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Changes in dental outcomes after implementation of the Philadelphia beverage tax

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Abstract

Introduction: Beverage taxes are associated with declines in sugar-sweetened beverage (SSB) sales and consumption, but few studies have evaluated associations of these taxes with health outcomes. This study analyzed changes in dental decay after implementation of the Philadelphia sweetened beverage tax.

Methods: Electronic dental record data were obtained on 83,260 patients living in Philadelphia and control areas from 2014–2019. Difference-in-differences (DD) analyses compared the number of new Decayed, Missing, and Filled Teeth ($DMFT_{new}$) and new Decayed, Missing, and Filled Surfaces ($DMFS_{new}$) before (January 2014–December 2016) and after (January 2019–December

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2019) tax implementation in Philadelphia and control patients. Analyses were conducted in older children/adults (≥15 years) and younger children (<15 years). Subgroup analyses stratified by Medicaid status. Analyses were conducted in 2022.

Results: $DMFT_{new}$ did not change post-tax in Philadelphia in panel analyses of older children/adults (DD=−0.02, 95% CI: −0.08, 0.03) or in younger children (DD=0.07, 95% CI: −0.08, 0.23). There were similarly no post-tax changes in $DMFS_{new}$. However, in cross-sectional samples of patients on Medicaid, $DMFT_{new}$ was lower post-tax in older children/adults (DD=−0.18, 95% CI: −0.34, −0.03; −22% decline) and younger children (DD=−0.22, 95% CI: −0.46, 0.01; −30% decline), with similar results for $DMFS_{new}$.

Conclusions: The Philadelphia beverage tax was not associated with reduced tooth decay in the general population, but it was associated with reduced tooth decay in adults and children on Medicaid, suggesting potential health benefits for low-income populations.

INTRODUCTION

Several countries and U.S. localities have implemented sweetened beverage excise taxes to raise revenue and curb sugar-sweetened beverage (SSB) consumption, which is associated with chronic disease,[1,2] including tooth decay.[3] These taxes have produced large changes in behavior. A recent meta-analysis found that beverage taxes were associated with a mean 15% decrease in SSB sales, with similar declines observed in studies of SSB consumption.[4,5] Given that 49% of U.S. adults and 63% of U.S. youth drink SSBs daily, with higher consumption among low-income households,[6–9] beverage taxes may improve health outcomes, including oral health.

Dental caries are one of the most common diseases, with a prevalence of 46% in youth and 91% in adults in the U.S.[10,11] The prevalence of untreated caries in these groups is 13% and 27%, respectively, with higher prevalence in lower-income populations.[10,12] Untreated caries are associated with pain, infection, and poor school attendance and performance,[10,13–15] and emerging evidence suggests that tooth loss, which is often caused by long-term decay, is associated with cardiovascular disease.[16,17] Beverage taxes may mitigate tooth decay through reduced SSB consumption, especially among lower-income populations given their relatively higher consumption.[8,9] These benefits have been suggested in simulation studies[18–20] and observed in an evaluation of Mexico's beverage tax, which found posttax reductions in the number of teeth treated for caries.[21] However, no study has examined associations of U.S. beverage taxes with oral health outcomes.

This study examined changes in tooth decay after implementation of the Philadelphia beverage tax on January 1, 2017.[22] Large quasi-experimental evaluations of this 1.5 cent-per-oz tax, which applies to SSBs and artificially-sweetened beverages, have observed 22–35% declines in SSB purchases after accounting for increased beverage purchases outside of the city (i.e., tax avoidance),[23,24] and an approximate 15% decline in SSB consumption.[5] This study used difference-in-differences analyses of electronic dental records (EDR) to examine changes in tooth decay measures in Philadelphia residents versus residents of control areas.

METHODS

Study sample

EDR data with procedures from January 1, 2014 to October 28, 2021 were obtained from 51 University of Pennsylvania School of Dental Medicine clinics in Philadelphia and nearby suburbs. The clinics treat residents of Pennsylvania, New Jersey, Delaware, and Maryland. The data included procedures performed, procedure dates, specific teeth and tooth surfaces that were treated, as well as patient age, gender, insurance type, and residential zip code, which identified patients living in Philadelphia (intervention) or outside Philadelphia (control).

There were 1,215,036 procedures performed across all clinics over the study period. Procedures from 2017–2018 were excluded (n=317,423) because the authors hypothesized that the tax would require 2 years to affect dental health outcomes. Procedures performed in 2020–2021 were excluded (n=264,089) because patients may have changed their health behaviors or dental care utilization during the COVID-19 pandemic. Patients living in Delaware (n=15,183 procedures) or Maryland (n=1,772 procedures) were excluded because these states' Medicaid policies did not cover dental procedures over the study period, whereas Medicaid in Pennsylvania and New Jersey did.[25] Additionally, patients who lived in both Philadelphia and a control area at different points of the study were excluded (n=50,054 procedures) because they would have been exposed to both treatment conditions. After applying these criteria and removing 91 patients with missing data on age, gender, or zip code (n=305 procedures), the analytic sample included 83,260 patients (n=604,895 procedures). The majority (59%) of control patients lived in a county bordering Philadelphia (Bucks, Delaware, or Montgomery in PA; Camden or Burlington in NJ).

Analyses were conducted in repeated cross-sections of older children/adults (≥15 years; n=67,077) and younger children (<15 years; n=17,403); some patients were in both groups if they turned 15 during the study. Fifteen years was used as the cutoff because that is when most people have all their permanent teeth and when the University of Pennsylvania dental clinics transition children to the adult clinics. Longitudinal analyses were additionally conducted using panels of individuals with data in both the pre- (2014–2016) and posttax (2019) periods. Older children/adults in the panel (n=11,756) were ≥15 years from 2014–2019 and younger children in the panel (n=2,950) were <15 years from 2014–2019. All outcomes were aggregated at the patient-quarter level, which ensured enough time points to evaluate pretax trends.

Measures

Tooth decay was measured with two indices. First, the Decayed, Missing, and Filled Teeth (DMFT) index was calculated by summing the total number of decayed, missing, and filled teeth for each patient at each time point, based on EDR procedures (Appendix Table 1 lists procedures that were included and excluded in tooth decay calculations). DMFT counts all teeth that were ever treated, except third molars, and can only increase over time.[26] The Decayed, Missing, and Filled Surfaces (DMFS) index was also calculated, which captures the total number of treated surfaces except incisal surfaces (i.e., the biting edge) on each tooth (up to 4 on incisors and canines and up to 5 on premolars and molars),[26] providing greater detail on the level of decay. Similarly, this index can only increase over time. Analyses included only treatments on permanent teeth in older children/adults and treatments on both permanent and primary teeth in younger children.

The two primary outcomes were number of new teeth treated ($DMFT_{new}$) and number of new surfaces treated ($DMFS_{new}$). This was calculated by summing all newly treated teeth/surfaces at each time point for each patient. This approach assumed that the teeth/surfaces that were treated during the study had not been previously treated before study initiation in 2014, though they could have been treated in prior unobservable years. For patients with only 1 visit, $DMFT_{new}$ and $DMFS_{new}$ equaled the total DMFT and DMFS, respectively, from that visit. $DMFT_{new}$ and $DMFS_{new}$ were calculated before excluding the 2017–2018 data from analysis to ensure any treatments in 2019 accounted for 2017–2018 treatments.

The 2015 Social Deprivation Index (SDI) score of each patient's residential zip code was calculated. This score is a composite measure of 7 demographic characteristics to quantify neighborhood socioeconomic status (SES)[27,28] and ranges from 0 (least deprivation) to 100 (most deprivation). For participants who moved zip codes during the study, the median SDI score over follow-up was calculated. Patients were also classified by whether they were ever on Medicaid during the study as a marker of lower SES (e.g., Medicaid is available to adults in Pennsylvania and New Jersey with incomes <138% of the federal poverty level[29]). For panel members only, the total number of pretax non-treatment visits (i.e., well visits) was used as a measure of pretax dental care utilization.

Statistical analysis

Difference-in-differences analyses required pretax parallel trends in outcomes between Philadelphia and control patients.[30] Because the unadjusted pretax trends were not parallel in several analyses, inverse probability of treatment weights (IPTW) were created to adjust for variables that were imbalanced between the 2 groups and that could influence outcome trends[31] (age, gender, SDI score, Medicaid status and, for panel only, number of pretax non-treatment visits). The Appendix provides details on IPTW construction. IPTWs were truncated at the 95th percentile to reduce the influence of extreme weights. After weighting with IPTWs, the pretax trends were reassessed using a model for each outcome with terms for group (Philadelphia versus control), time (continuous quarter), and a group-by-time interaction. Pretax parallel trends were observed upon evaluation of the group-by-time interaction term and upon visual inspection (see Appendix).

Posttax changes in $DMFT_{new}$ and $DMFS_{new}$ in Philadelphia versus control were estimated using generalized estimating equations clustered at the patient level with robust empirical standard errors and weighted by IPTWs. The models specified a negative binomial distribution (i.e., for over-dispersed count outcomes) and included terms for group, period (pre versus post), and a group-by-period interaction, which estimated the difference-in-differences (DD). Absolute changes are reported from models with an identity link and percent changes from models with a log link (see Appendix). The main analyses examined $DMFT_{new}$ and $DMFS_{new}$ separately in the adult and child panels, as well as in the adult and child cross-sectional samples. Subgroup analyses were conducted by gender (men/women and boy/girl) because previous studies have observed posttax differences in health outcomes by gender.[32] Analyses also stratified by Medicaid status (ever/never on Medicaid). Stratified analyses were not conducted in the panels due to small sample sizes.

Several sensitivity analyses were conducted. First, patient-months were analyzed (versus patient-quarters) to determine robustness using different aggregations of time. Second, IPTWs were truncated at the 99th percentile (versus 95th), which led to better covariate balance between groups but resulted in more extreme weights. Third, New Jersey residents were excluded because New Jersey's Medicaid program included extensive dental benefits, whereas Pennsylvania's program only offered limited benefits.[25] Fourth, analyses adjusted for season. Fifth, in child cross-sectional analyses, Medicaid status was included in the regression model (versus in IPTW) because the Medicaid distribution differed over time between groups even after weighting. Sixth, analyses stratified by current Medicaid status (versus ever-/never-Medicaid in the main subgroup analyses). Seventh, analyses used 14- and 16-year cutoffs between older children/adults and younger children (versus 15 years). Eighth, Philadelphia residents who lived in zip codes on the city border, and could therefore more easily avoid the tax, were excluded. Lastly, models included city-specific trends in case there were undetected violations of the parallel trends assumption.

Analyses used SAS version 9.4 (Cary, NC) and calculated two-sided 95% confidence intervals (CI). This study was approved by the University of Pennsylvania institutional review board.

RESULTS

In the panel datasets, before applying IPTW, Philadelphia patients were more likely to have ever had Medicaid (older children/adults: 21% Philadelphia versus 7% control; younger children: 71% versus 28%) and live in neighborhoods with greater deprivation (older children/adults: mean [SD] SDI score of 77.7 [20.0] in Philadelphia versus 23.8 [24.1] in control; younger children: 87.1 [13.3] versus 27.0 [28.2]), with minor differences for other characteristics (Table 1). Approximately 7% of older children/adults (n=766) and 3% of younger children (n=85) were New Jersey residents; all other patients were from Pennsylvania. IPTW improved covariate balance, though some differences persisted in SDI score and Medicaid status. These same overall patterns were observed in the cross-sectional sample. However, applying IPTW made pretax trends much more similar between groups compared to the unweighted analyses for both samples (see Appendix). After weighting, characteristics of the cross-sectional samples were generally similar in each year except for Medicaid status, which increased in both groups over time (Appendix Table 2). Among ever-Medicaid patients, the covariate distributions over time were similar between Philadelphia and control (Appendix Table 3).

The mean (SD) pretax $DMFT_{new}$ in the Philadelphia panel was 0.51 (1.15) in older children/adults and 0.49 (1.39) in younger children after applying IPTW (Table 2). The mean pretax $DMFT_{new}$ was ~50% higher among ever-Medicaid patients versus never-Medicaid patients (older children/adults: 0.87 [1.86] versus 0.56 [1.26]; younger children: 0.66 [1.64] versus 0.42 [1.36]). The mean (SD) pretax $DMFS_{new}$ in the Philadelphia panel was 1.35 (3.46) in older children/adults and 1.48 (5.08) in younger children, with 60–75% higher values among ever-Medicaid versus never-Medicaid patients.

In the older child/adult panel, there were no differences-in-differences in $DMFT_{new}$ (DD=−0.02, 95% CI: −0.08, 0.03) or $DMFS_{new}$ (DD=−0.06, 95% CI: −0.29, 0.17) in Philadelphia versus control (Table 2; Figure 1; graphs of difference between cities in Appendix Figure 1), with similar findings in the cross-sectional sample ($DMFT_{new}$: DD=−0.05, 95% CI: −0.11, 0.01; $DMFS_{new}$: DD=−0.11, 95% CI: −0.37, 0.14). There were, however, differences-in-differences among ever-Medicaid older children/adults ($DMFT_{new}$: DD=−0.18, 95% CI: −0.34, −0.03; $DMFS_{new}$: DD=−0.64, 95% CI: −1.27, −0.01) (Table 2; Appendix Figure 2). This translated to a decline of −21.7% (95% CI: −36.5, −3.4) for $DMFT_{new}$ and −24.1% (95% CI: −41.7, −1.2) for $DMFS_{new}$. There were no associations among never-Medicaid patients or when stratifying by gender (Appendix Table 4). Results were similar in all sensitivity analyses but were stronger for $DMFT_{new}$ in the panel and cross-sectional sample when removing Philadelphia patients living in zip codes on the city border (e.g., panel: DD=−0.06, 95% CI: −0.12, 0.00) (Appendix Table 5). Truncating weights at the 99^{th} percentile improved covariate balance (Appendix Table 6).

There were no difference-in-differences in tooth decay in the younger child panel ($DMFT_{new}$: DD=0.07, 95% CI: −0.08, 0.23; $DMFS_{new}$: DD=0.43, 95% CI: −0.22, 1.09). The cross-sectional analysis revealed larger (though not statistically significant) differences-in-differences ($DMFT_{new}$: DD=−0.16, 95% CI: −0.33, 0.02; $DMFS_{new}$: DD=−0.70, 95% CI: −1.49, 0.09) (Table 2; Figure 2; graphs of difference between cities in Appendix Figure 3). Similar to results in older children/adults, among younger children ever on Medicaid, there was a difference-in-differences of −0.22 (95% CI: −0.46, 0.01) $DMFT_{new}$ and −1.03 (95% CI: −2.05, −0.01) $DMFS_{new}$, translating to declines of −30.1% (95% CI: −46.8, −8.0) and −34.1% (95% CI: −52.3, −8.9), respectively (Table 2; Appendix Figure 4). There were no associations among never-Medicaid younger children or when stratifying by gender (Appendix Table 4). Results were generally similar in sensitivity analyses (Appendix Table 7), though the main results were slightly attenuated when adjusting for Medicaid in the regression models (versus in IPTW). Truncating weights at the 99^{th} percentile improved covariate balance (Appendix Table 5).

DISCUSSION

Although no overall associations were observed between the Philadelphia beverage tax and tooth decay measures, the tax was on average associated with 22–24% (older children/adults) and 30–34% (younger children) reductions in tooth decay measures among those ever on Medicaid, which is available only to lower-income households. In Philadelphia, 21% of older children/adults and 56% of younger children are enrolled in Medicaid,[33] and income-related disparities in oral health are well established.[34,35] In this study, the mean pretax tooth decay outcomes were approximately 50–75% higher among ever-Medicaid patients than never-Medicaid patients. The beverage tax may thus increase dental health equity given that improvements were only observed within the lower-income group.

These results are consistent with sweetened beverage tax simulation studies that projected posttax reductions in dental caries and treatment costs, particularly among low-income populations.[18–20] Similar results were also observed in an evaluation of Mexico's tax,[21] which found posttax reductions in oral health outpatient visits, 0.31 fewer DMFT in children (6–19 years), and 0.57 fewer DMFT in adults (≥20 years). These larger effects may be because Mexico simultaneously passed an 8% tax on nonessential energy-dense foods,[36] which likely also contributed to dental health improvements. These taxes affected the entire country and so could not easily be avoided with cross-border shopping. Additionally, Mexico had higher per capita baseline SSB consumption and prevalence of untreated caries than the U.S.[21] The present study's findings among ever-Medicaid patients were in the same overall direction but with lower magnitude. Gracner et al., which is one of the only other studies to analyze health outcomes after tax implementation, observed a 1.3% reduction in overweight or obesity prevalence in girls per 10% increase in SSB prices following Mexico's sweetened beverage tax.[32] Additional research examining associations between beverage taxes and dental and nutrition-related health outcomes, particularly among lower-income populations, is needed.

The observed dental health improvements in the ever-Medicaid patients may be explained by greater posttax reductions in SSB intake in this population, who may be more sensitive to price increases than higher-income groups because higher prices represent a larger proportion of their income. Similar percent declines in SSB intake across lower and higher income groups could produce larger health effects in lower-income groups because they are likely to have greater baseline SSB intake *and* tooth decay.[8,9] Some,[37–39] but not all[24,40] previous studies have observed stronger posttax reductions in sales among lower-income groups, though most U.S. studies have not stratified by income.[4] Other nutrition policies, such as the 2010 Healthy, Hunger-Free Kids Act, have also been more strongly associated with improved health outcomes (e.g., reduced obesity prevalence) among lower SES versus higher SES populations,[41,42] perhaps owing to baseline disparities in diet and health. The present study's results were robust to stratifying by time-varying Medicaid status (versus ever-Medicaid status) and when excluding patients from New Jersey, which has slightly different Medicaid eligibility requirements than Pennsylvania. Additionally, although the cross-sectional analyses could be biased if the Medicaid population changed differently over time between groups, the sample was similar on all measured covariates over time between groups after applying IPTW.

Limitations

This study has several limitations. First, there may be measurement error of $DMFT_{new}$ and $DMFS_{new}$ because EDRs were not available before 2014 and some teeth/surfaces that were counted as newly treated may have been previously treated. Moreover, procedure codes do not directly reflect decay. In addition, some dental providers were students, who might be more prone to errors when documenting dental decay, but we would not expect such errors to vary by study group. Second, there may have been treatment contamination if patients who lived in one study group frequently consumed beverages purchased in the other (e.g., if patients lived in a control area but worked in Philadelphia). This could have attenuated associations in the overall sample; when excluding Philadelphia patients living in border zip codes (who may have more easily avoided the tax), we observed slightly stronger $DMFT_{new}$ results in adults. The public health effects of beverage taxes therefore might increase if they were implemented at a state or national level to limit tax avoidance. Third, IPTW did not achieve balance on all covariates, but pretax parallel trends were observed for all analyses after weighting, satisfying the difference-in-differences requirement. Truncating weights at the 99^{th} percentile (versus 95^{th}) produced better covariate balance and overall similar results. Another potential limitation is the modest sample size of the panel data, which may have prevented detection of small associations in the overall sample. Additionally, outcomes from 2020 and later were excluded because of COVID-19-related changes in dental care utilization, which further limited the sample size. Recent evidence indicates that the pandemic was associated with increases in SSB consumption among families experiencing financial hardship[45] and declines in children's oral health,[43,44] suggesting a need for future research on the post-pandemic effects of beverage taxes. Lastly, stratified analyses were not possible in the panel data given the smaller sample sizes, though those analyses would have been less vulnerable to changing sample composition than the cross-sectional analyses.

CONCLUSIONS

This study of dental records from 83,260 patients found reduced tooth decay measures in adults and children on Medicaid 3 years after implementation of the Philadelphia beverage tax, though no changes were observed in the general population. These findings suggest potential health benefits of the tax among low-income populations. More studies examining the association between sweetened beverage taxes and other health outcomes are needed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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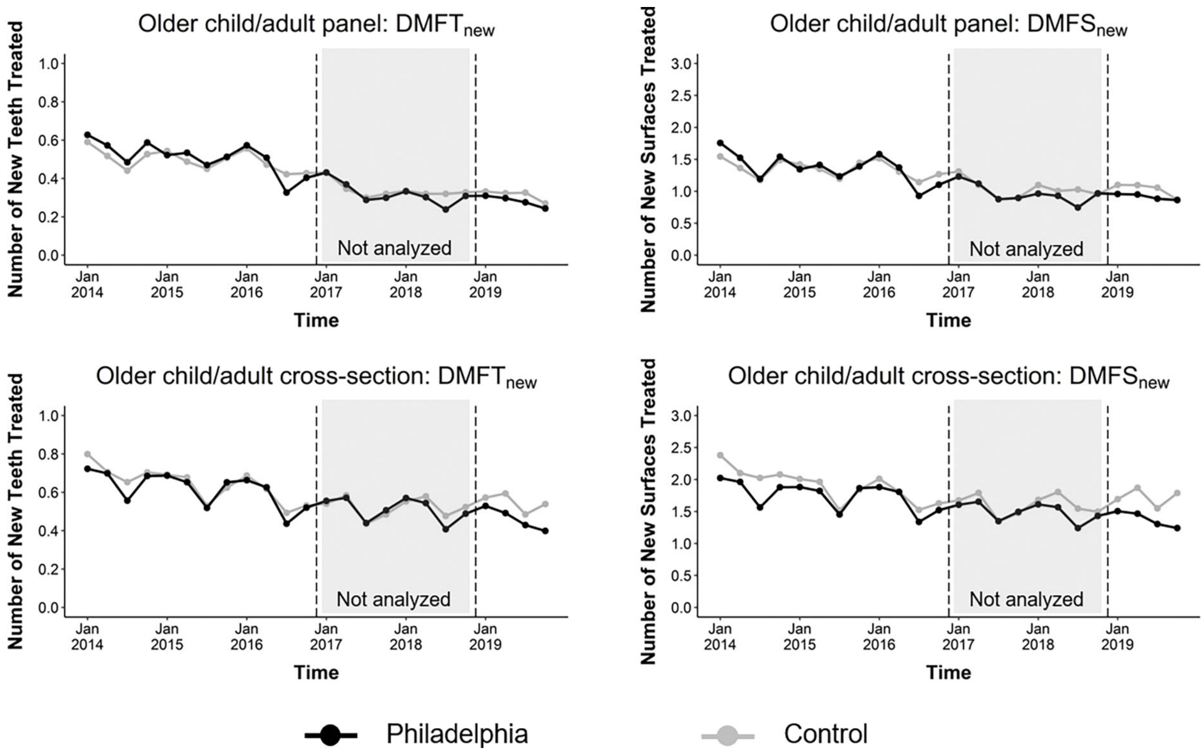

Figure 1. Difference-in-differences in dental outcomes among adults after Philadelphia beverage tax implementation.

The graphs show mean changes in $DMFT_{new}$ and $DMFS_{new}$ among Philadelphia (black) and control (grey) adult patients in the panel and cross-sectional samples.

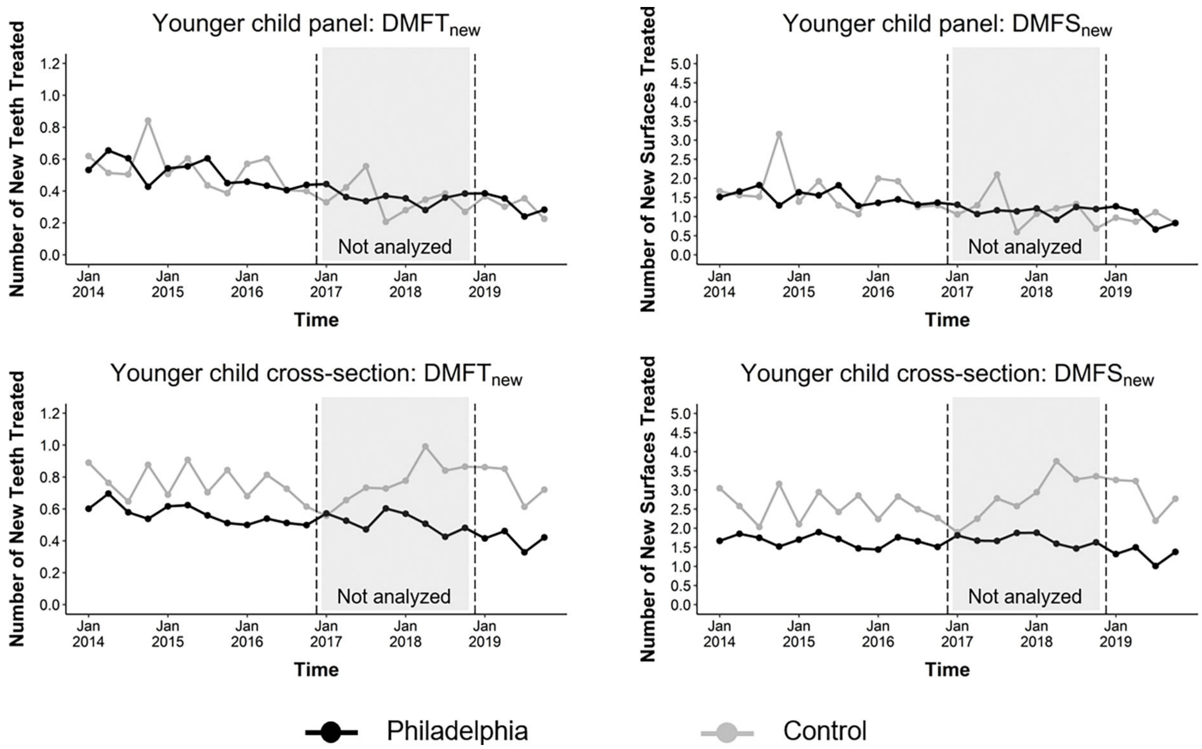

Figure 2. Difference-in-differences in dental outcomes among children after Philadelphia beverage tax implementation.

The graphs show mean changes in $DMFT_{new}$ and $DMFS_{new}$ among Philadelphia (black) and control (grey) child patients in the panel and cross-sectional samples.

Table 1.

Characteristics of panel and cross-sectional samples before and after inverse probability of treatment weighting[a]

	Older children/adults				Younger children			
	Before weighting		After weighting		Before weighting		After weighting	
Characteristic[b]	**Philadelphia**	**Control**	**Philadelphia**	**Control**	**Philadelphia**	**Control**	**Philadelphia**	**Control**
Panel								
N	7,043	4,713	7,043	4,713	2,088	862	2,088	862
Age at baseline, years	45.1 (17.2)	49.3 (16.0)	46.3 (17.4)	48.7 (16.0)	4.1 (2.8)	4.6 (2.7)	4.1 (2.8)	4.6 (2.7)
Gender								
Female	62%	57%	61 %	59 %	48%	49%	48%	50%
Male	38%	43%	39%	41%	52%	51%	52%	50%
Other	<1%	0%	<1%	0%	--	--	--	--
%Ever Medicaid	21%	7%	19%	12%	71%	28%	67%	45%
Zip code SDI score	77.7 (20.0)	23.8 (24.1)	69.7 (23.9)	41.2 (32.0)	87.1 (13.3)	27.0 (28.2)	83.6 (17.0)	52.7 (35.6)
Number of pre-tax non-treatment visits	4.2 (2.5)	4.7 (2.4)	4.3 (2.5)	4.6 (2.4)	3.3 (2.1)	4.0 (2.2)	3.4 (2.1)	3.9 (2.2)
Cross-section								
N	44,093	22,978	44,093	22,978	11,853	5,550	11,853	5,550
Age, years	40.9 (17.9)	46.2 (18.4)	41.8 (18.2)	44.2 (18.0)	7.7 (3.7)	8.0 (3.8)	7.6 (3.8)	8.1 (3.8)
Gender								
Female	58%	55%	57%	56%	48%	48%	48%	47%
Male	42%	45%	43%	44%	52%	52%	52%	53%
Other	0%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
%Ever Medicaid	29%	21%	26%	22%	69%	34%	65%	54%
Zip code SDI score	81.4 (18.7)	30.6 (27.5)	74.0 (23.3)	55.4 (33.1)	87.3 (13.0)	34.1 (30.2)	82.2 (18.3)	64.9 (32.6)

[a]Inverse probability of treatment weights accounted for all listed covariates and were truncated at the 95th percentile.

[b]Mean (SD) or %

Table 2.

Difference-in-differences in number of new treatments ($DMFT_{new}$) and surfaces ($DMFS_{new}$) after Philadelphia beverage tax implementation

	Pre-tax Mean (SD)[a]		Post-tax Mean (SD)[a]		
Outcome	**Philadelphia**	**Control**	**Philadelphia**	**Control**	**Difference-in-differences (95% CI)[b]**
Older children/adults					
$DMFT_{new}$					
Panel	0.51 (1.15)	0.49 (1.14)	0.28 (0.79)	0.31 (0.93)	−0.02 (−0.08, 0.03)
Cross-section	0.62 (1.40)	0.64 (1.48)	0.46 (1.20)	0.55 (1.45)	−0.05 (−0.11, 0.01)
Cross-section, ever-Medicaid	0.87 (1.86)	0.77 (1.71)	0.65 (1.48)	0.72 (1.76)	**−0.18 (−0.34, −0.03)**
Cross-section, never-Medicaid	0.56 (1.26)	0.62 (1.43)	0.40 (1.08)	0.49 (1.33)	−0.02 (−0.08, 0.03)
$DMFS_{new}$					
Panel	1.35 (3.46)	1.35 (3.29)	0.91 (2.72)	1.03 (3.44)	−0.06 (−0.29, 0.17)
Cross-section	1.76 (4.66)	1.91 (5.16)	1.38 (4.13)	1.73 (5.26)	−0.11 (−0.37, 0.14)
Cross-section, ever-Medicaid	2.69 (6.86)	2.46 (6.30)	2.02 (5.34)	2.36 (6.91)	**−0.64 (−1.27, −0.01)**
Cross-section, never-Medicaid	1.54 (3.93)	1.79 (4.90)	1.16 (3.60)	1.53 (4.66)	0.00 (−0.23, 0.22)
Younger children					
$DMFT_{new}$					
Panel	0.49 (1.39)	0.52 (1.56)	0.32 (0.94)	0.31 (0.93)	0.07 (−0.08, 0.23)
Cross-section	0.56 (1.53)	0.76 (1.99)	0.41 (1.20)	0.77 (2.21)	−0.16 (−0.33, 0.02)
Cross-section, ever-Medicaid	0.66 (1.64)	0.89 (2.15)	0.49 (1.29)	0.94 (2.45)	−0.22 (−0.46, 0.01)
Cross-section, never-Medicaid	0.42 (1.36)	0.63 (1.82)	0.27 (1.01)	0.49 (1.62)	0.04 (−0.15, 0.22)
$DMFS_{new}$					
Panel	1.48 (5.08)	1.63 (6.02)	0.99 (3.44)	0.94 (3.45)	0.43 (−0.22, 1.09)
Cross-section	1.66 (5.69)	2.57 (7.91)	1.31 (4.55)	2.91 (9.43)	−0.70 (−1.49, 0.09)
Cross-section, ever-Medicaid	1.96 (5.99)	3.04 (8.56)	1.56 (4.92)	3.66 (10.65)	**−1.03 (−2.05, −0.01)**
Cross-section, never-Medicaid	1.23 (5.25)	2.10 (7.16)	0.88 (3.85)	1.68 (6.52)	0.30 (−0.59, 1.18)

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

[a]Weighted by inverse probability of treatment weights.

[b]Difference-in-differences models were fit with generalized estimating equations weighted by inverse probability of treatment weights with variables for group (Philadelphia=1, control=0), period (pre-tax=0, post-tax=1), and a group

*period interaction, which estimated the difference-in-differences.