, the time immediately at implementation, or after the tax ([Table 2](#)). When examining the number of advertisements purchased for taxed beverages, there were 0.13 (95% CI:  $-0.25, -0.003$ ) fewer quarterly ads purchased per 100 households across all examined media type in Philadelphia compared to Baltimore at baseline (first quarter of 2016), but no differences in pretax time trends, immediate tax effects, or post-tax time trends. There were no differences between the

**Table 1.** Mean Quarterly Expenditures and Number of Beverage Ads Purchased in Philadelphia and Baltimore, 2016–2019<sup>a,b</sup>

Year (n)	Taxed beverages—Philadelphia		Taxed beverages—Baltimore		Not taxed beverages—Philadelphia		Not taxed beverages—Baltimore	
	Mean (SD) costs (\$) <sup>c</sup>	Mean (SD) units <sup>d</sup>	Mean (SD) costs (\$) <sup>c</sup>	Mean (SD) units <sup>d</sup>	Mean (SD) costs (\$) <sup>c</sup>	Mean (SD) units <sup>d</sup>	Mean (SD) costs (\$) <sup>c</sup>	Mean (SD) units <sup>d</sup>
2016 (n=4)	41.81 (25.61)	0.18 (0.07)	35.88 (22.58)	0.35 (0.12)	0.92 (1.16)	0.0004 (0.0004)	0.02 (0.02)	0.001 (0.0004)
2017 (n=4)	36.96 (24.39)	0.32 (0.13)	38.84 (24.63)	0.92 (0.33)	2.55 (2.37)	0.01 (0.02)	0.53 (1.03)	0.01 (0.02)
2018 (n=4)	34.05 (16.02)	0.54 (0.18)	26.54 (13.46)	0.79 (0.22)	16.38 (18.78)	0.06 (0.06)	7.75 (8.95)	0.04 (0.05)
2019 (n=4)	30.62 (9.88)	0.51 (0.24)	22.80 (10.12)	0.86 (0.35)	9.70 (7.17)	0.02 (0.02)	5.41 (4.87)	0.02 (0.03)

<sup>a</sup>Media types included: internet, spot TV, local radio, national radio, newspaper, outdoors, and magazines.

<sup>b</sup>Per 100 households.

<sup>c</sup>Mean costs are the estimated average advertising expenditures in U.S. dollars spent per 100 households by beverage companies. For example, in 2016, we estimated that for each quarter of 2016, beverage companies spent an average of \$41.81 per 100 households to advertise taxed beverages in Philadelphia.

<sup>d</sup>Mean units are the estimated average number of ads purchased per 100 households by beverage companies.

cities related to the proportion of ads that were for taxed beverages at any time point.

When examining outcomes stratified by media type (Table 3), there were no differences between cities for local radio advertising expenditures or number of ads purchased. However, when looking just at internet advertising, after having no significant differences in baseline taxed beverage advertising trends, there were 0.42 (95% CI: –0.77, –0.06) fewer quarterly internet ads purchased per 100 households for taxed beverages in Philadelphia compared to Baltimore immediately post-tax, with no change in post-tax trend differences after that initial drop. Correspondingly, a smaller percentage of internet ads was for taxed beverages in Philadelphia compared to Baltimore immediately post-tax (–4.6 percentage points per quarter [95% CI: –9.1, –0.10]), with no significant changes afterward. Meanwhile, when examining spot TV alone, the percentage of ads per quarter that was purchased for taxed beverages was greater at baseline (first quarter of 2016) in Philadelphia compared to Baltimore by 28.0 percentage points (95% CI: 1.9, 54.1), but after baseline and before the tax there was a more negative trend in the percentage of taxed beverage ads out of all beverage ads in Philadelphia compared to Baltimore, such that this initial difference at baseline disappeared. Then, while there was no significant difference between the cities immediately post-tax, the percentage of taxed beverage advertisements began to increase each quarter in Philadelphia compared to Baltimore, suggesting that there may have been a shift towards more taxed beverage ads relative to not taxed beverage ads in Philadelphia among spot TV (13.5 percentage points more per quarter in Philadelphia than Baltimore [95% CI: 0.3, 26.6]).

In sensitivity analyses where uncategorized ads were treated as ads for not taxed beverages, there were no significant findings for any model, except the finding that

the percentage of internet ads that was for taxed beverages was significantly less in Philadelphia compared to Baltimore post-tax (Appendix Tables 2 and 3, available online). See Appendix Table 4 (available online) for pooled analyses results.

## DISCUSSION

The results showed that contrary to the hypothesis, there were no meaningful shifts in overall mass media advertising expenditures and number of ads purchased of taxed beverages in Philadelphia compared to Baltimore as a result of the Philadelphia beverage tax. However, stratification by media type resulted in mixed findings. Among internet ads only, there were fewer numbers of taxed beverage internet ads purchased immediately post-tax in Philadelphia versus Baltimore, suggesting, if anything, a shift away from these ads in the taxed city compared to the not taxed city. In contrast, when examining spot TV ads, it appeared that, post-tax, the percentage of ads shown for taxed beverage out of all beverage ads increased more in Philadelphia compared to Baltimore; analysis on taxed beverage ad expenditures did not reflect those changes. Taken together, this study did not find evidence of changes in mass media advertising for taxed beverages in Philadelphia after the tax.

These findings add to existing literature that has also shown mixed findings in response to beverage taxes when examining different forms of marketing: in-store promotions and marketing displays, and price promotions. Lee et al<sup>20</sup> looked at beverage advertising 24 months post-tax in Philadelphia, finding that compared to small stores in Baltimore, marketing of taxed beverages increased by 0.91 ads per store overall, but 1.68 ads per store for stores located in low-income areas. Prior literature has also shown that in-store marketing for SSBs increased during SNAP issuance dates,

**Table 2.** Quarterly Changes in Beverage ad Expenditures and Number of Beverage Ads Purchased, Philadelphia Versus Baltimore<sup>a</sup>

Outcome	Taxed <sup>b-e</sup>				Not taxed <sup>b,c,e,f</sup>			
	Initial mean level difference in Philadelphia versus Baltimore $\beta$ (95% CI)	Difference in mean baseline trend $\beta$ (95% CI)	Mean level difference in Philadelphia versus Baltimore immediately post-tax $\beta$ (95% CI)	Pre-post trend compared to Baltimore $\beta$ (95% CI)	Initial mean level difference in Philadelphia versus Baltimore $\beta$ (95% CI)	Difference in mean baseline trend $\beta$ (95% CI)	Mean level difference in Philadelphia versus Baltimore immediately post-tax $\beta$ (95% CI)	Pre-post trend compared to Baltimore $\beta$ (95% CI)
Total								
Costs (\$)	10.37 (-33.59, 54.33)	-2.96 (-28.63, 22.72)	2.22 (-79.87, 84.31)	3.64 (-22.38, 29.65)	0.73 (-0.74, 2.21)	0.11 (-0.92, 1.15)	2.05 (-8.64, 12.75)	0.20 (-1.67, 2.08)
# of ads	<b>-0.13 (-0.25, -0.003)</b>	-0.03 (-0.11, 0.04)	-0.29 (-0.76, 0.19)	0.06 (-0.05, 0.16)	-0.001 (-0.001, 0.0002)	0.0003 (-0.0001, 0.001)	0.01 (-0.04, 0.06)	-0.001 (-0.01, 0.01)
Proportion								
Costs	-0.01 (-0.03, 0.02)	-0.002 (-0.02, 0.01)	-0.04 (-0.22, 0.14)	0.005 (-0.03, 0.04)	0.01 (-0.02, 0.03)	0.002 (-0.01, 0.02)	0.04 (-0.14, 0.03)	-0.005 (-0.04, 0.03)
# of ads	0.002 (-0.002, 0.01)	-0.001 (-0.003, 0.0004)	-0.04 (-0.10, 0.02)	0.005 (-0.005, 0.01)	-0.002 (-0.01, 0.002)	0.001 (-0.0004, 0.003)	0.04 (-0.02, 0.10)	-0.005 (-0.01, 0.005)

Note: Boldface indicates statistical significance ( $p < 0.05$ ).

<sup>a</sup>Complete case analysis controlling for seasonality with all media types included (i.e., internet, spot TV, local radio, national radio, newspaper, outdoors, and magazines) in a controlled interrupted time series regression.

<sup>b</sup>Per 100 households.

<sup>c</sup>Total costs and number of ads represent the estimated change in the average expenditures and number of ads purchased by beverage companies per 100 households in Philadelphia compared to Baltimore from before to after the beverage tax. For example, beverage companies spent a nonsignificant \$10.37 more in expenditures per quarter for taxed beverage ads per 100 households in Philadelphia compared to Baltimore in 2016 (before the tax).

<sup>d</sup>Proportion=taxed/(taxed+not taxed).

<sup>e</sup>Proportional costs and number of ads represent the estimated change in the percent make-up of each respective category comparing Philadelphia to Baltimore. For example, the percentage of expenditures per quarter that was for taxed beverage ads was smaller at baseline in Philadelphia compared to Baltimore by a nonsignificant 1.0 percentage point.

<sup>f</sup>Proportion=not taxed/(taxed+not taxed).



**Table 3.** Quarterly Changes in Beverage ad Expenditures and Number of Beverage Ads Purchased by Media Type<sup>a</sup>

Outcome	Initial mean level difference in Philadelphia versus Baltimore $\beta$ (95% CI)	Difference in mean baseline trend $\beta$ (95% CI)	Mean level difference in Philadelphia versus Baltimore immediately post-tax $\beta$ (95% CI)	Pre–post trend compared to Baltimore $\beta$ (95% CI)
Internet				
Taxed <sup>b,c</sup>				
Costs (\$)	–1.01 (–2.11, 0.09)	0.33 (–0.14, 0.79)	–0.78 (–1.96, 0.40)	–0.21 (–0.71, 0.29)
# of ads	–0.08 (–0.17, 0.01)	0.04 (–0.01, 0.08)	<b>–0.42 (–0.77, –0.06)</b>	–0.02 (–0.10, 0.06)
Proportion <sup>d,e</sup>				
Costs (\$)	0.002 (–0.01, 0.01)	–0.001 (–0.004, 0.002)	–0.14 (–0.31, 0.04)	0.02 (–0.003, 0.04)
# of ads	0.01 (–0.02, 0.03)	–0.003 (–0.01, 0.01)	<b>–0.05 (–0.09, –0.001)</b>	0.01 (–0.002, 0.02)
Spot TV				
Taxed <sup>b,c</sup>				
Costs (\$)	–0.79 (–7.77, 6.19)	–0.56 (–6.25, 5.14)	0.57 (–20.07, 21.20)	0.61 (–5.23, 6.45)
# of ads	–0.01 (–0.05, 0.03)	0.0002 (–0.02, 0.02)	0.01 (–0.04, 0.06)	–0.001 (–0.02, 0.02)
Proportion <sup>d,e</sup>				
Costs (\$)	0.01	–0.01	–0.003	–0.001
# of ads	<b>0.28 (0.02, 0.54)</b>	<b>–0.12 (–0.23, –0.01)</b>	0.15 (–0.31, 0.61)	<b>0.13 (0.003, 0.27)</b>
Local Radio				
Taxed <sup>b,c</sup>				
Costs (\$)	–4.97 (–23.35, 13.42)	–2.48 (–12.38, 7.43)	8.49 (–21.16, 38.14)	3.09 (–6.91, 13.08)
# of ads	–0.04 (–0.20, 0.13)	–0.07 (–0.16, 0.02)	0.12 (–0.20, 0.43)	0.07 (–0.02, 0.17)
Proportion <sup>d,e</sup>				
Costs (\$)	–0.0005 (–0.001, 0.0002)	0.0004 (–0.0001, 0.001)	–0.07 (–0.22, 0.08)	–0.004 (–0.03, 0.02)
# of ads	–0.001 (–0.003, 0.001)	0.0004 (–0.001, 0.001)	–0.05 (–0.17, 0.08)	–0.005 (–0.02, 0.01)

Note: Boldface indicates statistical significance ( $p < 0.05$ ).

<sup>a</sup>Complete case analysis controlling for seasonality in controlled interrupted time series regressions.

<sup>b</sup>Per 100 households.

<sup>c</sup>Total costs and number of ads represent the estimated change in the average expenditures and number of ads purchased by beverage companies per 100 households in Philadelphia compared to Baltimore from before to after the beverage tax. For example, beverage companies spent a nonsignificant \$1.01 less in expenditures per quarter for taxed beverage internet ads per 100 households in Philadelphia compared to Baltimore in 2016 (before the tax).

<sup>d</sup>Proportional costs and number of ads represent the estimated change in the percent make-up of each respective category comparing Philadelphia to Baltimore. For example, the percentage of expenditures per quarter that was for taxed beverage internet ads was greater at baseline in Philadelphia compared to Baltimore by a nonsignificant 0.2 percentage points.

<sup>e</sup>Proportion=taxed/(taxed+not taxed).

suggesting that the flexibility of in-store marketing may be used to respond to certain policies.<sup>25</sup> In contrast, evaluations out of Oakland found no immediate or long-term changes in store advertising practices after that city’s beverage tax,<sup>21,22</sup> and gray literature for an evaluation of Seattle’s supermarket advertising practices also found no changes.<sup>26</sup> The one available study examining the impact of a beverage tax on price promotions showed that in Oakland, the prevalence of these promotions did not significantly change for taxed beverages, though the amount discounted increased when compared to a control site.<sup>27</sup> It is possible that changes in price promotions have occurred even though there were no changes in advertising expenditures because food and beverage companies spend most of their marketing

budgets (~70%) on in-store marketing (e.g., purchasing shelf space) and the rest on advertising.<sup>28</sup> This may be because in-store marketing encompasses pricey slotting fees in which companies must invest heavily to have a presence in the store.<sup>28</sup> For mass media advertising, it is also possible that these results did not show differential changes because advertising tends to occur at the national level, not local level. Since TV ad purchases are mainly national, for instance, spot TV ads may not capture all of the advertising practices in Philadelphia and Baltimore.<sup>29</sup>

The tax revenue in Philadelphia is dedicated to fund universal pre-K, parks and recreation, and community schools, among other citywide projects. The most recent data dating through June 2022 shows that nearly

\$160 million has funded 4,000 pre-K seats; nearly \$20 million has gone toward funding 20 community schools, and \$2.4 million has gone toward rebuilding parks and rec.<sup>30</sup> Based on these results, there is little evidence that shifts in mass media advertising have occurred to counteract the effects of the tax; however, people continue to purchase taxed beverages, and tax revenue is high. These results may assuage concerns that shifts in advertising exposure could render the taxes less effective over time.

This paper has several strengths. To the authors' knowledge, this is the first paper to characterize whether beverage companies changed the amount of money spent on taxed beverage ads and the number of taxed beverage ads purchased as a result of a beverage tax. This paper also used objectively collected data from a marketing research firm. Finally, the data included internet ads, which is a growing form of advertisement in the food and beverage industry.

### Limitations

This paper also has several limitations. First, the data did not have product-level information for the ads shown in 2016–2018. To address this limitation, screenshots of ads from 2019, which did have product information, were used and merged with taxed and not taxed categorizations from the 2016–2018 data. Even with the screenshots, about a quarter of the data could not be categorized as either taxed or not taxed beverage ads. Sensitivity analyses were conducted to include all the data, which did not always replicate the results to the primary analyses. These results should therefore be interpreted with caution. Second, the data only included 1 year of baseline data prior to implementation. It is possible that public discourse about the coming beverage tax during that year (2016) could have already been influencing advertising practices. Third, while the data measures advertisements and related expenditures for the overall DMAs for Philadelphia and Baltimore, these data do not measure individuals' exposure to these ads; thus, it cannot be ruled out that there may have been differential consumption of different types of ads among individuals. The aggregated data also meant that assessments on whether there were any differences in advertising exposure by race/ethnicity, which has been a concern in previous studies, could not be conducted.<sup>12</sup> Fourth, the data did not include cable TV, only spot TV, which accounts for 2% of beverage advertising exposure among children and teens.<sup>29</sup> However, the inclusion of cable TV advertising (which is purchased at a national level) may not have provided extra information for the study given that changes would be expected at a regional level for this city-specific tax.

## CONCLUSIONS

This study found no evidence of changes in advertising practices on mass media platforms including internet, spot TV, local radio, national radio, newspaper, outdoors, and magazines between 2016 and 2019 in response to the Philadelphia beverage tax. These results suggest that changes in marketing tactics may be limited to more localized in-store promotional marketing. Future research can expand the current work to include ad exposure data or include other cities with beverage taxes.

## ACKNOWLEDGMENTS

We would like to thank Jasmine Norris for her help with coding the data.

The contents of this article have been previously presented at The Obesity Society annual conference.

This study was funded by Healthy Eating Research, a national program of the Robert Wood Johnson Foundation. Dr. Hua was supported by the NIH National Research Service Award (training grant T32 DK 007703). The content of this article is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

No financial disclosures were reported by the authors of this paper.

## CREDIT AUTHOR STATEMENT

Sophia V. Hua: Methodology, Formal analysis, Writing—original draft, Writing—review and editing. Matthew M. Lee: Methodology, Writing—review and editing. Rebecca Mozaffarian: Project administration, Writing—review and editing. Sara N. Bleich: Conceptualization, Funding acquisition, Writing—review and editing. Christina A. Roberto: Methodology. Frances Fleming-Milici: Methodology, Writing—review and editing. Briana Stephenson: Methodology, Writing—review and editing. Erica L. Kenney: Conceptualization, Funding acquisition, Methodology, Resources, Writing—review and editing, Supervision.

## SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at <https://doi.org/10.1016/j.amepre.2024.03.011>.

## REFERENCES

1. Dietary guidelines for Americans, 2020–2025. 2020. [DietaryGuidelines.gov](https://www.dietaryguidelines.gov). Accessed May 24, 2021.
2. Hu FB. Resolved: there is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases. *Obes Rev*. 2013;14(8):606–619. <https://doi.org/10.1111/obr.12040>.
3. Malik VS, Hu FB. Sugar-sweetened beverages and cardiometabolic health: an update of the evidence. *Nutrients*. 2019;11(8):1840. <https://doi.org/10.3390/nu11081840>.

4. Map and chart the movement. Healthy Food America. Updated June 2020. <https://www.healthyfoodamerica.org/map>. Accessed October 9, 2023.
5. 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. <https://doi.org/10.1001/jama.2019.4249>.
6. 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. <https://doi.org/10.1377/hlthaff.2019.01058>.
7. Powell LM, Leider J. The impact of Seattle's sweetened beverage tax on beverage prices and volume sold. *Econ Hum Biol*. 2020;37:100856. <https://doi.org/10.1016/j.ehb.2020.100856>.
8. Leider J, Li Y, Powell LM. Pass-through of the Oakland, California, sugar-sweetened beverage tax in food stores two years post-implementation: a difference-in-differences study. *PLoS One*. 2021;16(1):e0244884. <https://doi.org/10.1371/journal.pone.0244884>.
9. 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, U.S.: a before-and-after study. *PLoS Med*. 2017;14(4):e1002283. <https://doi.org/10.1371/journal.pmed.1002283>.
10. Hua SV, Petimar J, Mitra N, et al. Philadelphia beverage tax and association with prices, purchasing, and individual-level substitution in a national pharmacy chain. *JAMA Netw Open*. 2023;6(7):e2323200. <https://doi.org/10.1001/jamanetworkopen.2023.23200>.
11. 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. <https://doi.org/10.1016/j.ehb.2020.100865>.
12. Harris JL, Fleming-Milici F, Mancini S, Kumanyika S, Ramirez AG. Targeted food and beverage advertising to Black and Hispanic consumers: 2022 update. 2022. <https://uconnruddcenter.org/wp-content/uploads/sites/2909/2022/11/Rudd-Targeted-Marketing-Report-2022.pdf>. Accessed August 16, 2023.
13. Harris JL, Bargh JA, Brownell KD. Priming effects of television food advertising on eating behavior. *Health Psychol*. 2009;28(4):404–413. <https://doi.org/10.1037/a0014399>.
14. Smith R, Kelly B, Yeatman H, Boyland E. Food marketing influences children's attitudes, preferences and consumption: a systematic critical review. *Nutrients*. 2019;11(4):875. <https://doi.org/10.3390/nu11040875>.
15. Russell SJ, Croker H, Viner RM. The effect of screen advertising on children's dietary intake: a systematic review and meta-analysis. *Obes Rev*. 2019;20(4):554–568. <https://doi.org/10.1111/obr.12812>.
16. Harris JL, Pomeranz JL, Lobstein T, Brownell KD. A crisis in the marketplace: how food marketing contributes to childhood obesity and what can be done. *Annu Rev Public Health*. 2009;30:211–225. <https://doi.org/10.1146/annurev.publhealth.031308.100304>.
17. Committee on Communications, American Academy of Pediatrics, Strasburger VC. Children, adolescents, and advertising. *Pediatrics*. 2006;118(6):2563–2569. <https://doi.org/10.1542/peds.2006-2698>.
18. Powell LM, Wada R, Kumanyika SK. Racial/ethnic and income disparities in child and adolescent exposure to food and beverage television ads across the U.S. media markets. *Health Place*. 2014;29:124–131. <https://doi.org/10.1016/j.healthplace.2014.06.006>.
19. Ward ZJ, Long MW, Resch SC, Giles CM, Craddock AL, Gortmaker SL. Simulation of growth trajectories of childhood obesity into adulthood. *N Engl J Med*. 2017;377(22):2145–2153. <https://doi.org/10.1056/NEJMoa1703860>.
20. Lee MM, Gibson LA, Hua SV, et al. Advertising and stocking at small retailers: a sweetened beverage excise tax in Philadelphia. *Am J Prev Med*. 2024;66(3):408–417. <https://doi.org/10.1016/j.amepre.2023.09.022>.
21. Zenk SN, Li Y, Leider J, Pipito AA, Powell LM. No long-term store marketing changes following sugar-sweetened beverage tax implementation: Oakland, California. *Health Place*. 2021;68:102512. <https://doi.org/10.1016/j.healthplace.2021.102512>.
22. Zenk SN, Leider J, Pugach O, Pipito AA, Powell LM. Changes in beverage marketing at stores following the Oakland sugar-sweetened beverage tax. *Am J Prev Med*. 2020;58(5):648–656. <https://doi.org/10.1016/j.amepre.2019.12.014>.
23. Philadelphia MMM Map in 2023. Media Market Map. <https://www.mediamarketmap.com/philadelphia-designated-market-media-map/>. Accessed October 9, 2023.
24. Baltimore MMM Map in 2023. Media Market Map. <https://www.mediamarketmap.com/baltimore-designated-market-media-map/>. Accessed October 9, 2023.
25. Moran AJ, Musicus A, Gorski Findling MT, et al. Increases in sugary drink marketing during Supplemental Nutrition Assistance Program benefit issuance in New York. *Am J Prev Med*. 2018;55(1):55–62. <https://doi.org/10.1016/j.amepre.2018.03.012>.
26. Asa N. *Associations Between the Sweetened Beverage Tax Implementation in Seattle, WA and Changes in Supermarket Interior Marketing Displays*. Seattle, WA: M.P.H. University of Washington; 2022. <https://www.proquest.com/docview/2696321790?pq-origsite=gscholar&fromopenview=true#>. Accessed April 3, 2024.
27. El-Sayed OM, Powell LM. The impact of the Oakland sugar-sweetened beverage tax on price promotions of sugar-sweetened and alternative beverages. *PLoS One*. 2023;18(6):e0285956. <https://doi.org/10.1371/journal.pone.0285956>.
28. Rivlin G. *Rigged: Supermarket Shelves for Sale*. Washington, DC: Center for Science in the Public Interest, 2016.
29. Harris JL, Fleming-Milici F, Kibwana-Jaff A, Phaneuf L. Sugary drink FACTS 2020—sugary drink advertising to youth: continued barrier to public health progress. 2020. [https://www.sugarydrinkfacts.org/resources/Sugary%20Drink%20FACTS%202020/Sugary\\_Drink\\_FACTS\\_Full%20Report\\_final.pdf](https://www.sugarydrinkfacts.org/resources/Sugary%20Drink%20FACTS%202020/Sugary_Drink_FACTS_Full%20Report_final.pdf). Accessed August 18, 2023.
30. Brady C, Rhynhart R. Data release: beverage tax revenue and expenditures. Office of the Controller. <https://controller.phila.gov/philadelphia-audits/data-release-beverage-tax/>. Accessed October 9, 2023.