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Research

Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study

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Abstract

Study question What has been the effect on purchases of beverages from stores in Mexico one year after implementation of the excise tax on sugar sweetened beverages?

Methods In this observational study the authors used data on the purchase of beverages in Mexico from January 2012 to December 2014 from an unbalanced panel of 6253 households providing 205 112 observations in 53 cities with more than 50 000 inhabitants. To test whether the post-tax trend in purchases was significantly different from the pretax trend, the authors used a difference in difference fixed effects model, which adjusts for both macroeconomic variables that can affect the purchase of beverages over time, and pre-existing trends. The variables used in the analysis included demographic information on household composition (age and sex of household members) and socioeconomic status (low, middle, and high). The authors compared the predicted volumes (mL/capita/day) of taxed and untaxed beverages purchased in 2014—the observed post-tax period—with the estimated volumes that would have been purchased if the tax had not been implemented (counterfactual) based on pretax trends.

Study answer and limitations Relative to the counterfactual in 2014, purchases of taxed beverages decreased by an average of 6% (–12 mL/capita/day), and decreased at an increasing rate up to a 12% decline by December 2014. All three socioeconomic groups reduced purchases of taxed beverages, but reductions were higher among the households of low socioeconomic status, averaging a 9% decline during 2014, and up to a 17% decrease by December 2014 compared with pretax trends. Purchases of untaxed beverages were 4% (36 mL/capita/day) higher than the counterfactual, mainly driven by an increase in purchases of bottled plain water.

What this study adds The tax on sugar sweetened beverages was associated with reductions in purchases of taxed beverages and increases in purchases of untaxed beverages. Continued monitoring is needed to

linking purchases to nutrition data is currently not possible in Mexico owing to the lack of comprehensive data sources related to labeling. Therefore we focused on changes in the volumes of beverages purchased.

Each year the Nielsen Mexico Consumer Panel Services samples Mexican households in 53 cities (in 28 states plus Mexico City) with more than 50 000 inhabitants. Based on government statistics, this sample represents 63% of the Mexican population and 75% of food and beverage expenditures in 2014.³¹ The original dataset contained 205 827 household-month observations from 6286 households. We used complete case analysis; 715 observations (0.3%) were dropped because of missing information on the highest educational attainment of the heads of the households. Consequently, our analytic sample included 205 112 household months across 6253 households, of which 86% participated in all rounds. Each household is weighted based on household composition, locality, and socioeconomic measures through iterative proportional fitting to match demographic estimates from the National Institute of Statistics and Geography (Instituto Nacional de Estadística Geografía e Informática, INEGI). Enumerators visited the households every two weeks to collect diaries, product packaging from special bins provided for this study (scanned by the enumerators), and receipts, and to carry out pantry surveys. Bar code information provided all other data.

For descriptive purposes, we categorized the sample into the six regions used by INEGI: central north, central south, Mexico City, north east, north west, and south. The variables we used in the analysis included demographic information on household composition (age and sex of each household member) and socioeconomic status; information that is updated annually. Socioeconomic status groups (low, middle, and high) were based on a six category measure derived from annually updated questions on household ownership of assets (for example, number of bathrooms, number of bedrooms, number of vehicles owned) and education attainment of the head of the household. Onto the Nielsen Mexico Consumer Panel Services data we overlaid two contextual measures: the state's quarterly unemployment rate from INEGI,³² and the two economic minimum daily salary for each year from Mexico's National Commission of Minimum Salaries³³ (after adjusting for state and quarter specific inflation from INEGI's consumer price indices, www.inegi.org.mx/est/contenidos/proyectos/inp/inpc.aspx).

In this analysis we used the purchase of beverages by each household between 1 January 2012 and 31 December 2014. Data from the Nielsen Mexico Consumer Panel Services include the number of units purchased and the volume and price of each unit. From these we totalled the monthly volume and beverage categories each household purchased across each of the 36 months. Then we calculated the volume per capita per day for interpretability. Our beverage categories followed the 2012 National Health and Nutrition Survey (Encuesta Nacional de Salud y Nutrición) groupings for beverage intake as much as possible^{22 34}; these were further grouped into larger categories or subgrouped as described in supplemental table 1. We classified products into beverage categories in 2014 based on product descriptions and sources available on the internet and in stores. In this study we focus on the top level taxed and untaxed beverages. Our two categories for taxed beverages were carbonated sodas and non-carbonated sugar sweetened beverages, and our three categories for untaxed beverages were carbonated drinks such as diet sodas; sparkling, still, or plain water; and other drinks, including unsweetened dairy beverages and fruit juices. The Consumer Panel Services did not collect information on purchases of dairy products from all of the sampled households until October 2012 (personal communication). Therefore we limited our analyses of the categories "other untaxed drinks" and "overall untaxed beverages" to October 2012 through December 2014.

Patient involvement

No patients were involved in setting the research question or outcome measures, nor were they involved in the design and implementation of the study. There are no plans to involve patients in the dissemination of results.

Descriptive statistics

We present descriptive statistics of the households in the analytic data. Then we present the unadjusted trends in household purchases as reported during the period January 2012 through December 2014, which includes

Weighted descriptive statistics of analytic sample from Nielsen Mexico Consumer Panel Services.

Values are weighted means* (standard errors) unless stated otherwise

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Before controlling for any potential factors, strong seasonal effects on beverage purchases need to be considered. In Mexico, seasonality can be due to changes in temperature (though these temperature changes are not extreme in Mexico), holidays and festivities, and fewer purchases at the beginning of the year after the festivities in December (see supplemental fig 1). There is also a decrease in overall purchases of taxed beverages (see supplemental fig 1a), particularly in

2014. We are only able to present unadjusted purchases since October 2012 for untaxed beverages (see supplemental fig 1b), and there is an absolute increase in the volume purchased over time.

Model predicted differences in beverage purchases in stores: overall findings

Supplemental table 2 presents the coefficient estimates for each of the beverage categories from the difference in difference fixed effects models at the household level controlling for socioeconomic status, age, and sex, and for contextual measures of households. Based on these estimates, we back transformed the predicted log volumes for each of the 12 post-tax months using Duan smearing.³⁸ We compared estimated counterfactual volumes purchased in the post-tax period based on pretax trends (expected volumes if the tax had not been implemented) to adjusted volumes purchased in the post-tax period (based on predicted values from the model) and derived the absolute and relative differences from January to December 2014.

Table 2[↓] and figure 1[↓] show that for taxed beverages the absolute and relative differences between the post-tax volume and its counterfactual widened over the 12 post-tax months from -11 mL/capita/day (-5.6% relative to the counterfactual) in June to -22 mL/capita/day (-12% relative to the counterfactual) by December 2014, giving an average change of -6.1% over 2014. In total, during 2014 the average urban Mexican purchased 4241 mL (seven 600 mL or 20 oz bottles) fewer taxed beverages than expected (based on pretax trends). This was related to a decrease in purchases of non-carbonated sugar sweetened beverages (-17% relative to the counterfactual) and taxed sodas (-1.2% relative to the counterfactual). See supplemental Figure 2.

Table 2

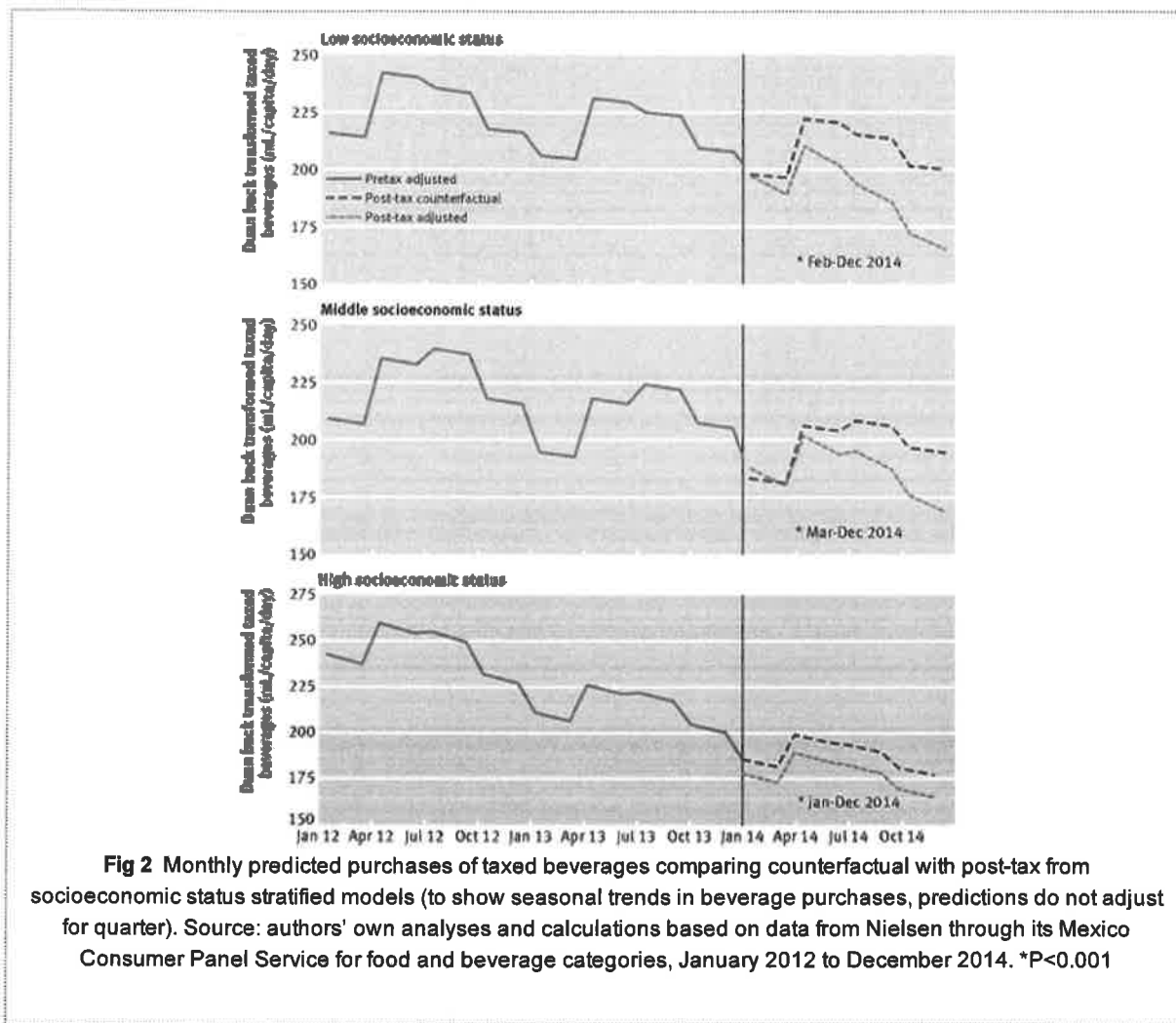
Overall absolute and relative differences in estimated adjusted counterfactuals and post-tax volume purchased (mL/capita/day)

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For untaxed beverages the absolute (and relative) differences were initially higher, at 63 mL/capita/day (7.5% relative to the counterfactual) in January 2014, and though the difference remained positive, it decreased over the 12 month post-tax period and was no longer statistically different from the counterfactual by November 2014. None the less, this represents an average increase in the purchase of untaxed beverages, of 36 mL/capita/day (4% relative to the counterfactual), which translates to the purchase of 12 827 mL (21 600 mL or 20 oz bottles) more untaxed beverages by the average urban Mexican over 2014 than expected.

Sensitivity analyses among the untaxed beverages showed that the model appears sensitive to the pretax period used. Limiting the analyses to untaxed beverages excluding dairy beverages, we found a relative increase in purchases by 2% when using January 2012 to December 2013 as the pretax period. This was 5% when using October 2012 to December 2013 as the pretax period. These results suggest that the estimated 4% for all untaxed beverages may be an overestimate, but positive (relative increase) none the less. Given the nature of incomplete data on beverages from the diaries, we are unable to provide an estimate on the



low socioeconomic status both showed larger differences in the earlier months that became smaller over the year, whereas changes among households of high socioeconomic status were less steep over the 12 months, maintaining a difference of 13 to 17 mL/capita/day (1.4% to 1.8%) throughout.

have focused on taxes for sugar sweetened beverages using model based approaches (owing to the lack of empirical data on actual taxations) recommend that taxes need to be set at a minimum of 20% to observe the higher reductions in purchases and consumption that may have an effect on health outcomes.⁴⁵ The current Mexican tax is half that level.

However, unpublished monitoring in-store and by the media has revealed aggressive in-store promotions and marketing to try to retain market shares for sugar sweetened beverages, which may limit both short term and long term effects. The impacts of these in-store and out of store marketing efforts are unclear. For example, industries may use a cost shifting strategy of passing more of the tax to the smaller beverage package sizes than to the larger packages.²⁶ Consequently, consumers may choose to purchase the larger versions, which are cheaper per liter. Future work that incorporates additional data and qualitative monitoring of industry marketing and promotions will allow the study of the longer term effects of the tax on sugar sweetened beverages and the response by industry.

We also found larger reductions in purchases of non-carbonated taxed beverages compared with carbonated taxed beverages. We hypothesize that this could be due to higher prices and high price elasticities of non-carbonated beverages, as shown in earlier work⁴⁶; and consumers shifting to lower priced versions of taxed carbonated beverages given the large variation in prices.²⁶ Moreover, the reduction in purchases of taxed sodas and carbonated beverages may be underestimated if purchases of smaller package sizes (which showed a larger increase in price than larger packages after the tax) are not well reported in the data, as these are individual purchases that may be consumed on the go and may be underreported by the key household informant.

Our findings on differential changes by socioeconomic status also shed light on the potential health implications of the tax in Mexico. Over the 12 month taxation period, households of low socioeconomic status reduced their intake of taxed beverages by more than 9%, but, more importantly, by December the decline was 17.1% more than the counterfactual, with a mean of almost 35 mL. Though prevalence rates for overweight and obesity in the low socioeconomic status group are not significantly higher than those in the higher socioeconomic status groups for all ages, trends in overweight and obesity are increasing faster in children and adolescents in low socioeconomic status groups than in the middle and high socioeconomic status groups.¹⁷ Taxes on food and beverages have been argued to be regressive as the poor pay a higher proportion of their income. However, results from this study showing a larger reduction in purchases among households of low socioeconomic status suggest that the burden of the tax was lower than it would have been if there was no differential impact by socioeconomic status. Additionally, if the tax revenue is appropriated toward decreasing disparities in health or socioeconomic status, the broader fiscal effects of the tax could arguably be progressive. Although the tax revenue has not been specifically earmarked, the senate made a resolution to use part of the taxes for providing potable water to public schools, particularly in low income areas.

Strengths and limitations of this study

A major limitation of this work is that causality cannot be established, as other changes are occurring concurrent with the tax, including economic changes, health campaigns about sugar sweetened beverages, and antiobesity programs. We attempted to deal with potential contextual economic factors by controlling for state quarterly unemployment rates and state yearly minimum salaries, but this may have been insufficient. The difference in difference approach attempts to take into account any pre-existing (pretax) trends in purchases, but it assumes that these trends would have continued if the tax had not been instituted.

Weaknesses include the incomplete data on dairy beverages before October 2012, which limited the overall analysis for untaxed beverages to a shorter period and likely overestimated the relative increase in purchases of untaxed beverages during the post-tax period. This is not ideal, as a longer pretax period may have allowed findings to be more robust. This is true in general (for all beverages), but we were limited by how far back we

effects of taxes on both sugar sweetened beverages and non-essential energy-dense food on purchases, diets, and ultimately health outcomes. In addition, future analysis will look at the distribution of changes in food purchases to determine if the tax on sugar sweetened beverages is more strongly associated with changes among consumers who purchase and consume larger quantities of sugar sweetened beverages.

What is already known on this topic

Mexico has one of the highest prevalence rates for diabetes, overweight, and obesity in the world

Reducing the consumption of sugar sweetened beverages has been an important target for obesity and diabetes prevention efforts

Mexico implemented an excise tax of 1 peso/L on sugar sweetened beverages from 1 January 2014

What this study adds

During the first year of the tax, the average volume of taxed beverages purchased monthly was 6% lower in 2014 than would have been expected without the tax

The reduction was greatest among the households of the lowest socioeconomic status

Footnotes

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- Contributors: MAC was involved in the literature search, study design, and data analysis and interpretation. BMP was involved in the literature search, study design, and data collection and interpretation. JAR was involved in the literature search, study design, and data interpretation. SWN was involved in the literature search, study design, and data collection, management, analysis, and interpretation. All authors helped to write the manuscript. They had access to the data (including statistical reports and tables) in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. BMP and SWN are guarantors for this study.
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15. †Rivera-Dommarco J, Shamah T, Villalpando-Hernández Set al., eds. *Encuesta Nacional de Nutrición 1999*. INEGI. Ministry of Health, National Institute of Public Health, 2001.
16. †Gutiérrez J, Rivera-Dommarco J, Shamah-Levy Tet al. *Encuesta Nacional de Salud y Nutrición 2012. Resultados Nacionales*. Instituto Nacional de Salud Pública, 2012.
17. †Rivera JA, Gonzalez de Cossio T. Nutrición y salud. In: *Rolando Cordera CM, ed. Los determinantes sociales de la salud en México*. Fondo de Cultura Económica; 2012:269-320.
18. †Organization for Economic Cooperation and Development Health at a Glance 2015. Poorkings Institution Press; 2015. www.brookings.edu/research/books/2015/health-at-a-glance-2015.
19. †Institute of Health Metrics and Evaluation. Mexico global burden of disease. IHME; 2014. www.healthdata.org/mexico.
20. †Barquera S, Hernandez-Barrera L, Tolentino MLet al. Energy intake from beverages is increasing among Mexican adolescents and adults. *J Nutr* 2008;**138**: 2454-61. doi:10.3945/jn.108.092163 19022972
21. †Barquera S, Campirano F, Bonvecchio A, Hernández-Barrera L, Rivera JA, Popkin BM. Caloric beverage consumption patterns in Mexican children. *Nutr J* 2010;**9**: 47-56. doi:10.1186/1475-2891-9-47 20964842
22. †Stern D, Piernas C, Barquera S, Rivera JA, Popkin BM. Caloric beverages were major sources of energy among children and adults in Mexico, 1999-2012. *J Nutr* 2014;**144**: 949-56. doi:10.3945/jn.114.190652 24744311
23. †Barquera S, Campos I, Rivera JA. Mexico attempts to tackle obesity: the process, results, push backs and future challenges. *Obes Rev* 2013;**14**(Suppl 2): 69-78. doi:10.1111/obr.12096 24103026
24. †Rivera JA, Muñoz-Hernández O, Rosas-Peralta M, Aguilar-Salinas CA, Popkin BM, Willett WCComité de Expertos para las Recomendaciones. [Beverage consumption for a healthy life: recommendations for the Mexican population]. *Salud Publica Mex* 2008;**50**: 173-95. doi:10.1590/S0036-36342008000200011 18372998
25. †Chamber of Deputies of the Mexican Congress. Ley de Impuesto Especial sobre Producción y Servicios. [Law of special tax on production and services]. 2013. www.diputados.gob.mx/LeyesBiblio/pdf/78_181115.pdf.
26. †Colchero MA, Salgado JC, Unar-Munguía M, Molina M, Ng S, Rivera-Dommarco JA. Changes in prices after an excise tax to sugar sweetened beverages was implemented in Mexico: evidence from urban areas. *PLoS One* 2015;**10**: e0144408. doi:10.1371/journal.pone.0144408 26675166
27. †Grogger J. Soda taxes and the prices of sodas and other drinks: evidence from Mexico. Working Paper 21197. NBER, 2015. www.nber.org/papers/w21197.
28. †Ng SW, Popkin BM. Monitoring foods and nutrients sold and consumed in the United States: dynamics and challenges. *J Acad Nutr Diet* 2012;**112**: 41-45.e4. doi:10.1016/j.jada.2011.09.015 22389873
29. †Ng SW, Slining MM, Popkin BM. The Healthy Weight Commitment Foundation pledge: calories sold from U.S. consumer packaged goods, 2007-2012. *Am J Prev Med* 2014;**47**: 508-19. doi:10.1016/j.amepre.2014.05.029 25240967
30. †Finkelstein EA, Zhen C, Nonnemaker J, Todd JE. Impact of targeted beverage taxes on higher- and lower-income households. *Arch Intern Med* 2010;**170**: 2028-34. doi:10.1001/archinternmed.2010.449 21149762
31. †Instituto Nacional de Estadística y Geografía. Encuesta Nacional de Ingreso y Gastos de los Hogares. [National Household Income and Expenditure Survey]. 2008, 2010, 1012, 1014. www.inegi.org.mx/est/contenidos/Proyectos/encuestas/hogares/regulares/enigh.
32. †Instituto Nacional de Estadística y Geografía. Encuesta Nacional de Ocupación y Empleo. Indicadores estratégicos. [National Survey of Occupation and Employment: strategic indicators]. 2014. www3.inegi.org.mx/sistemas/temas/default.aspx?s=est&c=25433&t=1.
33. †Comisión Nacional de los Salarios Mínimos. Tabla de Salarios Mínimos Generales y Profesionales por áreas geográficas. [Table of minimum wages: general and professional by geography]. 2014. www.conasami.gob.mx/t_sal_mini_prof.html.
34. †Romero-Martínez M, Shamah-Levy T, Franco-Núñez Aet al. Encuesta Nacional de Salud y Nutrición 2012: diseño y cobertura. [National Health and Nutrition Survey 2012: design and coverage]. *Salud Publica Mex* 2013;**55**(Suppl 2): S332-40. 24626712
35. †StataCorp. Stata statistical software: Release 13. StataCorp, 2014.

Fumiaki Imamura et al., [The BMJ](#), 2015

STAT

Cardiovascular screening to reduce the burden from cardiovascular disease: microsimulation study to quantify policy options

WHO urges countries to raise taxes on sugary drinks

Martin O'Flaherty et al., [The BMJ](#), 2016

STAT

143 beverage intake among preschool children and its effect on weight status.

US soda tax battle bubbles up in San Francisco Bay Area

T. O'Connor et al., *J Investig Med*, 2006

STAT

Western Regional Meeting 2016, Carmel, California, January 28–30, 2016

Sugar-Sweetened Beverages, Diet Soda, and Risk of Fatty Liver Disease

BMJ Publishing Group Ltd, *J Investig Med*, 2016

PracticeUpdate, 2015

Drinking artificially sweetened drinks in pregnancy shows link to overweight infants

Jacqui Wise et al., [The BMJ](#), 2016

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