American Journal of
Preventive Medicine

RESEARCH ARTICLE

Sugar-Sweetened Beverage Taxes and Perinatal Health: A Quasi-Experimental Study

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Introduction: One in 5 pregnant individuals report consuming sugar-sweetened beverages at least once per day. Excess sugar consumption during pregnancy is associated with several perinatal complications. As sugar-sweetened beverage taxes become increasingly common public health measures to reduce sugar-sweetened beverage consumption, evidence of the downstream effects of sugar-sweetened beverage taxes on perinatal health remains limited.

Methods: This longitudinal retrospective study examines whether sugar-sweetened beverage taxes in 5 U.S. cities were associated with decreased risk of perinatal complications, leveraging 2013−2019 U.S. national birth certificate data and a quasi-experimental difference-in-differences approach to estimate changes in perinatal outcomes. Analysis occurred from April 2021 through January 2023.

Results: The sample included 5,324,548 pregnant individuals and their live singleton births in the U.S. from 2013 through 2019. Sugar-sweetened beverage taxes were associated with a 41.4% decreased risk of gestational diabetes mellitus (−2.2 percentage points; 95% CI= −4.2, −0.2), a −7.9% reduction in weight-gain-for-gestational-age *z*-score (−0.2 standard deviations; 95% CI= −0.3, −0.01), and decreased risk of infants born small for gestational age (−4.3 percentage points; 95% CI= −6.5, −2.1). There were heterogeneous effects across subgroups, particularly for weight-gain-for-gestational-age *z*-score.

Conclusions: Sugar-sweetened beverage taxes levied in five U.S. cities were associated with improvements in perinatal health. Sugar-sweetened beverage taxes may be an effective policy instrument for improving health during pregnancy, a critical window during which short-term dietary exposures can have lifelong consequences for the birthing person and child.
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INTRODUCTION

Birthing people and their children are vulnerable to acute and long-term health impacts of poor diet quality and excess sugar consumption during pregnancy.[1,2] Sugar-sweetened beverages (SSBs) are the largest source of added sugar for pregnant individuals, who on average consume 50% more calories from added sugar than recommended.[1] One in five pregnant individuals consumes SSBs at least once per day.[3] In the general population, SSB intake is associated with weight

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0749-3797/$36.00
https://doi.org/10.1016/j.amepre.2023.03.016

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gain and risk of obesity, Type 2 diabetes (T2D), and cardiovascular disease (CVD).[4−6] Growing evidence also supports the hypothesis that greater maternal SSB intake is associated with elevated risk for a range of perinatal complications, including gestational diabetes mellitus (GDM),[7,8] gestational and postpartum weight gain,[9,10] hypertensive disorders of pregnancy,[11,12] preterm birth,[13,14] and abnormal birthweight,[1,15] conditions which increase the risk of CVD and T2D later in life.[16−18] Not only are pregnant individuals with GDM at elevated risk of excess gestational weight gain (GWG), but excess GWG also increases the risk of neonatal complications, notably the baby being small for gestational age (SGA).[19,20]

Population-wide interventions to reduce SSB intake and improve diet among pregnant individuals remain critical.[21] SSB taxation is one promising policy to reduce SSB consumption,[22−24] sugar intake, and chronic disease risk.[25] As of December 2019, seven U.S. cities were levying an excise tax of $0.01−$0.02 per fluid ounce of SSBs. Although modeling studies suggest that SSB taxes reduce chronic disease risk in the general population,[26,27] empirical studies of the health impacts have proven difficult to conduct because chronic diseases such as T2D develop over a long latency period. It also remains unclear whether SSB taxes improve the health of pregnant individuals and infants by reducing SSB consumption during pregnancy. Pregnancy is not only a critical period for later-life outcomes but also a time-limited period during which nutrition policies can have observable health effects.[28−31] Thus, pregnancy is a uniquely valuable context for studying SSB taxes.

This study examined whether SSB taxes were associated with a reduction in maternal and birth complications among pregnant individuals and offspring using data from >5 million U.S. births. Leveraging a quasi-experimental difference-in-differences design, this study compared before−after SSB tax changes in perinatal outcomes among pregnant individuals in five SSB-taxed U.S. cities while accounting for secular trends for pregnant individuals in untaxed comparator cities. This study also investigated subgroup effects of SSB taxes: by race and ethnicity motivated by the racial disparities in sugar intake and maternal and infant health outcomes[32−37] and by prepregnancy BMI, maternal age, and parity due to their modifying effects on perinatal risk.[38,39] As SSB taxes become increasingly common across the U.S. and globally,[25] evidence of their health impacts can inform policy making and community-level interventions targeting maternal and child nutrition and chronic disease.[40]

METHODS

Study Sample

Individual-level data were drawn from the National Center for Health Statistics Vital Statistics Birth Data Files of all live births in the U.S.[41] The data included 5,324,548 birthing individuals and their live singleton births from January 1, 2013 through December 31, 2019 with identifiable city of maternal residence in metropolitan U.S. counties (areas ≥1 million population, which were expected to be a better comparator) within 22−44 weeks of gestation and birthweight-for-gestational age within 3 SDs of the mean (Appendix Figure 1, available online).[42] The study period included 8−20 quarters (24−60 months) before tax and 8−11 quarters (21−33 months) after tax, varying by city owing to staggered policy adoption (Appendix Figure 1, available online). The University of California San Francisco IRB approved the study procedures (Protocol Number 18-26719). Analysis occurred from April 2021 through January 2023.

Measures

The following five U.S. cities with an SSB excise tax in effect as of December 31, 2019 were included as intervention cities, with the date of tax implementation in parentheses: Berkeley, CA (March 1, 2015); Philadelphia, PA (January 1, 2017); Oakland, CA (July 1, 2017); San Francisco, CA (January 1, 2018); and Seattle, WA (January 1, 2018). Pregnant individuals residing in the intervention cities whose date of delivery fell on or after the quarter of SSB tax implementation in their city of residence were classified as exposed (Appendix Methods, available online). Pregnant individuals residing in all other cities (comparator cities) were classified as unexposed.

Primary outcomes were perinatal outcomes reported on birth certificates that, on the basis of previous observational findings, could be affected by a pregnant individual's SSB consumption.[7−9,43−45] These included a binary variable for whether a pregnant individual was diagnosed as having GDM and a continuous variable for the pregnant individual's weight-gain-for-gestational-age *z*-score (i.e., GWG *z*-score), calculated using a previously validated weight-gain-for-gestational-age percentile and *z*-score chart generated from a cohort of U.S. women.[46,47]

Secondary outcomes included binary variables for hypertensive disorders of pregnancy (gestational hypertension and preeclampsia, available as a combined measure only[48]); whether the birthing individual was above, below, or within 2009 Institute of Medicine GWG recommendations for BMI[49]; low birthweight (<2,500 g); SGA; large-for-gestational-age[42]; preterm (born before 37 weeks gestation)[42]; and continuous variables for birthweight (grams) and weeks of gestation at delivery. Although excess sugar consumption during pregnancy has been shown to increase the risk of several of these outcomes, including preeclampsia, gestational hypertension, preterm birth, and birthweight,[12,14,15,50−53] evidence that SSB consumption during pregnancy causally influences these outcomes is lacking. Furthermore, these outcomes are more distal to SSB tax exposure and are often mediated by GDM and GWG.

Covariates included sociodemographic variables on the birth certificate that might confound the association between the city of residence and perinatal outcomes: birthing individual's race and ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian, other), age (<25, 25−29, 30−34, ≥35 years), education (some high school, high school diploma/GED, some college, college degree and beyond), parity (primiparous, multiparous, nulliparous), prepregnancy smoking status, and prepregnancy BMI (underweight, normal weight, overweight, obese). Models also included fixed effects (i.e., indicator variables) for city of residence to account for measured and unmeasured city-specific and time-invariant characteristics (e.g., retail environment, demographic composition) and birth quarter to adjust for secular trends (e.g., seasonality).

Statistical Analysis

The analysis first tabulated sample characteristics and the prevalence of outcomes stratified by exposure group before and after tax implementation in intervention cities. For the main analysis, the study estimated the association of SSB taxes with perinatal outcomes using the Callaway-Sant'Anna (CS) difference-in-differences approach—a recently developed quasi-experimental approach that is unbiased by staggered policy adoption and includes doubly robust estimation with inverse probability weighting (Appendix Methods, available online).[54,55] The study assessed changes in perinatal outcomes before versus after SSB tax implementation for pregnant individuals residing in intervention cities compared with changes for those residing in comparator cities.

The study followed a standard approach used in difference-in-differences analyses to estimate linear regressions for binary and continuous outcomes owing to differences in the interpretation of interaction terms in nonlinear models and technical issues with implementing logistic models with fixed effects.[56−58] Binary outcomes may therefore be interpreted as percentage-point changes in risk. All regressions adjusted for the covariates listed earlier, with the exception of GWG-related outcomes, for which prepregnancy BMI was incorporated directly into the outcome measure. The inclusion of unit (city) and time fixed effects accounted for many measured and unmeasured sources of confounding. For ease of interpretation, estimates are expressed as the average percentage change in outcomes, calculated as the difference-in-differences estimate divided by the average before-tax outcome value in tax-exposed cities, as done in several related studies.[23,59,60]

To examine dynamic policy effects, the study estimated event-study difference-in-differences analyses of the time-varying associations between tax exposure and each perinatal outcome of interest.[61,62] An important assumption of difference-in-differences is that before−after differences in outcomes would be the same in the intervention and comparator groups in the absence of the intervention. Although this parallel trends assumption is not directly testable, the study followed the literature to assess whether before-tax outcome trends were parallel between intervention and control groups by testing the significance of before-tax coefficients in the event studies (Appendix Methods, available online).[63,64]

Subgroup analyses were conducted by birthing individuals' race/ethnicity, education, age, prepregnancy BMI, and parity. Using stratified analyses, the study estimated the same CS difference-in-differences models as outlined earlier for each subgroup (Appendix Methods, available online).

To assess cohort effects by year quarter of SSB tax implementation, the CS approach allowed for the identification of cohort-specific effects by tax implementation date (Appendix Methods, available online). Cohorts therefore included Berkeley, Oakland, Philadelphia, and Seattle and San Francisco combined.

To assess the robustness of estimates to different estimation approaches, the study implemented two alternate approaches: (1) the difference-in-differences approach developed by Borusyak and colleagues, also designed for staggered policy adoption,[63,65] and (2) a generalized difference-in-differences approach that includes 2-way fixed-effects for city and year-quarter (Appendix Methods, available online). To assess the sensitivity of estimates to the choice of comparator, the study conducted the CS difference-in-differences analysis restricting the comparator group to large cities in Census Divisions where tax-exposed cities were located (Appendix Methods, available online).

To mitigate potential misclassification bias, the study conducted a sensitivity analysis for outcomes using imputed date of conception to define exposure status and excluding pregnant individuals exposed to SSB taxation for part of their pregnancy only (Appendix Methods, available online). The study also conducted a sensitivity analysis for GDM, excluding individuals in San Francisco, which changed its GDM testing procedures in 2016 (Appendix Methods, available online).[66] Finally, the study examined prepregnancy smoking status and marital status as placebo outcomes in CS models (Appendix Methods, available online).

RESULTS

Tax-exposed individuals were more likely than those in comparator cities to be non-Hispanic White or Black, to be older, to be educated, to have smoked before pregnancy, and to have normal BMI, although these differences were modest (Table 1). Perinatal health was similar for individuals living in intervention and comparator cities before SSB tax implementation (Table 2), including GDM prevalence (5.4% in intervention cities vs 5.5% in comparator cities) and GWG z-score (−1.8 vs −1.9 SD).

SSB taxes were associated with a 41.4% reduction in GDM (−2.2 percentage point; 95% CI= −4.2, −0.2) and a 7.9% reduction in GWG z-score (−0.2 SD; 95% CI= −0.3, −0.01) (Table 2). In addition, SSB taxes were associated with a 39.1% reduction in SGA risk (−4.4 percentage point; 95% CI= −6.5, −2.1). There was no association between SSB taxes and other secondary outcomes (Table 2).

Event-study estimates revealed that before-tax differences for primary outcomes between tax-exposed and tax-unexposed individuals were small and not significant, suggesting roughly parallel before-tax outcome trends (Figure 1). Before-tax trends were also similar between tax-exposed and comparator individuals for most secondary outcomes, except birthweight, gestational age, and preterm birth (Appendix Figure 2, available online).

Event-study estimates further highlighted that SSB taxes were associated with decreased GDM risk 2−4 quarters after tax implementation, attenuated thereafter

Table 1. Characteristics of Pregnant Individuals by Tax Exposure Before and After SSB Tax Implementation (2013–2019)

	SSB tax cities[a] (*n*=267,952)		Comparator cities[b] (*n*=5,056,596)	
Characteristics	**Before (%)**	**After (%)**	**Before (%)**[c]	**After (%)**[c]
Maternal race and ethnicity				
Non-Hispanic White	37.6	36.0	30.4	29.9
Non-Hispanic Black	24.5	26.6	20.3	20.5
Hispanic	18.6	19.9	36.9	36.4
Asian/Pacific Islander	16.6	14.5	10.7	10.9
Other race[d]	2.7	3.0	1.7	2.3
Age (years)				
<25	19.6	17.8	26.7	22.7
25–29	22.4	22.7	27.3	27.2
30–34	32.4	32.8	27.8	29.4
35+	25.6	26.6	18.2	20.8
Education				
Less than high school diploma	12.7	11.4	18.7	15.6
High school diploma or GED	21.0	22.2	25.5	26.3
Some college or associate degree	20.6	20.7	25.5	24.8
College degree or above	45.6	45.7	30.2	33.3
Prepregnancy BMI				
Underweight, <18.5	5.5	3.6	4.9	3.6
Normal, 18.5–24.9	52.7	49.6	47.1	44.7
Overweight, 25.0–29.9	22.8	24.4	25.5	26.5
Obese, >30	19.0	22.4	22.6	25.1
Parity				
Nulliparous	38.0	37.0	33.9	33.4
Primiparous	28.8	27.3	27.6	27.6
Multiparous	33.2	35.7	38.4	39.0
Prepregnancy smoking	5.9	5.1	4.7	3.6

[a]Birthdate cut off for pregnant individuals before or after the SSB tax; Berkeley Q1 2015, Philadelphia Q1 2017, Oakland Q3 2017, San Francisco Q1 2018, and Seattle Q1 2018.
[b]Women from 193 comparator U.S. cities were included in this analysis. The total same size of precomparator and postcomparator city residence varies by SSB tax implementation date.
[c]Values are equal to the average sum of comparator cities pre- or post-SSB tax cut off date (when SSB taxes were enacted in each of the 5 SSB-taxed cities) divided by 5.
[d]American Indian/Alaskan Native, multirace, and other racial groups were combined into a single variable to avoid small cell sizes and unstable estimates.
Q, quarter; SSB, sugar-sweetened beverage.

(Figure 2). For GWG *z*-score, the intervention–comparator difference particularly grew in later quarters. For SGA risk, there was a sustained decrease for 5 quarters after tax implementation (Appendix Figure 2, available online). Event-study plots for other secondary outcomes are provided in Appendix Figure 2 (available online) and discussed in the Appendix (available online).

There were subgroup differences in the estimated associations between SSB taxes and outcomes (Figure 2 and Appendix Figure 3, available online). Event studies for some subgroups indicated pre-tax imbalance between intervention and control cities (Appendix Figure 4, available online); results for those subgroups should be interpreted cautiously. Reductions in GDM risk and GWG *z*-score were more pronounced among Asian individuals. Reductions in GWG *z*-score were largest among those aged 25–29 and 35+ years, among those with a high-school diploma, as well as for multiparous individuals and individuals with obesity. Subgroup findings are further discussed in the Appendix (available online).

Cohort-specific analyses showed larger improvements in Philadelphia than in other cohorts for GWG *z*-score (Appendix Table 3, available online, and Appendix Figure 5, available online). Philadelphia and Seattle/San Francisco also had larger declines in SGA risk (Appendix Table 1, available online, and Appendix Figure 6, available online). All cohorts except Berkeley showed declines in GDM risk, yet none attained statistical significance. Results for other cohort-specific effects are provided in Appendix Figure 6 (available online).

Table 2. Estimated Association of SSB Tax Exposure and Perinatal Outcomes

	SSB tax cities		Comparator cities		Adjusted difference-in-differences estimate[a]		
Outcomes	**Before**	**After**	**Before**	**After**	**Coefficient (95% CI)**	***p*-value**	**Adjusted % change[b]**
Panel A. Primary outcomes							
Gestational diabetes, %	5.4	5.5	5.5	6.6	−2.22 (−4.22, −0.22)	**0.03**	−41.4
Weight-gain-for-gestational-age *z*-score[c]	−1.8	−1.8	−1.9	−1.9	−0.15 (−0.28, −0.01)	**0.03**	−7.9
Panel B. Secondary outcomes							
Hypertensive disorders of pregnancy,[d] %	5.8	8.5	4.8	6.4	−1.63 (−3.3, 0.05)	0.06	−28.5
GWG 2009 IOM recommendations, %							
Below recommendations	47.5	47.1	44.4	43.7	−2.21 (−5.07, 0.66)	0.13	−10.6
Above recommendations	31.7	31.6	32.9	33.2	−0.39 (−4.13, 3.36)	0.84	−0.8
Within recommendations	20.7	21.3	22.6	23.1	2.59 (−0.78, 5.97)	0.13	8.1
Birthweight, grams[c]	3,315.0	3,290.0	3,291.4	3,286.8	17.17 (−26.06, 60.4)	0.44	0.5
Low birthweight, %	6.5	7.1	6.5	6.9	0.61 (−1.46, 2.68)	0.57	9.4
Gestational age, weeks[c]	39.0	39.0	39.0	39.0	17.17 (−26.06, 60.40)	0.44	0.5
Small for gestational age, %	11.0	11.0	8.3	7.8	−4.28 (−6.49, −2.06)	**<0.001**	−39.1
Large for gestational age, %	8.3	7.9	7.1	6.8	0.47 (−1.52, 2.45)	0.65	5.6
Preterm birth, %	6.7	6.7	4.8	6.4	0.59 (−1.60, 2.77)	0.60	8.8

Note: Boldface indicates statistical significance ($p<0.05$).
[c]Mean values were calculated for continuous variables.
[a]Estimates, expressed as percentage points for binary outcomes, from Callaway-Sant'Anna difference-in-difference models adjusted for race and ethnicity (non-Hispanic Black, non-Hispanic White, Hispanic, non-Hispanic Asian/Native Hawaiian and other Pacific Islander, non-Hispanic other race), maternal age (<25, 25−29, 30−34, 35+ years), education (some high school, diploma/GED, some college, college degree), parity (nulliparous, primiparous, multiparous), prepregnancy smoking status, and prepregnancy BMI (underweight, normal weight, overweight, obese) and fixed effects for maternal city of residence and quarter of birth. Gestational weight gain−related outcomes incorporated prepregnancy BMI into the outcome measure.
[b]Adjusted percentage changes are calculated by dividing the difference-in-differences estimate by the average pretax outcome in the intervention city.
[d]Gestational hypertension and preeclampsia, which are combined in US national birth certificate data.
GWG, gestational weight gain; IOM, Institute of Medicine; SSB, sugar-sweetened beverage.

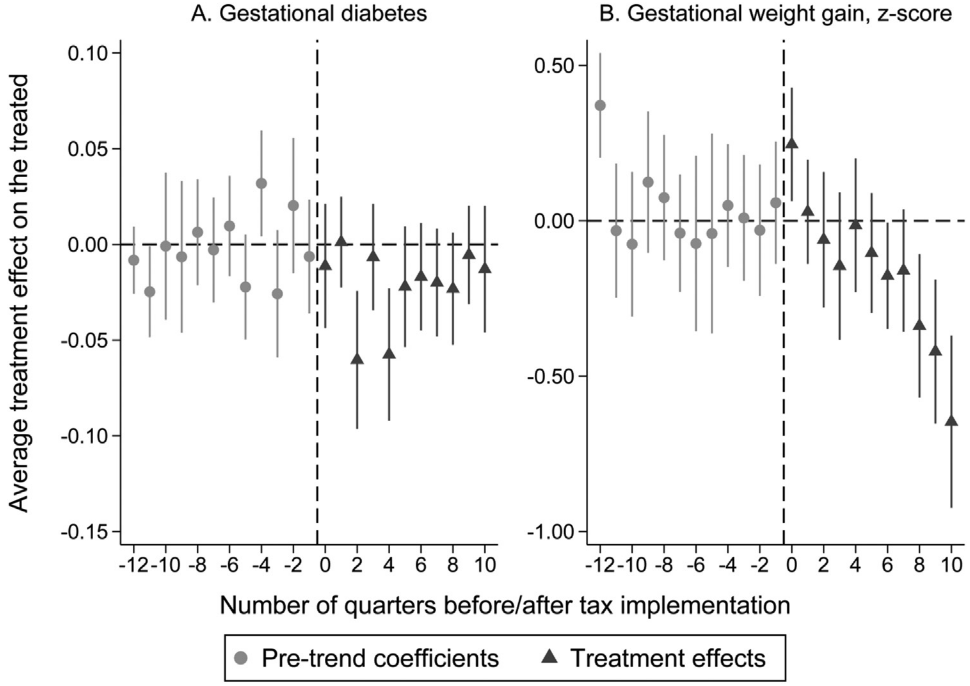

Figure 1. Time-varying association between SSB taxes and primary health outcomes
Note: These plots of the time-varying differences in outcomes between those in SSB tax cities and those in comparator cities are estimated from Callaway-Sant' Anna event-study difference-in-differences regressions. Quarterly estimates are relative to the quarter just before SSB tax implementation (Quarter −1, dotted line). The 95% CIs were calculated from robust SEs.
SSB, sugar-sweetened beverage.

Findings from additional sensitivity analyses were similar to those of the primary analysis but smaller in magnitude for GWG *z*-score and SGA, yet differed somewhat for GDM (Appendix Tables 1−2, available online, and Appendix Figures 7−8, available online). Sensitivity estimates for GDM risk were also more muted and did not attain statistical significance for several models. Placebo analyses showed no significant association between prepregnancy smoking nor marital status and SSB taxes, suggesting that time-varying confounding of the estimates is less likely (Appendix Table 2, available online).

DISCUSSION

This study provides, to the authors' knowledge, the first estimates of the association between city-level SSB taxes and perinatal outcomes. Using quasi-experimental difference-in-differences methods, SSB taxes were associated with a 41.4% reduction in GDM risk and a 7.9% decrease in GWG *z*-score. GDM and excess GWG are well-studied predictors of birthweight, preeclampsia, and preterm delivery and even risk of CVD and T2D later in life for the birthing person and child,[18,67,68] highlighting these conditions as important mechanisms through which SSB taxes may affect longer-term health.[7−9,52] SSB taxes were also associated with a 39.1% decrease in SGA risk, in line with the improvements in GDM and GWG *z*-score, which are predictors of SGA.[19,20] Sensitivity and placebo analyses supported the robustness of our findings for GWG *z*-score and SGA but conflicted somewhat with the GDM findings. Studies that leverage additional data sets with more information on mechanisms and less measurement error of maternal outcomes[69] may address this knowledge gap. Overall, our results suggest that SSB taxes induce clinically relevant changes that may translate into population-wide health improvements, although the findings should be interpreted with caution.

There were no consistent overall improvements in other maternal and neonatal health outcomes. Further research is needed to investigate the long-term health impacts of SSB taxes as more postperiod data become available. One plausible explanation for the null findings is that individuals undercut the health benefits of SSB taxes through compensatory caloric intake, although recent literature has tended to find such substitution effects to be limited.[24]

Given recent evidence that Philadelphia experienced among the largest behavioral effects on SSB purchasing

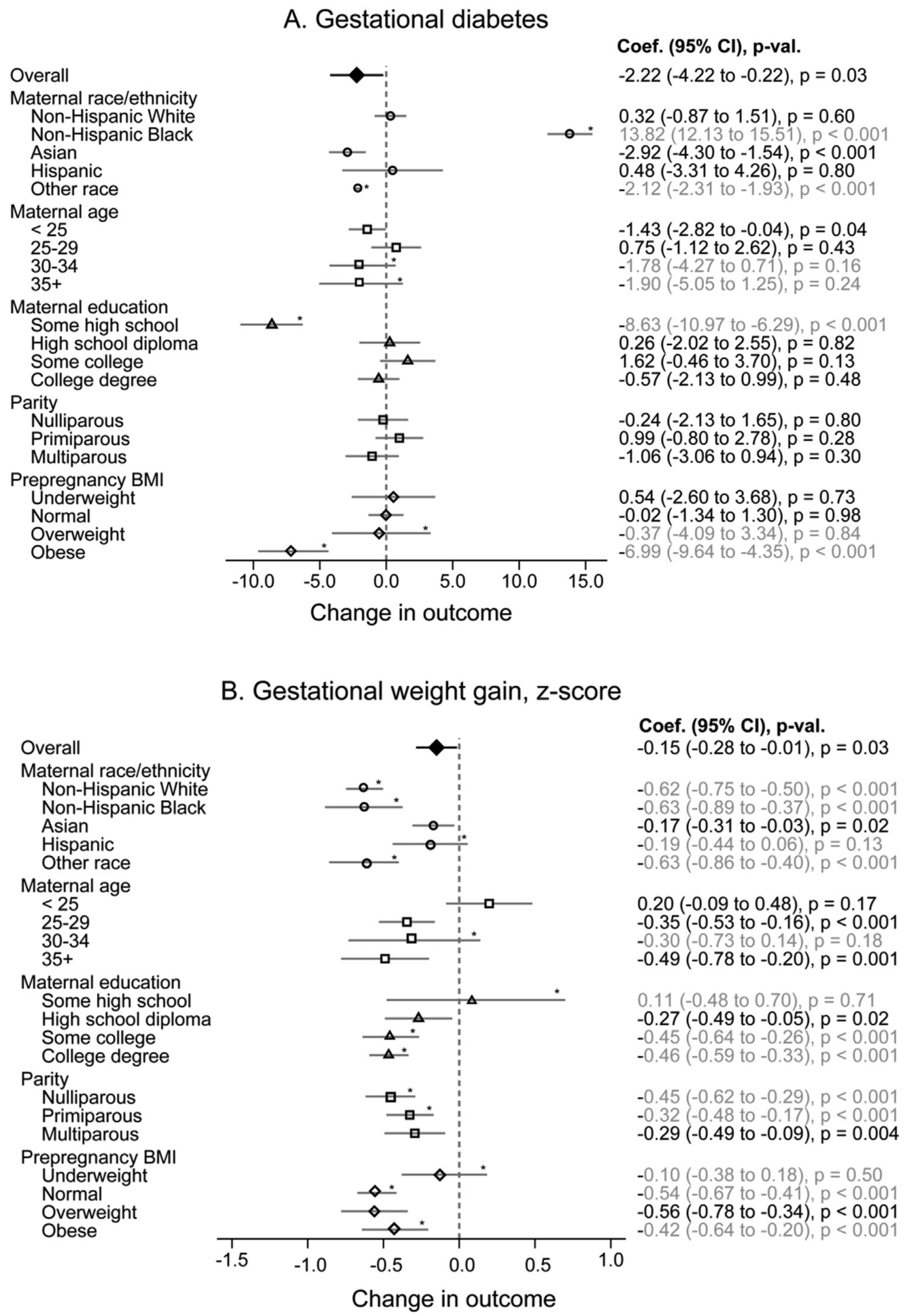

Figure 2. Associations between sugar-sweetened beverage taxes and primary outcomes by population subgroup

Note: Each row represents a Callaway-Sant'Anna difference-in-differences estimate from a separate regression, either using the full sample or stratifying by a population subgroup and adjusting for race and ethnicity (NH-Black, NH-White, NH-Asian/NHOPI, Hispanic, NH other race), maternal age (<25, 25−29, 30−34, 35+ years), education (some high school, diploma/GED, some college, college degree), parity (nulliparous, primiparous, multiparous), prepregnancy smoking status, and prepregnancy BMI (underweight, normal weight, overweight, obese) and fixed effects for maternal city of residence and quarter of birth. Estimated values written in light gray and with an asterisk (*) indicate imbalance during the pretax period (≥2 quarters with significant intervention−comparator differences at *p*>0.05) and likely violate the parallel trends assumption required for valid inference.

NH, non-Hispanic; NHOPI, Native Hawaiians and Other Pacific Islanders.

and consumption owing in part to its slightly higher SSB tax rate, it was hypothesized that Philadelphia would also see larger improvements in perinatal health than other cities.[24,59] Our cohort-specific findings support this hypothesis, strengthening the case for a causal link between SSB taxes and improvements in perinatal health. Nevertheless, further research leveraging individual-level SSB consumption data would help to further test the causal relationship.

There were notable differences in the association between SSB taxes and perinatal health across subgroups. Growing evidence has similarly underscored the role of disparities in perinatal outcomes among these groups.[39,70,71] Differential exposure to SSBs has been driven partly by targeted marketing of SSBs to racial/ethnic minority and low-income communities,[33−38,72] contributing to notably higher SSB consumption among Black and Hispanic than among White women during pregnancy (28% and 33% vs 15%).[3] This highlights the need to disaggregate results by subgroup. Our findings show larger declines in GDM and GWG *z*-score among non-Hispanic Asian pregnant people exposed to SSB taxes; violations of parallel trends for other racial subgroups precluded the study from inferring the impact of SSB taxes on racial disparities and perinatal health. There were large improvements in GWG *z*-score across other subgroups, including young (aged 25−29 years) individuals, less educated (high school GED) individuals, and individuals with overweight, indicating that SSB taxes could produce downstream health benefits, even among structurally disadvantaged subgroups. Additional years of follow-up data, along with larger sample sizes for subgroups of interest, might clarify the persistence of the perinatal effects, including among subgroups.

This study provides the first quasi-experimental evidence suggesting that SSBs contribute to GDM, excess GWG risk, and SGA and that policies to reduce excess sugar consumption among pregnant individuals may be an effective strategy to improve perinatal health. These findings are consistent with a recent federal commission suggesting that SSB taxes can reduce T2D risk[73] and come at a critical time because pregnancy complications in the U.S. are highly prevalent and have grown in recent years. In population-based studies, the reported U.S. prevalence for GDM is 6.2% (∼230,000 births)[74] and 47.5% for excess GWG (∼1,780,000 births)[75]; GDM prevalence has increased by ≥4% over the last 2 decades, with a marked rise among non-White, overweight, and low-income groups.[76] Women with GDM also have a sevenfold increased risk of developing T2D and a 43% increased risk of myocardial infarction or stroke after pregnancy, with even higher rates among Black and Hispanic people.[16,17,77,78] Our study also builds on previous findings that singular nutrition policies—for example, healthy revisions to the food package offered through the Women, Infants, and Children Nutrition Program—can improve perinatal health.[28−32] Tobacco taxation also provides a model of an effective policy intervention that has translated into population-wide improvements in perinatal health.[79]

Limitations

This study has several strengths. It used a large nationally representative sample of 5 million births and applied quasi-experimental difference-in-differences and fixed-effects techniques to evaluate the taxes independently of many potential measured and unmeasured confounders.[54] This study also has several limitations. First, data were not available for U.S. cities with populations <100,000, including Boulder and Albany. Results may not apply to smaller or more rural counties and cities. Second, the study lacked data to define individual-level SSB exposure. Because not all pregnant people in intervention cities consumed SSBs during pregnancy, the study likely underestimated the magnitude of the population-wide association between SSB taxes and our outcomes of interest among those who actually changed their SSB intake. Third, an important assumption of difference-in-differences analysis is that no other exposures differentially influenced outcomes between intervention and control groups during the study period. The study cannot rule out the existence of co-occurring policies that would violate this assumption. Finally, estimates were not adjusted for multiple comparisons.

CONCLUSIONS

A 2021 federal commission recommended a federal excise tax on SSBs as a strategy to control and prevent diabetes, yet empirical data regarding this relationship have been scant.[73] This study's results suggest that SSB taxes in five U.S. cities were associated with declines in GDM, GWG *z*-score, and SGA at the population level, with cohort differences by city and subgroup differences. These results provide critical evidence that SSB taxes may improve maternal outcomes as well as some improvements to neonatal outcomes, strengthening the evidence base for improving maternal nutrition during pregnancy.

ACKNOWLEDGMENTS

This work is supported in part by DK's award from the UCSF-Kaiser Department of Research Building Interdisciplinary Research Careers in Women's Health Program from the National Institute of Child Health and Human Development and the Office of Research on Women's

Health (K12 HD052163) as well as in part by RH's award from the National Institute of Diabetes and Digestive and Kidney Diseases (2P30 DK092924). All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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

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SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2023.03.016.

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