Online supplemental material for "Building upon the sugar beverage tax in Mexico: a modeling study of tax alternatives to increase benefits"

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1 Consolidating Health Economic Evaluation Reporting Standards (CHEERS) 2022 Checklist

1. Title: Redesigning the sugar-sweetened beverage tax in Mexico for higher benefits: a modeling analysis. Our study does not use a standard cost-benefit analysis as we are not including implementation costs and we added job losses as a cost. However, as in several cost-benefit analyses, we included health care savings (p5). We assessed what would happen if Mexico redesigned its existing sugar-sweetened beverage (SSB) tax to get higher benefits based on currently implemented taxes elsewhere. We identified taxes that maximize health-related savings and reduce lost jobs.

2. Abstract: The abstract provides the context (effectiveness of the current SSB tax in Mexico and justification for a design), methods, results, and alternative analyses to the tax scenario with the highest benefit (p2).

3. Introduction: The introduction provides the context and justification for a redesign of the current SSB tax in Mexico, and its objective (p4-5). The practical relevance for policy is under the heading for the journal: How this study might affect research practice or policy (p3).

Methods

4. Health economic analysis plan We conceived a general analysis plan when writing the proposal and more specific when we started but it is not written.

5. Study population: The Mexican population (adults 19 years old).

6. Setting and location: The study applies to Mexico, the SSB tax was implemented at the Federal level. This is a modeling analysis that applies to a nationally representative sample of the population. We do not envision any contextual information that may influence findings.

7. Comparators: We assessed multiple tax scenarios based on taxes implemented in several countries representing different designs and amounts across the world. If Mexico would: 1) double the existing excise tax (2018) from 1.17 Mexican pesos (1.17 as the one peso per liter in 2014 was adjusted to inflation) to 2.34 Mexican pesos per SSB liter; 2) implement a sugar-density tax, based on sugar content, such as the tax implemented in South Africa (a tax per gram of sugar above 4 sugar grams/100 ml) and multi-tier sugar taxes (excise and ad valorem) where the tax increases based on sugar-density thresholds such as the ones in the United Kingdom, Portugal, Ireland, Chile, Peru, and Ecuador; 3) implement an ad valorem tax where the tax amount is a function of consumer prices, such as in Thailand, India, Kiribati, and Bahrain; and 4) implement an excise tax to volume such as the tax in Mexico regardless of the amount of added sugar, such as in the Philippines and cities in the United States (Berkeley, Boulder, and Philadelphia) (p5).

8. Perspective: Social perspective as we are including indirect costs of economic loss from premature mortality, absenteeism (lost days of work due to illness), and presenteeism (productivity reduced at work) (p5 and 9).

9. Time horizon: Time horizon: 10 years appropriate for modeling effects of a tax, assuming no changes in rate or design after implementation (p11).

10. Discount rate: We used a discount rate of 4%, as recommended for upper-middle-income countries such as Mexico (p10).

11. Selection of outcomes: We estimated net benefits as the difference between health-related savings (direct and indirect costs of obesity) and lost jobs (p10).

12. Measurement of outcomes: Based on baseline consumption and body mass index for each individual in the sample of the 2018 National Health and Nutrition Survey, changes in weight status were modeled based on expected consumption reductions associated with the SSB tax (using price elasticities). If the weight status was obese, direct and indirect costs were included. For employment, for each, we estimated job losses from a fraction of job losses per liter not consumed based on the input-output matrix (methods and online supplemental material).

13. Valuation of outcomes: Mexican population (adults ¿19 years old). Obesity is estimated using parameters/data sets. Baseline consumption, weight and BMI from the 2018 National Health and Nutrition Survey (p6,7). Changes in prices come from data that is collected to estimate the Consumer Price Index (p8). Price elasticities of the demand for SSB come from a paper: M. A. Colchero, J. C. Salgado, M. Unar-Munguía, M. Hernández-Ávila, and J. A. Rivera-Dommarco, "Price elasticity of the demand for sugar-sweetened beverages and soft drinks in Mexico," Econ. Hum. Biol., vol. 19, 2015 (p8).

14. Measurement and valuation of resources and costs: Direct and indirect costs were selected from a recent paper that estimated obesity costs for México: A. Okunogbe, R. Nugent, G. Spencer, J. Ralston, and J. Wilding, "Economic impacts of overweight and obesity: current and future estimates for eight countries," BMJ Glob. Heal., vol. 6, no. 10, p. e006351, Oct. 2021.

15. Currency, price date, and conversion: We expressed all monetary results in 2019 real prices in USD (p.10)

16. Rationale and description of the model: We provide an overview of the model (p6) and details in the methods section and in the online supplemental material. We used Hall´s dynamic weight change model to estimate the projected changes in body weight based on the author´s estimations. The rest of the modeling was done by the authors, a detailed description is provided in the online supplemental material.

17. Analytics and assumptions: Data cleaning and validations are described and mentioned in the online supplemental material: validations of the food frequency questionnaire and conversion to calories; data cleaning for implausible values for energy intake and body mass index, exclusion due to missing values for weight (online supplemental file section 2).

18. Characterizing heterogeneity: For the tax with the highest net benefit, we conducted an equity analysis to determine how health benefits are distributed across household income quintiles (p10).

19. Characterizing distributional effects: The model is based on a nationally representative sample from the 2018 National Health and Nutrition Survey (p6). For the tax with the highest net benefit, we conducted an equity analysis to determine how health benefits were distributed across household income quintiles (p10 and Table 4).

20. Characterizing uncertainty: The methods section describes how uncertainty to get confidence intervals for the main outcomes was calculated (p.11).

21. Approach to engagement with patients and others affected by the study: Not applicable: the study is a modeling analysis that uses different data sets and parameters from the literature.

Results

22. Study parameters: All inputs are described for each tax scenario in Tables 1 and 2. Table 1 describes the taxes, change in price, the amount of the tax, and caloric change (due to price and reformulation). Table 2 shows change in price, calories, weigh and obesity in absolute and relative change as well as millions of cases.

23. Summary of main results: Table 3 provides for each tax scenario: mean cost (lost jobs), benefits (reduction in direct costs and indirect costs) and net benefits, all in billion USD with confidence intervals.

24. Effect of uncertainty: We used uncertainty to estimate confidence intervals for our estimations (p11). We did not vary the discount rate or time horizon as it would equally affect all tax scenarios.

25. Effect of engagement with patients and others affected by the study: Not applicable.

Discussion

26. Study findings, limitations, generalizability, and current knowledge: The discussion summarizes the main findings, limitations of the study and policy relevance (p21-25).

Other Relevant Information

27. Source of funding: This study was funded primarily by Bloomberg Philanthropies, with support from the National Institutes of Health R01DK108148 and the Instituto Nacional de Salud Pública. Beyond financial support, funders had no role in the study design, data collection, analyses, or interpretation of results.

28. Conflicts of interest: The authors do not have any conflict of interest to declare.

2 Baseline consumption of beverages in adults

The 2018 National Health and Nutrition Survey (ENSANUT in Spanish) was the baseline data source for the models.

To estimate the baseline intake of beverages with tax in Mexico, we used the 2018–2019 wave of the National Health and Nutrition Survey (ENSANUT for its Spanish acronym). The ENSANUT is a cross-sectional, multistage, stratified, and cluster-sampled survey representative at the national, regional, and rural/urban levels. The survey is designed to assess the prevalence and distribution of health and nutrition issues and risk factors in the Mexican population. The data-sets are available on the ENSANUT website, [9]. ENSANUT-2018 collected demographic, socioeconomic, nutritional, and health-related data for 50,654 households, [9].

Within ENSANUT 2018, we used data from the semi-quantitative food frequency questionnaire (FFQ). The FFQ tracks the consumption of 140 items over a week, including a variety of calorie-dense beverages. Data include the number of days, times per day, serving size, and the number of times a food was consumed in the 7 days preceding the interview. A subset of subjects was randomly selected to participate in the food frequency questionnaire, from which we included 17,048 individuals 19 years and older. Using the nutritional table, the number of beverages consumed per day was converted into daily energy intake for each subject (Kcal/day/person) using standard procedures. Previously, this instrument was validated in Mexican adolescents and adults. Table A presents the selected beverages based on the SSB tax in Mexico.

Using the variables that uniquely identify the individual (*folio* and *intp*), we merged three data-sets (anthropometric, household, and food frequency questionnaires). The anthropometric data-set contains weight and height measurements obtained by qualified personnel using standard procedures. Body weight was measured with digital scales with a precision of 100 g while participants wore light clothing; height was measured with stadiometers with a precision of 2 mm. We excluded individuals with extreme values of energy

Table A: FFQ taxed beverages categories 2018

Food group	Description
Taxed industrialized carbonated beverages	Soft drinks (cola and other flavors).
Taxed industrialized non-carbonated beverages	Industrialized flavored drinks or waters with sugar
	Fruit nectars or industrialized fruit pulp with sugar
	Yakult o similar
	Non-diet yogurt to drink with fruit

intake, and volume consumption 3 standard deviations above or under mean intake (n=1,257). We excluded people younger than 20 years old (n=55) and missing data of weight or height (n=614) and people with body mass index higher than 58 kg/m2 (n=13). Our final sample size had 15,109 participants, representing 76,221,919 persons in Mexico's adult population. We accounted for the ENSANUT 2018 survey design using the R program's "Survey" package as follows:

```
Svy.design.2018 <- svydesign( id = ~id_sujeto,
strata = ~est_dis, weights = ~f_alim_com_insp,
PSU = ~upm_dis, data = Adults.ENSANUT.2018)
options(survey.lonely.psu = ''adjust'')
```

We estimated the baseline consumption of taxed beverages in terms of energy (kcal/day) and volume (ml/day).

Table B: Baseline consumption of taxed beverages by socioeconomic level

SES	Baseline consumption in Kcal	C.I. Baseline consumption in Kcal	Baseline consumption in ml	C.I. Baseline consumption in ml
Q1	88.4	(81.3 , 95.6)	204.7	(187.5 , 222.0)
Q2	110.4	(102.7 , 118.1)	253.6	(235.7 , 271.6)
Q3	116.6	(107.2 , 126.1)	266.4	(245.0 , 287.8)
Q4	115	(106.4 , 123.7)	265.4	(244.6 , 286.2)
Q5	105.8	(95.0 , 116.6)	242.7	(217.7 , 267.8)
POPULATION	107.7	(103.6 , 111.9)	247.6	(238.0 , 257.3)

The resulting data-set contains the variables detailed in table C :

Table C: Variables in final data-set.

Variable	Description
ID	Identifier for each individual in ENSANUT's data-set.
Strata	Strata for the estimation of variances accounting for survey design.
Weight_svy	Complex survey weight.
PSU	Identifier of primary sampling unit.
SES_5q	Socioeconomic status, divided in quintiles, using the weighted sample.
TEI	Daily total caloric intake at baseline (kcal).
SSB_cal	Daily total caloric intake at baseline from sugar-sweetened beverage (kcal).
SSB_ml	Daily total intake at baseline from sugar-sweetened beverage (ml).
Age	Age (yrs).
Sex	Sex of the individual.
Weight	Weight at baseline (kg).
Height	Height (cm).
BMI	Body mass index before intervention (kg/m^2).
Obesity	Categories of "obesity" (1), "else" (0) at baseline.
Elasticity	SSB elasticity per SES.

3 Price increase and reformulation due to SSB tax

3.1 Marginal price increase calculation

We propose tax increases based on existing tax designs in other countries and cities around the world. When we adapt these designs to the case of Mexico, we add to each design the IEPS (existing in Mexico since 2014) according to its value in 2018.

Next, we describe the general procedure for adjusting international interest taxes in Mexico.

1. We deconstruct the observed consumer price in Mexico using the following formula:

$$P_{PreTax} = \frac{P_{Ob}}{1 + RP} - Tax_{2018}$$

where P_{PreTax} is the price without tax and without the profit of the retailers, P_{Ob} is the average price observed to the consumer per liter of sugar-added beverage, RP is the profit of the retailer, and Tax_{2018} is the amount of tax in 2018. We assume the following values: $P_{Ob} = \$17.7$ [12]; $RP = 10.52\%$ and; the current IEPS in 2018 was \$1.17 obtaining as a result $P_{PreTax} = \$14.8$ for

Mexico in 2018. Therefore:

$$P_{PreTax} = \frac{17.7}{1 + 0.1052} - 1.17 = 14.8$$

2. With the P_{PreTax} identified it is possible to manipulate the amount of the tax. Specifically, we calculate the price to the consumer in a scenario without tax and with benefit for the retailer with the following formula:

$$P_{NoTax} = P_{PreTax}\,(1 + RP) = 14.8\,(1 + 0.1052) = 16.4$$

where P_{NoTax} is the estimated price before tax after adding the retailer's profit, the estimate for P_{NoTax} was \$16.4.

3. On the other hand, we identify tax schemes implemented in various regions such that Js the identifier for each region. In each tax scenario we relate an expected percentage change in price: in the schemes where the tax was differentiated by levels of energy density, we weighted the percentage change taking into account the market share of different brands and the change in the price registered in Literature; in ad valorem tax designs we assume the same magnitude of change in price and, finally; in tax schemes with specific taxes we take from the literature the observed magnitude of change in the price to the consumer, in the cases where we do not find observed information we estimate the change in the price of each tax using cost of living pages ([8]) . The cost of living pages have a historical record of the cost of different products and services by region or country.

4. The expected percentage change in prices (ΔP_J) in scenario J, we add to the estimated price without tax for Mexico (P_{NoTax}) to obtain the consumer price that would correspond to said scenario (P_J). We then add the price change to the estimated price without tax because these scenarios were raised in contexts where there was no prior tax. Therefore, we used the following formula:

$$P_J = P_{NoTax}(1 + \Delta P_J)$$

Below, as an example, we describe the application of the procedure described above for the adaptation of the tax in the United Kingdom in Mexico. Therefore, we will use the parameters with subscript UK to represent the information for United Kingdom. So, we update P_J as:

$$P_{UK} = 16.4\,(1 + 0.093) = 17.9$$

Where ΔP_{UK} corresponds to the UK price change given by your tax. We assume for the United Kingdom a price increase estimate of 9.3% under the assumption that the tax is fully transferred to prices. Consequently, the consumer price would be \$17.9 in this scenario if instead of our tax, we had the

UK design in Mexico. Next, we deconstruct this alternative consumer price in order to obtain the total tax amount to arrive at that 9.3% increase.

$$P_{PreTax} = \frac{P_J}{1+RP} - Tax_J$$

ergo:

$$Tax_J = \frac{P_J}{1+RP} - P_{PreTax}$$

so:

$$Tax_{UK} = \frac{P_{UK}}{1+RP} - P_{PreTax} = \frac{17.9}{1+0.1072} - 14.8 = 1.4$$

This calculation means that a tax of $1.4 in Mexico is equivalent to the expected price increase in the UK under its existing tax. Now, we calculate the scenario where this amount of tax is incorporated into the pre-existing 2018 tax:

$$Tax_{TotalUk} = Tax_{UK} + Tax_{2018} = 1.4 + 1 = 2.5$$

The change in the consumer price with this total tax with respect to the observed price, which we will call the marginal change (ΔP_{MgJ}), we explain this process with the following formula:

$$\Delta P_{MgJ} = \frac{P_{PreTax} + Tax_{TotalJ}(1+RP)}{P_{Ob}} - 1$$

so:

$$\Delta P_{MgUK} = \frac{P_{PreTax} + Tax_{TotalUK}(1+RP)}{P_{Ob}} - 1 = \frac{14.8+2.5)(1.1072)}{17.7} - 1 = 0.086$$

The new consumer price for the UK tax design in Mexico is equivalent to a price increase of 8.6%. This 8.6% is less than the expected change in prices of 9.3% in the UK. This difference is the result of the existence of the tax on sugary drinks in Mexico since 2014, which dilutes the expected change in prices when we add the tax from another country or city.

3.2 The extent of the reformulation for sugar-density taxes

To inform the extent of reformulation in Mexico under sugar-density taxes, we assumed that it would be equivalent to the observed reformulation in South Africa under its existing sugar tax. We follow the next steps:

1. Based on data from the soft-drink price assessment after the sugar tax implementation in South Africa [14], we split products into one-gram sugar groups per 100 ml (i.e., 4 gram/100 ml, 5 gram/100, etc.) according to their baseline sugar content.

2. For each of these groups, we calculated their average reformulation (by comparing sugar content before and after the tax implementation) in terms of sugar reduction per 100 ml. However, it is worth highlighting two adjustments when calculating this average:

   (a) The original soft-drink data from South Africa did not include products whose baseline sugar content was 6 or 9 grams per 100 ml. Conversely, the relevant product data from Mexico had products with the aforementioned sugar content. Thus, we used the average reformulation for the 5-gram and 7-gram groups for the 6-gram group and the average reformulation for the 8-gram and 10-gram groups for the 9-gram group.

   (b) According to the South African data, there was no reformulation for the top two cola brands. We did not include these brands when calculating the one-gram reformulation averages because we will assume that these two products are not reformulated in Mexico either.

3. Once we have the average reformulation data for South Africa, we match this data to the selected top 47 sugar-sweetened beverages (SSB) in Mexico [3] using the one-gram sugar groups per 100 ml as the common identifier.

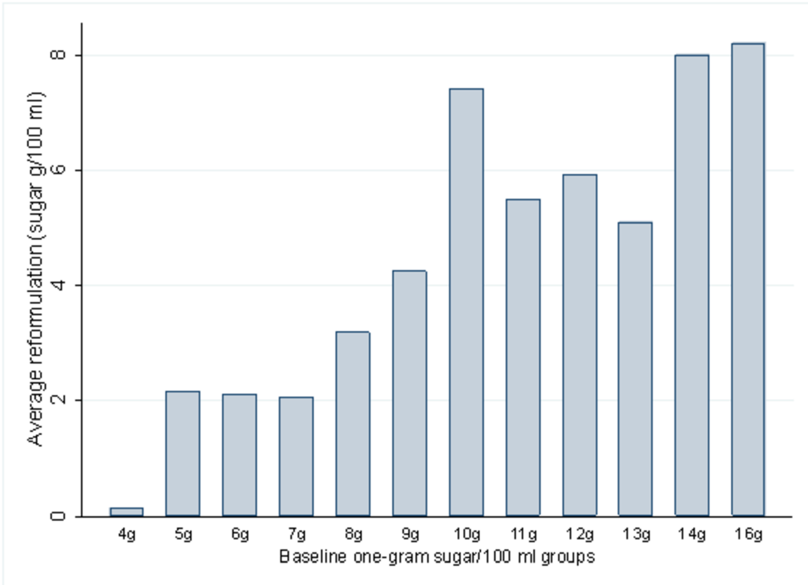
4. We subtracted the average reformulation in South Africa from the selected top 47 products' sugar content in Mexico for all reformulation scenarios. Subsequently, we conducted the following adjustments:

   (a) For multi-tiered sugar taxes, we adjusted the sugar content after reformulation to bunch just below the threshold of the closest lower tax tier.

   (b) For all reformulation scenarios, we assumed the top two cola brands had no reformulation in line with the observed outcomes for these top brands in South Africa.

5. Based on the selected products in Nielsen MX CPS (2016), we calculated the quantity-weighted average sugar content before reformulation, where weights corresponded to monthly purchases in 2013 in Nielsen MX. Subsequently, we calculated the quantity-weighted equivalent figure for each tax design for which we assume reformulation. By comparing quantity-weighted sugar content before and after the assumed reformulation, we calculated the percentage sugar content change, which we report in Table 1.

Fig. A: Average sugar reformulation for soft drinks in South Africa; based on information from [14]



4 Caloric, weight, and BMI changes

4.1 Caloric change (kcal/day/person)

For each individual k in the sample, we estimated the expected caloric change attributed to the tax implementation. The projected energy intake change ΔI_k of each individual k in the baseline sample, is a constant vector of length t, according to its SES group and the tax scheme to be modeled:

$$\overrightarrow{\Delta I}_k(t) = -((I_k^{2018} \times \tau \times (1 - \rho_\tau) \times \xi_k) + (I_k^{2018} \times \rho_\tau)); \qquad (1)$$

where I^{2018} represents the initial energy intake of the k-th individual in the baseline year (2018), τ is the percentual price change of the tax scheme to be modeled, ρ_τ is the estimated percent of reformulation induced by the tax scheme, t is the number of days to simulate (for simulating by 2028, $t = (2028-2018) \times 365$), and ξ represents the elasticity of the SSB for the individual's socioeconomic status, such that:

$$\xi_k = \begin{cases} -1.16 & \text{if } k \in \text{Quintile 1, Low SES} \\ -1.22 & \text{if } k \in \text{Quintile 2, Middle low SES} \\ -1.16 & \text{if } k \in \text{Quintile 3, Middle SES} \\ -1.10 & \text{if } k \in \text{Quintile 4, Middle high SES} \\ -1.06 & \text{if } k \in \text{Quintile 5, High SES} \end{cases}$$

4.2 Weight change

We simulated body weight using the dynamic weight change model for adults proposed by Hall and colleagues The model simulates the adult human metabolism and predicts the time course of individual weight change in response to different SSB taxes schemes, [6, 5, 7]. The model considers sex, age, height, initial body weight (BW), physical activity level (PAL), and daily changes in energy and sodium to estimate individual changes in body weight. This model was previously used to predict multiple nutritional interventions in the Mexican population, [1]. To initialize the model, we used the individuals in the baseline sample (2018) considering their sex, age, weight, and height. The model was completely programmed in the *bw* package, [2], in R. A more detailed description of its implementation can be found elsewhere, [2].

Body weight was simulated for each individual, k, in the sample as follows:

$$\begin{aligned} BW_k(t) = BW_k^{\text{model}}\big(&t{+}age_k,\ \text{Sex}_k, \text{Height}_k(0), \text{BW}_k(0), \\ &\overrightarrow{PAL}_k(t), \overrightarrow{\Delta I}_k(t), \overrightarrow{\Delta Na}_k(t)\big), \end{aligned} \tag{2}$$

where $Height_k(0)$ and $BW_k(0)$ are the initial height and body weight, respectively. $\overrightarrow{PAL}_k(t)$ is the physical activity level by day, assumed to be constant over time (sedentary level = 1.5), $\overrightarrow{\Delta I}_k(t)$ and $\overrightarrow{\Delta Na}_k(t)$ are the daily changes in energy intake and sodium, respectively.

4.3 Change in BMI

To obtain the expected change in body mass index $BMI_k(t)$ for each individual k, we used:

$$BMI_k(t) = BW_k(t)/(H_k)^2, \tag{3}$$

where $BW_k(t)$ represents the estimated individual's body weight (kg) with Hall's model, t stands for the number of days after the intervention, and H_k represents individual's height in meters.

4.4 Change in obesity prevalence

We classified each individual's $BMI_k(t)$ into BMI categories using WHO's cut-off points [16]. We introduced a dummy variable ($Obesity_k(t)$) defined as:

$$Obesity_k(t) = 1, \text{ if } BMI_k \geq 30kg/m^2.$$

where $Obesity_k(t) = 1$ indicates obesity for each individual k in the sample and t stands for the number of days after the intervention.

Then, we calculated the change in obesity prevalence ($\Delta Obesity_k(t)$) with: $\Delta Obesity_k(t) = Obesity_k(0) - Obesity_k(t)$, where k represents each individual in the sample, $Obesity_k(0)$ corresponds to the baseline BMI category ($t = 0$) and $Obesity_k(t)$ represents the new BMI category at time t.

Finally, since ENSANUT is a cross-sectional, multi-stage, probabilistic survey representative of the Mexican population, [13], we used the R package survey, [10], to create summary statistics of $BW_k(t)$, $BMI_k(t)$ and $Obesity_k(t)$ in the overall adult population and in specific subpopulations by SES; we accounted for the survey design established as follows:

```
svystr <- svydesign(id = ~ id_sujeto,
strata = ~ est_dis,
weights = ~ f_alim_com_insp,
PSU = ~ upm_dis,
data = Adults.ENSANUT.2018)
options(survey.lonely.psu = "adjust")
```

5 Obesity cases averted in adults

To estimate the obesity cases averted, we assumed that obesity prevalence in 2019 was similar to the one reported in ENSANUT 2018 and remained constant during the 10-year period of our analysis. Then, we derived population projections of adults (20 and above years) of 2019 to 2028 from the National Council on Population (CONAPO), [4], as seen in table D;

Table D: Population projections of adults (20 and above years) in million people

	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Adults	81.74	83.09	84.42	85.74	87.03	88.32	89.59	90.84	92.06	93.25

Lastly, we obtained the total averted cases of obesity among adults as:

$$AvertedObesitycases(t) = AdultPopulation(t) \times \Delta Prevalence(t), \quad (4)$$

where $AdultPopulation(t)$ corresponds to the number of people aged 20 and above at time t; and $\Delta Prevalence(t)$ is the change in prevalence as explained in the previews section. To see the full table with the adverted cases per tax scheme for each year and in total please refer to table G in the complementary results of this appendix.

6 Obesity costs in adults

To estimate the obesity costs, both direct and indirect, we used the overweight and obesity costs estimated in Mexico by Okunogbe *et.al.*, [11], as a base. The cost in 2019 in Mexico was estimated to be 26.1 Billion USD for both for overweight and obesity cases, [11]. To break down the obesity and overweight costs, we employed the systematic review by Tsai *et.al.*, [15]. The authors found that 86.6% of total costs related to obesity. With this proportion, we estimated the obesity costs in Mexico (Table E). Then we divided the total cost of obesity by the people with obesity (35,139,475) in 2018 and estimate the cost per obesity case in 2019.

Table E: Estimated the obesity costs in Mexico

	Total cost (billion USD)	**Obesity cost (billion USD)**	**Cost per obesity case**
Direct cost	7.7	6.7	189.81
Indirect cost	18.4	15.9	453.57
Total cost	26.1	22.6	643.37

We used a 3% discount rate to obtain the cost of one case in present value over 10 years (Table F). Finally, we multiplied the individual cost of an obesity case with the estimated averted cases and added up the cost to obtain the averted direct and indirect costs for each tax scheme. To see the full table with the adverted costs per tax scheme for each year and in total please refer to table H and table I in the complementary results of this appendix.

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Table F: Estimated cost per year of an obesity case in Mexico

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Direct cost	$189.81	$184.28	$178.91	$173.70	$168.64	$163.73	$158.96	$154.33	$149.84	$145.47
Indirect cost	$453.57	$440.36	$427.53	$415.08	$402.99	$391.25	$379.85	$368.79	$358.05	$347.62
Total cost	$643.37	$624.63	$606.44	$588.78	$571.63	$554.98	$538.82	$523.12	$507.89	$493.09

7 Complementary results for main analysis

Table G: Adverted cases per tax scheme

Country	Change in price (%)	Percentage of reformulation	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total
Mexico	6.3%	0.0%	-0.47	-0.63	-0.70	-0.74	-0.85	-0.89	-0.91	-0.94	-0.96	-0.97	-8.05
United Kingdom	7.0%	8.2%	-1.02	-1.41	-1.57	-1.65	-1.75	-1.84	-1.88	-1.91	-1.94	-1.97	-16.94
South Africa	7.4%	15.0%	-1.35	-2.01	-2.36	-2.54	-2.68	-2.75	-2.80	-2.85	-2.90	-2.94	-25.19
Portugal	11.4%	8.2%	-1.22	-1.76	-2.13	-2.26	-2.43	-2.48	-2.53	-2.57	-2.60	-2.63	-22.62
Chile	14.6%	9.5%	-1.49	-2.19	-2.55	-2.83	-2.99	-3.15	-3.20	-3.25	-3.30	-3.34	-28.28
Peru	21.3%	12.4%	-2.08	-3.25	-3.61	-3.83	-3.98	-4.07	-4.15	-4.21	-4.27	-4.32	-37.77
Ireland	26.6%	8.2%	-2.17	-3.37	-3.79	-4.07	-4.18	-4.29	-4.40	-4.47	-4.55	-4.61	-39.90
Ecuador	9.4%	0.0%	-0.62	-0.99	-1.13	-1.19	-1.22	-1.29	-1.31	-1.36	-1.38	-1.40	-11.91
Thailand	13.1%	0.0%	-0.97	-1.36	-1.54	-1.62	-1.67	-1.76	-1.79	-1.83	-1.86	-1.89	-16.30
India	26.2%	0.0%	-1.76	-2.78	-3.32	-3.50	-3.62	-3.70	-3.77	-3.83	-3.88	-3.93	-34.09
Kiribati	37.5%	0.0%	-2.59	-3.82	-4.24	-4.65	-4.88	-5.00	-5.11	-5.18	-5.26	-5.33	-46.06
Bahrain	46.9%	0.0%	-3.36	-4.58	-5.18	-5.47	-5.68	-5.83	-5.96	-6.05	-6.15	-6.23	-54.49
Philippines	12.2%	0.0%	-0.88	-1.21	-1.47	-1.54	-1.61	-1.64	-1.67	-1.70	-1.72	-1.74	-15.17
Berkeley, USA	22.1%	0.0%	-1.51	-2.23	-2.61	-3.02	-3.16	-3.26	-3.32	-3.39	-3.45	-3.49	-29.44
Philadelphia, USA	33.2%	0.0%	-2.32	-3.47	-3.96	-4.16	-4.33	-4.44	-4.52	-4.58	-4.65	-4.71	-41.15
Boulder, USA	44.2%	0.0%	-3.25	-4.28	-4.94	-5.28	-5.49	-5.59	-5.71	-5.81	-5.90	-5.98	-52.22

Table H: Change in direct costs per tax scheme in million USD

Country	**Change in price** (%)	**Percentage of reformulation**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**Total**
Mexico	6.3%	0.0%	-89	-117	-126	-128	-143	-145	-145	-145	-143	-141	-1,322
United Kingdom	7.0%	8.2%	-194.24	-259.38	-280.75	-287.10	-295.15	-301.56	-299.30	-294.63	-290.25	-286.01	-2,788.37
South Africa	7.4%	15.0%	-256.85	-370.79	-422.82	-441.13	-451.38	-450.56	-445.58	-440.29	-434.42	-427.25	-4,141.07
Portugal	11.4%	8.2%	-231.11	-324.49	-381.68	-393.35	-410.18	-405.58	-402.33	-396.04	-389.68	-383.24	-3,717.68
Chile	14.6%	9.5%	-282.29	-403.98	-455.66	-492.30	-503.47	-515.88	-509.42	-501.47	-493.72	-485.57	-4,643.76
Peru	21.3%	12.4%	-394.35	-599.09	-645.87	-665.98	-672.01	-666.10	-659.29	-648.99	-639.30	-628.96	-6,219.95
Ireland	26.6%	8.2%	-411.02	-621.70	-678.93	-707.19	-704.55	-702.43	-698.65	-690.04	-681.59	-670.34	-6,566.45
Ecuador	9.4%	0.0%	-118.61	-183.24	-201.44	-207.36	-206.03	-210.99	-208.66	-210.37	-206.99	-203.57	-1,957.27
Thailand	13.1%	0.0%	-184.87	-250.19	-276.36	-280.63	-281.84	-288.53	-284.50	-282.85	-278.54	-275.47	-2,683.79
India	26.2%	0.0%	-333.20	-511.92	-594.28	-608.00	-611.13	-605.33	-599.97	-590.94	-581.64	-572.04	-5,608.46
Kiribati	37.5%	0.0%	-492.09	-704.54	-757.86	-807.40	-823.77	-819.30	-812.01	-799.88	-787.76	-774.83	-7,579.44
Bahrain	46.9%	0.0%	-637.23	-843.17	-927.12	-950.72	-957.25	-955.32	-947.28	-934.38	-921.53	-906.32	-8,980.34
Philippines	12.2%	0.0%	-167.97	-222.28	-262.46	-268.14	-270.74	-269.00	-265.42	-261.70	-257.49	-253.24	-2,498.43
Berkeley, USA	22.1%	0.0%	-286.07	-410.08	-467.68	-524.90	-532.96	-533.83	-527.74	-523.64	-516.67	-508.14	-4,831.71
Philadelphia, USA	33.2%	0.0%	-439.84	-640.34	-709.06	-723.32	-731.00	-727.15	-718.26	-707.56	-696.39	-684.90	-6,777.83
Boulder, USA	44.2%	0.0%	-616.08	-789.62	-884.11	-917.37	-926.03	-914.91	-907.65	-896.16	-883.85	-869.26	-8,605.04

Table I: Change in indirect costs per tax scheme in million USD

Country	Change in price (%)	Percentage of reformulation	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total
Mexico	6.3%	0.0%	-211.81	-278.61	-301.13	-305.64	-342.42	-347.17	-345.45	-347.53	-342.47	-336.82	-3159.04
United Kingdom	7.0%	8.2%	-464.16	-619.81	-670.89	-686.05	-705.29	-720.61	-715.22	-704.05	-693.59	-683.46	-6,663.12
South Africa	7.4%	15.0%	-613.77	-886.05	-1,010.39	-1,054.13	-1,078.61	-1,076.65	-1,064.75	-1,052.11	-1,038.11	-1,020.97	-9,895.54
Portugal	11.4%	8.2%	-552.26	-775.40	-912.07	-939.95	-980.17	-969.17	-961.41	-946.39	-931.18	-915.81	-8,883.81
Chile	14.6%	9.5%	-674.57	-965.36	-1,088.85	-1,176.40	-1,203.09	-1,232.76	-1,217.32	-1,198.31	-1,179.80	-1,160.32	-11,096.78
Peru	21.3%	12.4%	-942.35	-1,431.59	-1,543.38	-1,591.44	-1,605.85	-1,591.72	-1,575.44	-1,550.84	-1,527.69	-1,502.97	-14,863.25
Ireland	26.6%	8.2%	-982.17	-1,485.63	-1,622.38	-1,689.91	-1,683.61	-1,678.54	-1,669.50	-1,648.93	-1,628.73	-1,601.84	-15,691.25
Ecuador	9.4%	0.0%	-283.44	-437.88	-481.35	-495.52	-492.34	-504.18	-498.61	-502.71	-494.63	-486.46	-4,677.11
Thailand	13.1%	0.0%	-441.78	-597.86	-660.40	-670.60	-673.49	-689.47	-679.84	-675.90	-665.61	-658.26	-6,413.21
India	26.2%	0.0%	-796.22	-1,223.30	-1,420.11	-1,452.87	-1,460.37	-1,446.50	-1,433.69	-1,412.11	-1,389.90	-1,366.95	-13,402.02
Kiribati	37.5%	0.0%	-1,175.90	-1,683.58	-1,810.98	-1,929.38	-1,968.50	-1,957.82	-1,940.39	-1,911.41	-1,882.43	-1,851.53	-18,111.91
Bahrain	46.9%	0.0%	-1,522.74	-2,014.85	-2,215.46	-2,271.86	-2,287.45	-2,282.85	-2,263.62	-2,232.81	-2,202.11	-2,165.76	-21,459.51
Philippines	12.2%	0.0%	-401.37	-531.15	-627.17	-640.75	-646.97	-642.81	-634.25	-625.35	-615.30	-605.14	-5,970.28
Berkeley, USA	22.1%	0.0%	-683.59	-979.94	-1,117.57	-1,254.30	-1,273.58	-1,275.65	-1,261.09	-1,251.31	-1,234.63	-1,214.25	-11,545.91
Philadelphia, USA	33.2%	0.0%	-1,051.06	-1,530.17	-1,694.38	-1,728.46	-1,746.80	-1,737.61	-1,716.35	-1,690.80	-1,664.11	-1,636.64	-16,196.37
Boulder, USA	44.2%	0.0%	-1,472.19	-1,886.89	-2,112.67	-2,192.15	-2,212.84	-2,186.29	-2,168.94	-2,141.47	-2,112.06	-2,077.20	-20,562.69

8 Sensitivity analysis

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Table J: Tax effect on prices and consumption for sugar-sweetened beverages for the sugar taxes under three reformulation scenarios.

Country	Change in price (%)	Caloric change due to price change (%)	Caloric change due to reformulation (%)
Scenario where no reformulation occurs			
United Kingdom	8.7%	-9.8%	0.0%
South Africa	9.6%	-10.9%	0.0%
Portugal	13.2%	-15.0%	0.0%
Chile	16.5%	-18.7%	0.0%
Peru	23.2%	-26.3%	0.0%
Ireland	32.1%	-36.4%	0.0%
Scenario with predicted reformulation (Main scenario)			
United Kingdom	7.0%	-7.9%	-8.2%
South Africa	7.4%	-8.4%	-15.0%
Portugal	11.4%	-12.9%	-8.2%
Chile	14.6%	-16.5%	-9.4%
Peru	21.3%	-24.1%	-12.4%
Ireland	26.6%	-30.1%	-8.2%
Scenario where all SSB reformulate			
United Kingdom	1.7%	-2.0%	-42.3%
South Africa	0.9%	-1.0%	-59.9%
Portugal	6.9%	-7.8%	-42.3%
Chile	9.5%	-10.8%	-39.5%
Peru	16.2%	-18.3%	-50.5%
Ireland	6.4%	-7.3%	-42.3%

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Table K: Caloric, weight, and obesity change attributable to each tax scenario. Sensitivity scenarios for the sugar taxes under three reformulation scenarios

Country	Change in price (%)	Caloric change (kcal/day)	Weight change (kg)	Absolute change in obesity (pp)	Relative change in obesity (%)	Change in obesity cases (millions)
Scenario where no reformulation occurs						
United Kingdom	8.7%	-10.6 (-11 , -10.2)	-0.5 (-0.5 , -0.5)	-1.4 (-1.7 , -1.0)	-3.8 (-4.8 , -2.7)	-1.26 (-1.59 , -0.93)
South Africa	9.6%	-11.8 (-12.2 , -11.3)	-0.6 (-0.6 , -0.5)	-1.5 (-1.9 , -1.1)	-4.3 (-5.4 , -3.2)	-1.42 (-1.77 , -1.03)
Portugal	13.2%	-16.1 (-16.7 , -15.5)	-0.8 (-0.8 , -0.7)	-2.0 (-2.5 , -1.6)	-5.7 (-6.9 , -4.5)	-1.89 (-2.33 , -1.49)
Chile	16.5%	-20.1 (-20.9 , -19.4)	-1.0 (-1 , -0.9)	-2.6 (-3.1 , -2.1)	-7.3 (-8.6 , -5.9)	-2.42 (-2.89 , -1.96)
Peru	23.2%	-28.3 (-29.4 , -27.2)	-1.3 (-1.4 , -1.3)	-3.9 (-4.4 , -3.3)	-10.8 (-12.4 , -9.3)	-3.60 (-4.10 , -3.08)
Ireland	32.1%	-39.2 (-40.7 , -37.7)	-1.8 (-1.9 , -1.8)	-5.0 (-5.6 , -4.4)	-13.9 (-15.6 , -12.2)	-4.64 (-5.22 , -4.10)
Scenario with predicted reformulation (Main scenario)						
United Kingdom	7.0%	-16.6 (-17.3 , -16)	-0.8 (-0.8 , -0.8)	-2.1 (-2.5 , -1.7)	-5.9 (-7.1 , -4.7)	-1.97 (-2.33 , -1.59)
South Africa	7.4%	-23.8 (-24.8 , -22.9)	-1.1 (-1.2 , -1.1)	-3.1 (-3.7 , -2.6)	-8.8 (-10.2 , -7.4)	-2.94 (-3.45 , -2.42)
Portugal	11.4%	-21.6 (-22.4 , -20.8)	-1.0 (-1.1 , -1)	-2.8 (-3.3 , -2.3)	-7.9 (-9.3 , -6.5)	-2.63 (-3.08 , -2.14)
Chile	14.6%	-26.3 (-27.3 , -25.3)	-1.2 (-1.3 , -1.2)	-3.6 (-4.1 , -3.0)	-10.0 (-11.5 , -8.5)	-3.34 (-3.82 , -2.80)
Peru	21.3%	-36.1 (-37.5 , -34.8)	-1.7 (-1.8 , -1.6)	-4.6 (-5.2 , -4.0)	-13.0 (-14.6 , -11.3)	-4.32 (-4.85 , -3.73)
Ireland	26.6%	-38.6 (-40.1 , -37.2)	-1.8 (-1.9 , -1.8)	-4.9 (-5.6 , -4.3)	-13.8 (-15.5 , -12.1)	-4.61 (-5.22 , -4.01)
Scenario where all SSB reformulate						
United Kingdom	1.7%	-46.8 (-48.6 , -45)	-2.2 (-2.3 , -2.1)	-5.7 (-6.4 , -5.1)	-16.1 (-17.9 , -14.2)	-5.36 (-5.97 , -4.76)
South Africa	0.9%	-65.0 (-67.5 , -62.5)	-3.0 (-3.1 , -2.9)	-7.5 (-8.2 , -6.7)	-20.8 (-22.9 , -18.8)	-6.95 (-7.65 , -6.25)
Portugal	6.9%	-50.4 (-52.3 , -48.5)	-2.4 (-2.4 , -2.3)	-6.1 (-6.8 , -5.4)	-17.1 (-19 , -15.2)	-5.71 (-6.34 , -5.04)
Chile	9.5%	-49.6 (-51.5 , -47.7)	-2.3 (-2.4 , -2.2)	-5.9 (-6.6 , -5.3)	-16.6 (-18.5 , -14.8)	-5.55 (-6.15 , -4.94)
Peru	16.2%	-64.2 (-66.6 , -61.7)	-3.0 (-3.1 , -2.9)	-7.4 (-8.2 , -6.7)	-20.7 (-22.8 , -18.7)	-6.92 (-7.65 , -6.25)
Ireland	6.4%	-50.1 (-52 , -48.2)	-2.3 (-2.4 , -2.3)	-6.1 (-6.8 , -5.4)	-17.1 (-19 , -15.2)	-5.70 (-6.34 , -5.04)

Table L: The tax impact on revenue, employment, and direct and indirect obesity costs for the sugar taxes under three reformulation scenarios

Country	**Change in price (%)**	**Marginal decrease in consumption (million liters)**	**Lost jobs**	**Lost jobs ($ billion)**	**Decrease direct costs ($ billions)**	**Decrease indirect costs ($ billions)**	**Net benefits ($ billion)**
Scenario where no reformulation occurs							
United Kingdom	8.7%	71,493	164,523	$0.81	$1.74	$4.17	$5.10
South Africa	9.6%	70,621	182,990	$0.91	$1.92	$4.60	$5.62
Portugal	13.2%	67,372	251,821	$1.25	$2.58	$6.16	$7.50
Chile	16.5%	64,439	313,937	$1.55	$3.27	$7.81	$9.53
Peru	23.2%	58,415	441,526	$2.18	$4.84	$11.57	$14.23
Ireland	32.1%	50,410	611,086	$3.02	$6.33	$15.13	$18.44
Scenario with predicted reformulation (Main scenario)							
United Kingdom	7.0%	72,999	132,626	$0.66	$2.67	$6.37	$8.38
South Africa	7.4%	72,603	141,020	$0.70	$3.96	$9.45	$12.71
Portugal	11.4%	69,036	216,566	$1.07	$3.55	$8.49	$10.97
Chile	14.6%	66,183	277,003	$1.37	$4.44	$10.60	$13.66
Peru	21.3%	60,159	404,592	$2.00	$5.95	$14.21	$18.15
Ireland	26.6%	55,403	505,321	$2.50	$6.28	$15.00	$18.77
Scenario where all SSB reformulate							
United Kingdom	1.7%	77,675	33,576	$0.17	$7.34	$17.54	$24.71
South Africa	0.9%	78,468	16,788	$0.08	$9.53	$22.78	$32.23
Portugal	6.9%	73,078	130,947	$0.65	$7.80	$18.63	$25.78
Chile	9.5%	70,700	181,311	$0.90	$7.65	$18.27	$25.02
Peru	16.2%	64,756	307,222	$1.52	$9.45	$22.58	$30.51
Ireland	6.4%	73,475	122,553	$0.61	$7.75	$18.51	$25.65

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