Impacts of the Seattle sweetened beverage tax on perceived healthfulness of sweetened beverages

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Abstract

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Sweetened beverage tax implementation is associated with differences in reduced purchasing volumes of sweetened beverages. However, it's unclear whether the tax plays a role in shifting perceptions about sweetened beverages and their health impacts. We utilized pre-tax and post-tax survey data collected from Seattle and comparison area residents to compare differences in the perceived healthfulness of sweetened beverage consumption and drink types over time and across income groups. We found significant increases in the proportion of Seattle respondents with lower incomes who agreed that sweetened beverage consumption raises one's chances of diabetes (DD = 0.09 (95% CI 0.05, 0.13); p = 0.002), heart disease (DD = 0.07 (95% CI 0.02, 0.12); p = 0.017), and serious health problems (DD = 0.12 (95% CI 0.05, 0.19); p = 0.009), above and beyond the changes in the comparison area. In contrast, we found significant

decreases in the proportion of Seattle respondents with higher incomes, who agreed sweetened beverages raise one's chances of serious health problems (DD = -0.07 (95% CI -0.11, -0.03); p = 0.009) and heart disease (DD = -0.07 (95% CI -0.13, -0.01); p = 0.038), compared to analogous changes in the comparison area. Perceptual changes regarding the negative health impacts of sweetened beverages appear most prominent among respondents with lower incomes in taxed, versus non-taxed, areas. These changes may be influenced by the combination of tax price effects and pro-tax educational outreach.

1. INTRODUCTION

Over the past decade, cities and countries around the world have implemented sweetened beverage taxes with the goal of raising revenue and decreasing sweetened beverage consumption, which have been linked to diabetes and heart disease.[1] Regions that have implemented a sweetened beverage tax have shown declines in sweetened beverage purchasing volumes, likely related to tax costs being passed through to consumers, resulting in increased sweetened beverage prices.[2,3] The increase in price is hypothesized to be the primary way in which sweetened beverage taxes work to decrease purchasing. However, it has also been hypothesized that beverage taxes might additionally work by raising awareness of the ill-health effects of the products being taxed.[4] Essentially, a sweetened beverage tax is a "sin tax" and this may signal to the consumer that sweetened beverages are unhealthy and nonessential. Additionally, in most jurisdictions that implement a tax, there have been pro- and anti-tax campaigns that accompany the political process around the tax as well as tax implementation. The media coverage of the tax may also serve to increase awareness of the harms of sweetened beverage consumption and thus result in a second pathway by which these taxes may operate to change consumption of sweetened beverages.

Current evidence is mixed in terms of support for the hypothesis that sweetened beverage taxes may work to decrease purchasing and consumption by increasing awareness of the unhealthfulness of these beverages, in addition to increasing their price. Evidence against this "awareness pathway" was documented in the evaluation of Chicago's short-lived beverage tax whereby the purchasing of taxed beverages sharply declined immediately after implementation of the tax but returned to pre-tax levels shortly after the tax was repealed.[5] However, there is some suggestive evidence consistent with increased awareness from the evaluation of Seattle's

Sweetened Beverage Tax. Researchers in Seattle found that among a group of low-income families, sweetened beverage consumption decreased substantially in Seattle upon tax implementation but decreased to the same degree in families living in nearby cities which shared the same media market as Seattle.[4] Additionally, Cawley et al.[6] note that studies of beverage taxes that use a nearby comparison area find smaller tax effects compared to studies that use a more distant comparison area; this could be due to multiple causes, including sharing a media market, confusion about which areas are taxed, and being exposed to messaging about the tax.

While reductions in sweetened beverage purchases and consumption reflect the potential for taxation to positively impact long-term health outcomes, it remains unknown whether price changes are the primary motivators behind these shifts in purchasing and consumption, or whether increased awareness may also play a significant role. Gaining insight as to whether taxes of this nature play an educational role in shifting consumer perceptions will be an important consideration for tax initiatives or amendments moving forward.

In 2018 the city of Seattle implemented a 1.75 cent per ounce tax on sweetened beverage distributors, earmarking the revenue for services that improve food access for low-income families.[7] We conducted a survey to evaluate the impact of Seattle's Sweetened Beverage Tax on beliefs, attitudes, and norms, which included an oversampling of respondents with lower incomes to enable examination of differences by income level. Results from prior studies suggest that the impact of sweetened beverage taxes on purchasing behavior may differ across income levels. Evidence suggests that households with lower socioeconomic status potentially exhibit the greatest reductions in sweetened beverage purchases post-tax, compared to expected purchase volumes based on pre-tax data.[8–10]

Using pre- and post-tax data collected in Seattle and non-taxed comparison areas, the current study aimed to determine whether the beverage tax influenced perceptions of health risks associated with sweetened beverage, and if this differed by income. Additionally, we aimed to assess whether the beverage tax had an impact on changing consumer perceptions of healthfulness of different types of sweetened beverages (i.e., soda, sports drinks, etc.) and whether this also differed by income.

2. METHODS

2.1 Data Collection

From October to December 2017, we administered a pre-tax survey via telephone and online to residents of Seattle, WA and non-taxed comparison areas, which included Arlington, VA, Bethesda and Rockville, MD (combined) and Minneapolis, MN. A follow-up survey was later administered by telephone and online approximately two years following tax implementation between September and November 2019. The survey design, recruitment process, and selection of comparison cities have been discussed elsewhere.[11] Briefly, we chose the comparison areas based on places in the US with similar demographic characteristics and political leanings to Seattle, and where there was no existing sweetened beverage tax. We administered a repeated cross-sectional survey, surveying respondents pre- and post-tax in Seattle and at the same times in the comparison areas. We used quotas to ensure racial/ethnic representation approximately equivalent to each city's distribution and we oversampled people with lower incomes to enable income-specific comparisons. Survey questions pertained to demographics, opinions of the tax, and the perceived economic and health impacts of tax implementation and sweetened beverage consumption.

2.2 Primary variables

2.2.1 Independent variables

The primary independent variable was exposure to the beverage tax, wherein the "treatment" group consisted of Seattle residents and the "control" group consisted of residents in the comparison area. Additionally, we included time as a second independent variable to examine changes in the perceived health impacts of sweetened beverages between pre- and post-tax periods.

2.2.2 Dependent variables

The dependent variables of interest were the perceived health impacts of sweetened beverage consumption (serious health problems, dental health problems, obesity, diabetes, and heart disease), the perceived healthfulness of added sugar and different types of sweetened beverages (soda, fruit drinks, sports drinks, sweetened tea and coffee, energy drinks), and respondents' health score.

Survey respondents were asked to indicate how much they agreed or disagreed (strongly disagree, somewhat disagree, somewhat agree, strongly agree, or don't know) with statements like "*Drinking sugary drinks causes serious health problems,*" and *"Drinking sugary drinks significantly raises a person's chances of [dental health problems, obesity, diabetes, heart disease]."* Respondents were also asked whether they agreed or disagreed that excessive sugar from sources not limited to sugary beverages can lead to serious health problems. Responses to these questions were then dichotomized into a two-category variable: 'strongly agree' and 'somewhat agree' were combined into a new 'agree' category, while 'strongly disagree' and somewhat disagree' were combined into a new 'disagree' category.

Respondents were also asked to indicate whether they thought "R*egularly drinking [soda, fruit-flavored drinks, sports drinks, sweetened teas or coffees, energy drinks] affects a person's chances of developing health problems like diabetes or becoming overweight."* Answer options included 'Doesn't increase,' 'Probably increases,' 'Definitely increases,' or 'Don't know.' Responses to these questions were also dichotomized into a two-category variable: 'doesn't increase' remained its own category, while 'probably increases' and 'definitely increases' were combined into a new 'increases' category. We limited our analysis to only include those who answered all the health impacts, added sugar, and drink type questions; those who answered 'Don't know' to any of the questions were also excluded from the analysis.

To measure respondents' overall health perceptions of sweetened beverages in response to the tax, we created a health score using the 11 questions that asked about: drink type (fruit drinks, soda, sports drinks, sweetened tea/coffee, energy drinks), added sugar, and negative health outcomes (serious health problems, dental health problems, diabetes, obesity, and heart disease). Respondents received a –1 if they disagreed that sweetened beverages negatively impact health, a 0 if they said, "don't know," and a 1 if they agreed that sweetened beverages negatively impact health. Scores ranged from -11 to 11, where higher scores represent the perception that sweetened beverages negatively impact health.

2.2.3 Covariates

We stratified by income based on prior evidence that post-tax changes in sweetened beverage purchasing may differ by income.[8–10] Respondents were asked to report their household size and annual household income, which was then used to create a dichotomous income variable: "lower income" was categorized as having an income <260% of the federal poverty line (FPL), and "higher income" was categorized as having an income ≥260% FPL. We controlled for

race/ethnicity (Non-Hispanic White, Non-Hispanic Black/African American, Non-Hispanic Asian, Non-Hispanic Other, Hispanic), education (some high school, completed high school, some college or vocational training, completed college or university, completed graduate or professional degree), age (18-30, 31-40, 41-50, 51-64, 65+), sex (male or female), survey mode (phone or web), and political affiliation (democrat, independent, republican, other, don't know).

2.3 Statistical Analysis

We created two different weights to use in this analysis. First, we used the raking method to create population weights, so that our study samples were representative of their respective city's demographics (race/ethnicity, sex, age, and annual median household income), according to the 2017 5-year American Community Survey.[11,12] We then stratified by income (<260% FPL and ≥260% FPL) and created propensity score weights for each stratum to minimize group differences across time and location; all covariates other than income were used in the creation of propensity score weights. This method weighted each group (Seattle pre-tax, comparison pre-tax, Seattle post-tax, comparison post-tax) in such a way as to allow resemblance and comparison to the Seattle pre-tax group. The population weights and propensity score weights were then multiplied together to create a final, combined weight for analysis.

To examine the changes in the perceived health impacts of sweetened beverage consumption and of different sweetened beverage types, we separately modeled 12 different outcomes for low and high incomes, resulting in 24 difference-in-difference linear probability regression models. Difference estimates across timepoints represent pre-tax changes in the proportion of the population, compared to post-tax changes. Difference-in-difference estimates represent changes in the proportion of the Seattle population over time compared to proportional changes in the comparison area over time. All models use this general format:

$$Y_{it} = \beta_0 + \beta_1(\text{city})_i + \beta_2(\text{time})_t + \beta_3(\text{city x time})_{it}$$

Statistical analysis was conducted using Stata 15.1 (StataCorp LP, College Station, Texas). This study was reviewed and determined to be exempt by the University of Washington Institutional Review Board.

3. RESULTS

3.1 Overall Score on Health Perceptions among High- and Low-Income Respondents in Seattle and Comparison Areas

The perception that sweetened beverages negatively impact health statistically significantly increased over time among Seattle respondents with higher incomes (Difference (D) = 0.19 (95% CI 0.11, 0.26); p = 0.002); non-statistically significant increases were found among comparison area respondents with higher incomes over time (Table 2). Comparing Seattle respondents with higher incomes to comparison area respondents in the same income bracket, the difference-in-difference (DD) estimates suggest there was no significant change in the perception that sweetened beverages negatively impact health (DD = -0.00 (95% CI -0.61, 0.60); p = 0.985).

Among Seattle respondents with lower incomes, the perception that sweetened beverages negatively impact health increased significantly over time (D = 0.64 (95% CI 0.41, 0.86); p = 0.001). Conversely, significant decreases over time were found among comparison area respondents with lower incomes (D = -0.42 (95% CI -0.81, -0.03); p = 0.04). Overall, we found that the changes in the perception that sweetened beverages negatively impact health among Seattle respondents with lower incomes increased significantly compared to changes in the

comparison area respondents of the same income bracket (DD = 1.05 (95% CI 0.57, 1.54); p = 0.004).

3.2 Differences in Perceived Health Impacts of Sweetened Beverage Consumption Among High-Income Respondents in Seattle and Comparison Areas

Perceptions around the healthfulness of sweetened beverage consumption shifted significantly from pre- to post-tax periods among Seattle respondents with higher incomes. The proportion of respondents who agreed that drinking sweetened beverages significantly increases the likelihood of dental health problems increased (D = 0.02 (95% CI 0.02, 0.02); p < 0.001). Increases were also shown for obesity (D = 0.04 (95% CI 0.03, 0.04); p < 0.001), diabetes (D = 0.05 (95% CI 0.04, 0.06); p < 0.001), and heart disease (D = 0.02 (95% CI 0.01, 0.03); p = 0.003). However, the proportion of people in Seattle who agreed that sweetened beverage consumption increases the chances of serious health problems overall decreased significantly by 2 percentage points (D = -0.02 (95% CI -0.02, -0.01); p = 0.001). Similarly, those in Seattle who agreed that added sugar in general increases the chances of serious health problems decreased by 2 percentage points (D = -0.02 (95% CI -0.02, -0.01); p = 0.001). Conversely, while there were increases in the proportion of comparison area respondents with higher incomes who agreed that sweetened beverage consumption increases the likelihood of negative health outcomes, these changes did not differ significantly between pre- and post-tax periods except for perceptions about heart disease (D = 0.09 (95% CI 0.03, 0.15); p = 0.017) and serious health problems overall (D = 0.05 (95% CI 0.01, 0.10); p = 0.03) (Table 3).

The difference-in-difference estimates showed non-statistically significant increases in the proportion of Seattle respondents with higher incomes who agreed that sweetened beverage consumption increases the likelihood of dental health problems, diabetes, and obesity, compared

to the analogous changes in the comparison area. However, statistically significant decreases were found in the proportion of Seattle respondents who agreed that sweetened beverage consumption increases the chances of serious health problems (DD = -0.07 (95% CI -0.11, -0.03); p = 0.009) and heart disease (DD = -0.07 (95% CI -0.13, -0.01); p = 0.038), compared to changes in the comparison area) (Table 3).

3.3 Differences in Perceived Health Impacts of Sweetened Beverage Consumption Among Low-Income Respondents in Seattle and Comparison Areas

Among Seattle respondents with lower incomes, there were statistically significant changes in the perceptions of the healthfulness of sweetened beverage consumption from before the tax to after the tax. There were statistically significant increases in the proportion of the population who agreed that sweetened beverage consumption increases the chances of dental health problems (D = 0.01 (95% CI 0.01, 0.02); p = 0.001), obesity (D = 0.05 (95% CI 0.03, 0.07); p = 0.001), diabetes (D = 0.01 (95% CI 0.00, 0.03); p = 0.031), and heart disease (D = 0.03 (95% CI 0.00, 0.05); p = 0.028). Additionally, the proportion of Seattle respondents with lower incomes who agreed that added sugar in general increases the likelihood of serious health problems increased by 11 percentage points from pre- to post-tax periods (D = 0.11 (95% CI 0.09, 0.12); p < 0.001). Changes in the proportion of the population who agreed that sweetened beverage consumption increased one's chances of serious health problems overall were not statistically significant (Table 3).

Interestingly, there were statistically significant decreases in the proportion of comparison area respondents with lower incomes who agreed that sweetened beverage consumption increases the likelihood of serious health problems (D = -0.11 (95% CI -0.18, -0.04); p = 0.012) and diabetes (D = -0.08 (95% CI -0.12, -0.04); p = 0.007) from before to after the tax.

Additionally, the proportion of these respondents who agreed that added sugar affects someone's chances of developing health problems significantly decreased over time (D = -0.09 (95% CI -0.13, -0.05); p = 0.004).

The difference-in-difference estimates showed that the proportion of Seattle respondents with lower incomes who agreed that sweetened beverage consumption increases the likelihood of various negative health outcomes differed significantly from respondents in comparison areas. Significant increases were found in the proportion of Seattle respondents (versus comparison area respondents) who agreed that sweetened beverage consumption increases the likelihood of serious health problems (DD = 0.12 (95% CI 0.05, 0.19); p = 0.009), diabetes (DD = 0.09 (95% CI 0.05, 0.13); p = 0.002), and heart disease (DD = 0.07 (95% CI 0.02, 0.12); p = 0.017). Additionally, the proportion of Seattle respondents who agreed that added sugar affected someone's chances of developing health problems increased significantly compared to the comparison area (DD = 0.20 (95% CI 0.15, 0.24); p < 0.001).

3.4 Differences in Perceived Healthfulness of Sweetened Beverage Types Among High-Income Respondents in Seattle and Comparison Areas

Seattle respondents with higher incomes showed shifts in how they perceived the healthfulness of various sweetened beverage types from pre- to post-tax periods. A significant increase was found in the proportion of those who agreed that soda (D = 0.02 (95% CI 0.02, 0.03); p < 0.001) affects someone's chances of developing health problems. Meanwhile, significant decreases were found in the proportion of those who agreed that fruit drinks (D = -0.01 (95% CI -0.02, -0.00); p = 0.028), sweetened tea/coffee (D = -0.01 (95% CI -0.01, -0.00); p = 0.026), and energy drinks (D = -0.01 (95% CI -0.01, -0.00); p = 0.01) affect someone's chances of developing health problems.

There were non-significant decreases over time in the proportion of comparison area respondents with higher incomes who agreed that fruit drinks and soda affect someone's chances of developing health problems (Table 4). Additionally, non-significant increases were found in the proportion of those who agreed that sports drinks and sweetened tea/coffee affect someone's chances of developing health problems (Table 4).

The difference-in-difference estimates comparing the change over time in the perceptions for Seattle respondents with higher incomes to the change over time in the same perceptions among comparison area respondents with higher incomes were not statistically significant (Table 4).

3.5 Differences in Perceived Healthfulness of Sweetened Beverage Types Among Low-Income Respondents in Seattle and Comparison Areas

Perceptions around the healthfulness of various sweetened beverage types also shifted among Seattle respondents with lower incomes, comparing perceptions after the tax to those before the tax. With the exception of energy drinks (D = -0.01 (95% CI -0.03, -0.00); p = 0.033), statistically significant increases were seen in the proportion of lower income respondents who agreed that fruit drinks (D = 0.03 (95% CI 0.02, 0.05); p = 0.001), soda (D = 0.02 (95% CI 0.01, 0.04); p = 0.009), sports drinks (D = 0.03 (95% CI 0.02, 0.03); p < 0.001), and sweetened tea/coffee (D = 0.03 (95% CI 0.02, 0.04); p = 0.001) affect someone's chances of developing health problems.

Among comparison area respondents with lower incomes, only the proportion who agreed that sweetened tea/coffee affect someone's chances of developing health problems increased significantly from pre- to post-tax periods (D = 0.10 (95% CI 0.04, 0.17); p = 0.012); non-

statistically significant increases were found for fruit drinks, sports drinks, and energy drinks (Table 4).

The difference-in-difference estimates suggest that the proportion of Seattle respondents with lower incomes who perceived fruit drinks, soda, and sports drinks as having negative health impacts increased non-significantly from the changes among comparison area respondents with lower incomes; a non-significant decrease was found for energy drinks (Table 4). However, the proportion of Seattle respondents who agreed that sweetened tea/coffee affects someone's chances of developing health problems significantly decreased compared to changes in the proportion of comparison area respondents (DD = -0.07 (95% CI -0.13, -0.01); p = 0.034).

4. DISCUSSION

We assessed changes in the health perceptions of sweetened beverage consumption and sweetened beverage drink types in Seattle and comparison areas across higher and lower income groups over time. Overall, among Seattle respondents with lower incomes, we found significant increases in the perception that sweetened beverages negatively impact health, compared to respondents in the comparison area; this was not the case among those with higher incomes. Additionally, we found significant increases in the proportion of Seattle respondents with lower incomes who agreed that sweetened beverage consumption increased the likelihood of serious health problems, diabetes, and heart disease, and that added sugar contributes to health problems, as compared to analogous changes in the comparison group. In contrast, among Seattle respondents with higher incomes, we found significant decreases in the proportion of those who agreed that sweetened beverage consumption contributes to serious health problems and heart disease, as compared to changes in the comparison area. Across both income groups, the changes

in the proportion of Seattle respondents who agree that fruit drinks, soda, sports drinks, and energy drinks affect someone's chances of developing health problems did not differ significantly from the changes in the comparison area. However, in Seattle, the proportion of those with lower incomes who perceived sweetened tea/coffee as having negative health impacts decreased significantly, as compared to the comparison group. The current study provides further insight into income-related differences in perceptions about sweetened beverage healthfulness, and how these perceptions might change in response to a tax.

The results from prior studies have suggested possible income-based divergences in purchasing and consumption responses to the tax,[8–10,13] and it's unclear whether this may be related to the tax signaling an awareness of the negative health impacts related to sweetened beverages. One study out of Berkeley found that 68% of all respondents reported having an awareness of the tax, and that groups with lower incomes reduced their sweetened beverage consumption by 21%, which coincided with robust media campaigns around the tax.[13] While this study did not assess correlation between tax awareness and consumption, a Mexican study of sweetened beverage tax signaling by Alvarez-Sanchez et al.[14] showed that self-reported decreases in consumption were associated with tax awareness. These findings echo what was found in Seattle, where consumption decreased among groups with lower incomes after tax implementation and decreased in nearby, non-taxed cities, which may suggest an educational role of the tax or media coverage of the tax. Interestingly, Alvarez-Sanchez et al.[14] found that the decreases in sweetened beverage consumption were not related to perceived healthfulness of sweetened beverages, which potentially places more weight on the influence of the tax itself, rather than personal health beliefs. This contrasts with the findings by Powell et al.[5] which showed that, in Chicago, the purchasing of sweetened beverages rebounded to the pre-tax levels

shortly after the repeal of the tax, suggesting the price effects of the tax impact consumer behavior more so than any lasting education effect of the tax or tax media. Notably, this rebound in purchasing could have been related to the fact that the beverage tax was only in place for 4 months prior to its repeal.[5] If tax presence is impacting consumer perceptions of health, it is possible that 4 months would not be enough to evoke significant changes in perception. Additionally, Chicago's pro-tax campaign focused mostly on revenue generated from the tax, rather than public health-focused messaging,[5] which could represent a lost opportunity for health education during the tax campaign and implementation.

While there was not a city-wide effort to promote the beverage tax in Seattle, grass-roots community-based organizations, such as the local organization Got Green, specifically targeted lower-income audiences for pro-tax messaging that communicated the negative health impacts of sweetened beverages.[15] Thus, it's possible that the combined exposure to these messages and the price effects of the tax may have influenced the perceived health impacts of sweetened beverages among these lower-income groups, despite the beverage industry's broader anti-tax campaigns which were aimed at the economic impacts of the tax. Consistent with this, we found that Seattle respondents with lower incomes significantly increased their perceptions that sweetened beverages negatively impact health, compared to respondents in the non-taxed comparison area. Furthermore, Seattle voters with higher incomes were not targeted in this early pro-tax campaign and did not show significant increases above and beyond those in the comparison area regarding their perceptions about sweetened beverages, implying the importance of public health-based tax messaging.

Our study is limited by the repeated cross-sectional design, which prevented us from sampling the same group of people over time. However, our use of population and propensity

score weights resulted in estimates that are "doubly robust"[16] and are more likely to account for income and location differences between groups over time. Additionally, we were only able to administer the Vietnamese survey online, whereas the English and Spanish versions were offered online and by telephone. However, we controlled for survey mode in our analysis.

5. CONCLUSION

Overall, we found that changes in the perceived health impacts of sweetened beverage consumption and various sweetened beverage types increased significantly in groups with lower incomes in Seattle, above and beyond the comparison area or the groups with higher incomes. Our evidence is less supportive of the sole ability of a tax to influence behavior or perceptions. Instead, we suspect that our findings may be related to the increased pro-tax public health messaging aimed at communicating the ill-health effects of sweetened beverages among groups with lower incomes. Future work could examine the relationship between health perceptions and changes in consumption and/or purchasing volumes in Seattle, as well as the associations between pro-tax messaging and changes in consumer perceptions of sweetened beverages.

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7. TABLES

Table 1. Demographic Characteristics of Samples[a]				
	Seattle		Comparison	
	Pre-Tax (N = 591)	Post-Tax (N = 559)	Pre-Tax (N = 517)	Post-Tax (N = 520)
	N (%)	N (%)	N (%)	N (%)
Age				
18-30	115 (21.1%)	121 (21.3%)	119 (20.7%)	158 (22.8%)
31-40	126 (23.0%)	130 (24.0%)	137 (24.9%)	131 (24.1%)
41-50	113 (21.0%)	110 (20.6%)	86 (19.7%)	68 (14.9%)
51-64	131 (23.4%)	145 (20.8%)	107 (23.5%)	106 (23.1%)
65+	169 (11.5%)	121 (13.3%)	124 (11.2%)	129 (15.1%)
Sex				
Male	258 (49.9%)	264 (50.8%)	313 (49.8%)	184 (48.5%)
Female	396 (50.1%)	363 (49.2%)	260 (50.2%)	408 (51.5%)
Race/Ethnicity				
Non-Hispanic White	459 (65.3%)	435 (65.9%)	361 (63.8%)	380 (67.5%)
Non-Hispanic Black/African American	38 (5.4%)	45 (8.4%)	44 (6.9%)	75 (5.3%)
Non-Hispanic Asian	54 (15.0%)	61 (13.9%)	61 (14.6%)	56 (12.8%)
Non-Hispanic Other	59 (7.1%)	40 (5.2%)	21 (6.4%)	39 (8.7%)
Hispanic	44 (7.3%)	46 (6.6%)	86 (8.3%)	42 (5.7%)
Income				
Lower income (< 260% FPL)	287 (36.3%)	258 (33.7%)	246 (43.9%)	248 (33.1%)
Higher income (≥ 260% FPL)	367 (63.7%)	369 (66.3%)	327 (56.1%)	344 (66.9%)
Education				
Some high school	16 (3.7%)	9 (4.0%)	31 (5.6%)	8 (4.2%)
Completed high school	58 (9.7%)	70 (9.3%)	64 (9.5%)	80 (10.3%)
Some college or vocational training	153 (22.1%)	181 (22.0%)	135 (22.8%)	147 (22.2%)
Completed college	239 (37.7%)	213 (37.3%)	175 (36.9%)	232 (38.2%)
Completed graduate degree	188 (26.7%)	154 (27.3%)	168 (25.1%)	125 (25.1%)
Political Affiliation				
Democrat	381 (55.7%)	354 (55.1%)	258 (56.3%)	305 (52.2%)
Independent	183 (29.6%)	166 (27.8%)	169 (27.2%)	141 (28.9%)
Republican	50 (8.7%)	58 (9.7%)	93 (8.2%)	76 (9.6%)
Other	9 (1.6%)	20 (1.7%)	13 (2.3%)	12 (2.8%)

a. The N's are unweighted counts, while the percentages were weighted using the raking method to improve representation of city demographics within each study sample

Table 2. Differences in Health Scores Among Seattle and Comparison Area Respondents with Higher and Lower Incomes[a-c]						
	Lower Income (N = 962)			Higher Income (N = 1300)		
	Seattle Difference (95% CI)	Comparison Difference (95% CI)	DD (95% CI)	Seattle Difference (95% CI)	Comparison Difference (95% CI)	DD (95% CI)
Health Score	**0.64 (0.41, 0.86)**	**-0.42 (-0.81, -0.03)**	**1.05 (0.57, 1.54)**	**0.19 (0.11, 0.26)**	0.19 (-0.43, 0.81)	-0.00 (-0.61, 0.60)

a. Bolded values indicate significance at $p < 0.05$ CI = Confidence Interval; DD = Difference-in-difference
b. Lower income is defined as having an income < 260% FPL; Higher income is defined as having an income ≥ 260% FPL
c. The estimates in these models were created using population weights combined with propensity score weights. Difference estimates represent changes in the proportion of the population over time, while differences-in-differences estimates represent changes over time in Seattle compared to the changes over time in comparison areas. Race/ethnicity, education, age, sex, survey mode, and political affiliation were controlled for in both models

Table 3. Income-Stratified Differences in Perceived Healthfulness of Sweetened Beverage Consumption in Seattle and Comparison Areas[a-c]						
	Lower Income (N = 962)			Higher Income (N = 1300)		
	Seattle Difference (95% CI)	Comparison Difference (95% CI)	DD (95% CI)	Seattle Difference (95% CI)	Comparison Difference (95% CI)	DD (95% CI)
Drinking sugary drinks causes serious health problems (don't know N = 113)	0.01 (-0.01, 0.02)	**-0.11 (-0.18, -0.04)**	**0.12 (0.05, 0.19)**	**-0.02 (-0.02, -0.01)**	**0.05 (0.01, 0.10)**	**-0.07 (-0.11, -0.03)**
Drinking sugary drinks significantly raises a person's chances of dental health problems, including cavities and tooth decay (don't know N = 79)	**0.01 (0.01, 0.02)**	-0.04 (-0.10, 0.03)	0.05 (-0.01, 0.12)	**0.02 (0.02, 0.02)**	-0.00 (-0.10, 0.09)	0.02 (-0.07, 0.12)
Drinking sugary drinks significantly raises a person's chances of obesity (don't know N = 85)	**0.05 (0.03, 0.07)**	0.02 (-0.03, 0.07)	0.03 (-0.02, 0.09)	**0.04 (0.03, 0.04)**	0.01 (-0.08, 0.09)	0.03 (-0.05, 0.12)
Drinking sugary drinks significantly raises a person's chances of diabetes (don't know N = 117)	**0.01 (0.00, 0.03)**	**-0.08 (-0.12, -0.04)**	**0.09 (0.05, 0.13)**	**0.05 (0.04, 0.06)**	0.02 (-0.05, 0.08)	0.03 (-0.03, 0.09)
Drinking sugary drinks significantly raises a person's chances of heart disease (don't know N = 318)	**0.03 (0.00, 0.05)**	-0.04 (-0.10, 0.01)	**0.07 (0.02, 0.12)**	**0.02 (0.01, 0.03)**	**0.09 (0.03, 0.15)**	**-0.07 (-0.13, -0.01)**
Consuming excessive amounts of sugar from any source can lead to health problems (don't know N = 148)	**0.11 (0.09, 0.12)**	**-0.09 (-0.13, -0.05)**	**0.20 (0.15, 0.24)**	**-0.02 (-0.02, -0.01)**	-0.03 (-0.08, 0.02)	0.01 (-0.03, 0.06)

a. Bolded values indicate significance at $p < 0.05$; CI = Confidence Interval; DD = Difference-in-difference
b. Lower income is defined as having an income < 260% FPL; Higher income is defined as having an income ≥ 260% FPL
c. The estimates in these models were created using population weights combined with propensity score weights. Difference estimates represent changes in the proportion of the population from pre- to post-tax, while differences-in-differences estimates represent changes over time in Seattle compared to the changes over time in comparison areas. Race/ethnicity, education, age, sex, survey mode, and political affiliation were controlled for in both models

Table 4. Income-Stratified Differences in Perceived Healthfulness of Sweetened Beverage Types in Seattle and Comparison Areas[a-c]						
	Lower Income (N = 962)			Higher Income (N = 1300)		
	Seattle Difference (95% CI)	Comparison Difference (95% CI)	DD (95% CI)	Seattle Difference (95% CI)	Comparison Difference (95% CI)	DD (95% CI)
Drinking fruit-flavored drinks affects a person's chances of developing health problems (don't know N = 227)	**0.03 (0.02, 0.05)**	0.02 (-0.05, 0.08)	0.02 (-0.05, 0.08)	**-0.01 (-0.02, -0.00)**	-0.04 (-0.13, 0.04)	0.03 (-0.05, 0.12)
Drinking soda affects a person's chances of developing health problems (don't know N = 149)	**0.02 (0.01, 0.04)**	-0.00 (-0.06, 0.06)	0.02 (-0.04, 0.09)	**0.02 (0.02, 0.03)**	-0.02 (-0.08, 0.04)	0.04 (-0.02, 0.09)
Drinking sports drinks affects a person's chances of developing health problems (don't know N = 409)	**0.03 (0.02, 0.03)**	0.01 (-0.07, 0.08)	0.02 (-0.06, 0.10)	0.01 (-0.01, 0.02)	0.02 (-0.01, 0.05)	-0.01 (-0.05, 0.02)
Drinking sweetened teas or coffees affects a person's chances of developing health problems (don't know N = 264)	**0.03 0.02, 0.04)**	**0.10 (0.04, 0.17)**	**-0.07 (-0.13, -0.01)**	**-0.01 (-0.01, -0.00)**	0.01 (-0.02, 0.03)	-0.01 (-0.03, 0.01)
Drinking energy drinks affects a person's chances of developing health problems (don't know N = 364)	**-0.01 (-0.03, -0.00)**	0.01 (-0.08, 0.10)	-0.02 (-0.10, 0.06)	**-0.01 (-0.01, -0.00)**	0.00 (-0.01, 0.02)	-0.01 (-0.02, 0.00)

a. Bolded values indicate significance at $p < 0.05$; CI = Confidence Interval; DD = Difference-in-difference
b. Lower income is defined as having an income < 260% FPL; Higher income is defined as having an income ≥ 260% FPL
c. The estimates in these models were created using population weights combined with propensity score weights. Difference estimates represent changes in the proportion of the population from pre- to post-tax, while differences-in-differences estimates represent changes over time in Seattle compared to the changes over time in comparison areas. Race/ethnicity, education, age, sex, survey mode, and political affiliation were controlled for in both models

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