

## **Labels, taxes, and food reformulation: A tale of sugar in carbonated soft drinks in Ecuador**

### **RESEARCH ARTICLE**

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### **Abstract**

The prevalence of obesity has increased significantly worldwide, including in low- and middle-income countries. In Ecuador, a middle-income country, the government has implemented two policies to improve the quality of its population's diet: (1) a traffic-light (TL) nutritional labeling requirement for processed foods and (2) a special tax scheme for drinks with a high sugar content (HSC). This study examines changes in carbonated soft drink (CSD) sugar formulation and its associated impacts on sugar consumption after the implementation of these two policies. Sugar content in soft drinks was obtained from the National Agency for Health Regulation, Control, and Surveillance (ARCSA) and directly from the labels of carbonated soft drinks sold in the country. CSD monthly purchase data from January 2013 to December 2019 were obtained from the Kantar World Panel (Ecuador). Mixed reactions followed the introduction of the TL in the sugar content reformulation of CSD. In contrast, the implementation of the HSC tax scheme was followed by extensive efforts to reformulate CSD as all brands studied decreased their sugar content. We also found evidence that CSD consumption reduced significantly after the HSC tax scheme was imposed. Overall, sugar consumption linked to CSD decreased after the implementation of these two policies. Still, most of this decrease is related to reformulation activities observed after the HSC tax scheme was implemented.

**Keywords:** food reformulation, labels, soft drinks, sugar, taxes

**JEL classification codes:** D12, H31, H32, I12, L66, Q18

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# 1. Introduction

Low physical activity, combined with a diet high in calories, generally leads to obesity problems associated with other chronic diseases, including diabetes and cardiovascular complications (Sandoval *et al.*, 2019; WHO, 2016). Therefore, improving the quality of the food intake in the general population is a key policy objective for governments.

Carbonated soft drinks (CSD) contribute to a diet high in calories since the majority of these products have high sugar content (CDC, 2023). This characteristic of CSD and other processed foods has resulted in the implementation of various policies worldwide to reduce their consumption. One approach is the use of supplementary nutritional labels on CSD and all processed food products to help consumers assess dietary information about these products (WHO, 2022a). Another option is implementing excise taxes per liter on the price of high sugar CSD.

How labeling policies affect the consumption of CSD and other sugar-sweetened beverages via changes in consumers' preferences is still under investigation, as research findings are inconclusive regarding the policies' effectiveness, especially in the long term (Kunz *et al.*, 2020; Melo *et al.*, 2023). Similarly, there is a lack of studies surrounding the effect of taxes via price changes on consumer behavior and health outcomes (e.g. obesity prevalence; Melo *et al.*, 2023; Nava and Dong, 2022).

A less explored consequence of the abovementioned policies relates to producers' strategic responses to food reformulations. These reformulations involve altering the processing or composition of a food or beverage product to improve its nutritional profile or reduce its content of ingredients or nutrients of concern (WHO, 2022b). In the case of CSD, food reformulation relates to reducing their sugar contents, thus helping consumers shift to healthier consumption patterns.

This study examines CSD reformulation and its associated impacts on sugar consumption after implementing nutritional labeling and tax policies in Ecuador, a middle-income country with significant obesity problems (Freire *et al.*, 2014). The Ecuadorian government has implemented two policies affecting the soft drink industry during the past decade: (1) a supplementary nutritional labeling requirement and (2) a special excise tax scheme for drinks with high sugar content (HSC), in addition to the value-added tax. The labeling policy requires using a traffic-light (TL) supplementary nutritional labeling system on the packages of all processed food products (MSP, 2013). The tax scheme on drinks with a high sugar content (HSC) requires the payment of a 10% ad-valorem tax for all soft drinks and an additional charge (US\$0.18/100 g sugar) if they exceed 25 g sugar/l beverage (Presidencia del Ecuador, 2016; USDA Foreign Agricultural Service, 2018).

We focused our analysis on the top seven brands of CSD sold in the country, as they account for more than 85% of the total local CSD market. Our specific objectives are threefold: (i) to study reformulation activities related to sugar used in CSD after the implementation of the labeling and tax policies, (ii) to analyze changes in the consumption of the top seven brands of CSD sold in the country and their relation to the labeling and tax policies, and (iii) to estimate the aggregated changes in sugar consumption associated with changes in CSD formulation and changes in CSD consumption.

Previous studies that have analyzed the associated effects of the use of TL labeling in Ecuador include Freire *et al.* (2017) and Sandoval *et al.* (2019). These studies found evidence that TL label use does not influence consumers' purchasing decisions, although it can influence food choices in more controlled environments (Sarasty *et al.*, 2023). In addition, Peñaherrera *et al.* (2018) found mixed results regarding reformulation activities. Out of the top seven brands of soft drinks, four reduced their sugar content, while three increased their sugar content. To the best of our knowledge, no previous studies have investigated reformulation activities and consumer purchasing decisions of soft drinks in Ecuador after the HSC tax scheme was put into effect. We aim to fill this gap in the literature by presenting an analysis of the reformulation activities

of food manufacturers and consumers' purchasing decisions during three periods: (i) before the introduction of the TL label system, (ii) after TL but before the introduction of the HSC tax scheme, and (iii) after the introduction of the HSC tax scheme.

Our work complements Peñaherrera *et al.* (2018) and Sandoval *et al.* (2019), who did not cover the reformulation and consumer responses associated with the HSC tax scheme. Moreover, due to the unique nature of the timing in implementing the TL and HSC tax policies in Ecuador, our data covering a more extended period allow us to compare the observed changes after the implementation of both policies. Results of this study can be helpful for other countries worldwide that are seeking to improve the diet quality in their populations and are considering the implementation of nutritional labeling and tax policies.

## 2. Background

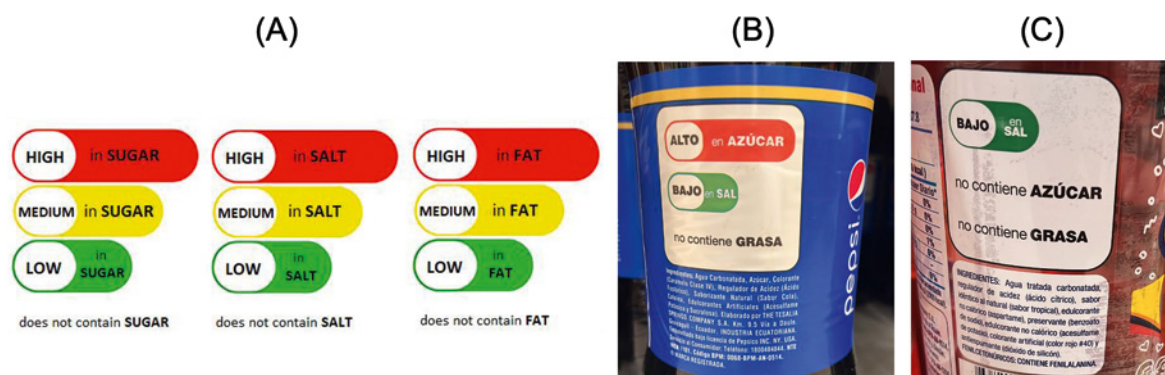
The prevalence of obesity has increased significantly for decades in low- and middle-income countries (LMIC) and high-income countries (Hajri, 2021). For example, in Ecuador, from 2000 to 2019, obesity rates have been estimated to have increased from 41.8% to 54.6% and 50.8% to 60.7% among male and female adults, respectively. Similarly, obesity rates during the same period increased from 16.5% to 29.7% and 20.5% to 31.0% among male and female children and adolescents, respectively (INEC, 2018; The Global Nutrition Report, 2022).

Traditional Ecuadorian diets typically include an intake of refined carbohydrates and saturated fats above international recommendations, with large sectors of the population reporting a high consumption of sugary beverages or carbonated soft drinks (Sandoval *et al.*, 2019). The USDA Foreign Agricultural Service estimated the total domestic table sugar consumption in Ecuador in 2013–2014 at 599 000 metric tons (MT), corresponding to an approximate per capita consumption of 38 kg per person per year (USDA Foreign Agricultural Service, 2015). However, the World Health Organization (WHO) strongly recommends that the intake of free sugars be less than 10% of total energy intake or about 50 g per day or 18.5 kg per year (WHO, 2015). Thus, Ecuador's per capita table sugar consumption in 2013/2014 was more than double the WHO's recommended amount of free sugars. In addition, since free sugars include fructose and table sugar added to foods and drinks and sugar that is naturally present in some foods (e.g. honey and fruit juices), the amount of free sugar consumption in the country was higher than the estimated table sugar consumption (WHO, 2015).

Two main policies have affected the domestic consumption of sugar in Ecuador in the past few years. The first policy, implemented on 29 November 2014, mandated the use of a TL nutritional label for all processed food products and beverages sold in the country (MSP, 2013). The label highlights a TL panel for the product content of sugar, fat, and salt, and classifies processed food as having a low (green), medium (yellow), or high (red) content of those ingredients. The use of this label seeks to reduce the consumption of foods high in sugar, fat, and sodium that are related to cases of obesity, overweight, and hypertension (Peñaherrera *et al.*, 2018). The TL nutritional label is a type of supplementary interpretative nutritional label. Interpretative nutritional labels show figures, symbols, or cautionary text to inform about a food product's nutrient content or healthfulness, including TL labels, Nutri-Score labels, warning labels, and health star ratings (Song *et al.*, 2021).

Figure 1 illustrates the use of this label. Figure 1A shows all the potential options of TL colors and text for sugar, fat, and salt. Figure 1B and C illustrate actual labels of soft drinks in Ecuador. Figure 1B displays a drink with high (*alto*) sugar (*azucar*), low (*bajo*) salt (*sal*), and no fat (*grasa*), while Figure 1C displays a drink with low salt, no sugar, and no fat.

The second policy, approved on 26 April 2016, relates to the Organic Law to Balance Public Finances that established a tax scheme for drinks with a high sugar content (HSC) (Presidencia del Ecuador, 2016). The



**Figure 1.** Traffic light nutritional labels in Ecuador. Source: Sarasty *et al.* (2023) and authors' elaboration.

tax scheme consists of (i) a 10% ad valorem tax for soft drinks and energy drinks with a sugar content of less than or equal to 25 g/l beverage and (ii) an additional charge of US\$0.18/100 g sugar for non-alcoholic drinks and soft drinks with a sugar content greater than 25 grams per liter of beverage, except for energy drinks; thus, the tax is both based on the price and sugar content. The tax is in addition to the value-added tax. Other governments use different soda tax schemes, including special value-added tax rates and per-unit soda taxes based on volume and not sugar content (Obesity Evidence Hub, 2023; Urban Institute, 2023).

### 3. Data and Methods

Data for this study were obtained from three sources. Data on soft drink purchases were obtained from the international market research company Kantar World Panel. Data on drinks' nutritional content were obtained from the National Agency for Health Regulation, Control, and Surveillance (ARCSA). Finally, the research team collected some of the nutritional content data directly from soft drink labels sold in the country.

Kantar World Panel's database includes monthly volume and price data from January 2013 to December 2019. The company collects data from a panel of 1646 Ecuadorian households and aims to represent the majority of the country's population of shoppers in terms of geographical distribution and socioeconomic level (S. Acosta, Officer at Kantar World Panel, pers. commun., 2016). Kantar World Panel's personnel visit panel households weekly and record their purchases (product brands and volumes) using the bar code scan method. The person in charge of household purchases is also asked to keep receipts or diaries for price data.

Using the collected data, Kantar estimates monthly aggregated data for the total consumption of soft drinks for three socioeconomic status groups: high and middle-high (7%), middle (27%), and low and very-low groups (66%). The classification is based on households' capacity to satisfy their basic needs. The high and middle-high groups include households that can meet their basic needs and afford some luxuries. The middle-class group comprises households that can completely meet all their basic needs. The low and very-low socioeconomic status group includes households that have difficulty satisfying or cannot satisfy their basic needs (Sandoval *et al.*, 2019; S. Acosta, Officer at Kantar World Panel, pers. commun., 2016).

The deadline for all companies adopting TL was November 2014, and data from January 2013 to November 2014 were considered the period before the label's introduction. The HSC tax policy came into effect on April 2016, thus, the period after November 2014 and before April 2016 was considered the period post-TL implementation and pre-HSC tax. Finally, the period after 2016 was analyzed as the post-HSC tax and TL period.

Kantar's World Panel contains purchase information of about nine drink companies and 23 different brands: Coca Cola Company (Coca Cola, Coca Cola Zero, Coca Cola Light, Coca Cola Lift, Fanta, Fioravanti, Sprint, Sprint Zero, Inca Kola and Inca Kola Zero); Pepsi Company (Pepsi, 7up, Kola Gallito and Mas);

Ajcuador Company (Big Cola, Oro, Tropical and Manzana); The Tesalia Sprints (Quintuples); Orangine S.A. (Orangine); Resgasa (Fox Kola); Pacific Bottling Company (Barrilitos O-Key); Fruit Del Ecuador (Fruit); and other manufacturers (others).

ARCSA provided a database on soft drinks' sugar content before and after the introduction of the TL labels, but before the implementation of the HSC tax policy. This nutritional content data were collected by ARCSA from drink companies' applications to obtain health authorization to commercialize the products in the country (columns 2 and 3 in Table 2). A license is needed for products processed in Ecuador or imported from other countries.

Finally, the researchers collected product formulation data from the drinks' nutrient declaration labels after the HSC policy went into effect. Researchers took photographs of each drink's product brand, nutrition declaration, and TL label. The formulation data were subsequently entered into Excel.

The analyses in this study only focuses on the top seven brands of CSD as data on the formulation for other brands were not available for all the periods, especially before the HSC tax (see Table A1 in the Appendix). One brand (Fox Cola) was not found in the market for direct data collection and was excluded from the analyses. The analyses also excluded soft drinks with zero (Coca Cola Zero, Sprite Zero, and Barrillitos O-key) or very low levels of sugar (Coca Cola Light had 0.2 g/100 ml sugar before the TL label policy). The market share for all these drinks was below 1% throughout the study period.

Data analysis included calculating summary statistics of CSD consumption and nutritional content. Graphical trend analyses were used for consumption and price data. Student's *t*-tests for differences in CSD mean consumption across the three analysis periods (pre-TL label versus post label/pre tax periods, and post label/pre tax versus post tax periods). Finally, a counterfactual analysis was used to assess the relative importance of changes in CSD nutritional content (reformulation) versus CSD consumption changes on the overall sugar intake linked to CSD (see details below in Section 4.3).

## 4. Main Results

In this section, we present the results from our data analyses. First, in Table 1 we report the changes in sugar content of soft drinks associated with the introduction of the two policies we investigated: a nutritional labeling requirement and a special tax for drinks with high sugar content. Second, in Table 2 and Figures 2 and 3, we present the associated changes induced by these policies on prices and consumption levels by socioeconomic groups and brands of CSD.

### 4.1 Food reformulations in soft drinks

We documented the content of sugar (grams/liter) of the top seven brands of soft drinks in Ecuador in terms of consumption—Coca-Cola, Fanta, Fioravanti, Sprite, Pepsi, Big Cola and Tropical (see Table 1). As documented in Peñaherrera *et al.* (2018), after the implementation of the TL labeling, only four of the top seven brands of soft drinks reduced their sugar content (Fioravanti, Sprite, Pepsi, and Tropical), while three increased their sugar content (Coca Cola, Fanta, and Big Cola). On average, the sugar content among the top seven brands of soft drinks was reduced from 106.90 g/l to 99.31 g/l. Accounting for only the top seven brands of CSD, we estimate a corresponding reduction in the domestic consumption of sugar from CSD of about 332 MT after the introduction of the TL label system (see Table A2 in the Appendix). This sugar consumption reduction is driven by manufacturers' reformulation activities and a decrease in CSD's general consumption. Before the implementation of TL, total consumption of CSD was around 26.75 million liters. After the implementation of the TL label, consumption of CSD was reduced to 25.64 million liters (see Table 2).

**Table 1.** Changes in sugar content in soft drinks

Brand	Sugar content (g/l)		
	Before TL (before 29 November 2014)	After TL but before HSC tax scheme (between 29 November 2014 and 26 April 2016)	After HSC tax scheme (after 26 April 2016)
Coca Cola	104.80	106.80	75.00
Fanta	124.50	138.10	50.00
Fioravanti	106.00	75.00	50.00
Sprite	100.00	75.00	0.00
Pepsi	119.00	107.00	80.10
Big Cola	94.00	102.30	25.00
Tropical	100.00	91.00	0.00
Average	106.90	99.31	40.01

TL, traffic-light nutritional labeling system; HSC, tax scheme on drinks with a high-sugar content.

Sources: Agencia Nacional de Regulación, Control y Vigilancia Sanitaria (ARCSA), and the authors.

**Table 2.** Mean consumption of soft drinks by socioeconomic status group and brand ( $\times 10^6$  liter)

	Before TL (before 29 November 2014)	After TL but before HSC tax scheme (between 29 November 2014 and 26 April 2016)	After HSC tax scheme (after 26 April 2016)	P value 1	P value 2
Socioeconomic status group					
High and Middle-High	1.65	1.61	1.40	0.478	0.000
Middle	7.75	7.40	6.00	0.107	0.000
Low and Very-Low	17.35	16.62	12.83	0.101	0.000
All	26.75	25.64	20.23	0.097	0.000
Brands					
Coca Cola	15.51	13.38	11.70	0.000	0.000
Fanta	0.86	0.85	0.43	0.804	0.000
Fioravanti	1.74	1.79	0.94	0.548	0.000
Sprite	2.21	1.83	0.98	0.000	0.000
Pepsi	1.09	1.08	0.76	0.923	0.000
Big Cola	1.81	1.77	1.71	0.520	0.587
Tropical	0.99	0.98	0.73	0.836	0.001

TL, traffic-light nutritional labeling system; HSC, tax scheme on drinks with a high sugar content. *P* value 1 refers to the test of equality of outcomes between the period Before TL and the period After TL but before HSC tax scheme. *P* value 2 refers to the test of equality of outcomes between the period After TL but before HSC tax scheme and the period After HSC tax scheme.

Source: Authors' elaboration with data from Kantar World Panel (2020).

More interestingly, after the HSC tax scheme, all the top seven brands significantly decreased the sugar content in the drinks. Two brands (Sprite and Tropical) completely eliminated the sugar content (see Table 1). On average, the sugar content among the top seven brands of soft drinks was reduced from 99.31 g/l to 40.01 g/l. We estimate a further reduction in the domestic consumption of sugar from CSD of about 1155 MT after the introduction of the HSC tax scheme (see Table A2 in the Appendix). Again, this reduction in sugar consumption was driven by manufacturers' reformulation activities, which, in this case, were significantly more extensive than those observed after the implementation of the TL system. This reduction is also driven

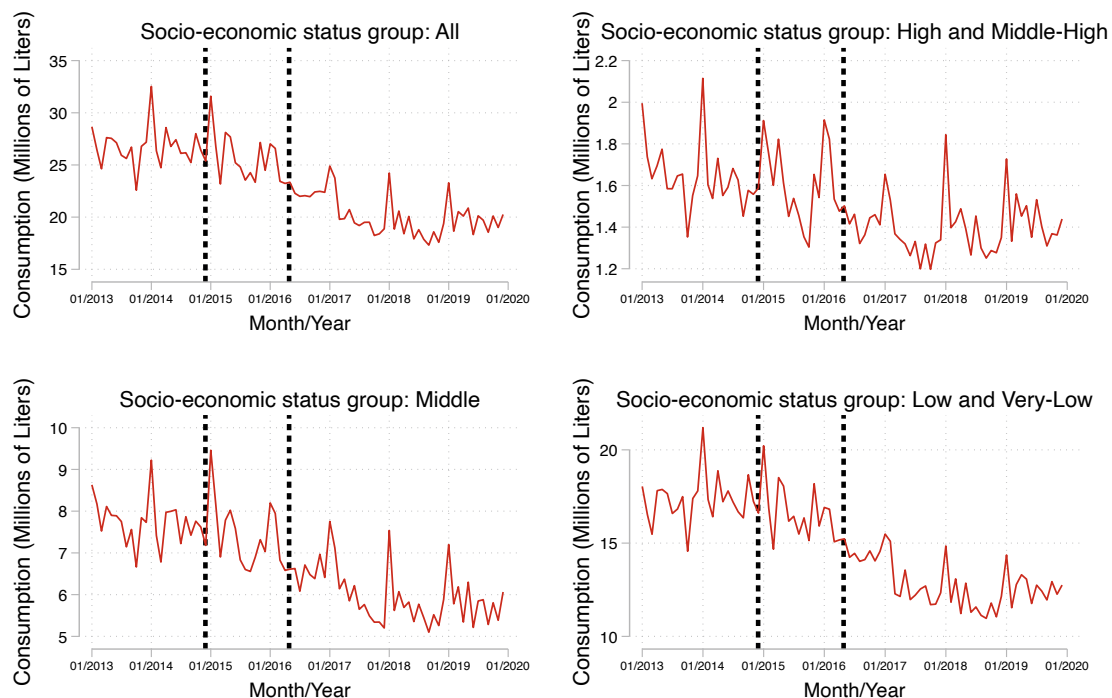
by a further decrease in the general consumption of CSD. Before the introduction of the HSC tax scheme, the total consumption of CSD was around 25.64 million liters, while after the implementation of the HSC tax scheme, consumption of CSD was reduced to 20.23 million liters (see Table 2).

#### 4.2 Changes in consumption and prices of soft drinks

In Figure 2 we illustrate the evolution of CSD consumption from 2013 to 2019. We highlight the introduction of the TL label and HSC tax policies with vertical dotted lines. Total national CSD consumption, as well as consumption in each of the socioeconomic status groups, shows a decreasing trend over time. However, t-tests show that mean differences across periods are only significant after the introduction of the HSC tax scheme (see Table 2). This suggests that, at least initially, the introduction of the TL label was not associated with a change in the consumption of CSD at the aggregate level. Significant reductions in the consumption of CSD were only observed after the introduction of the HSC tax scheme.

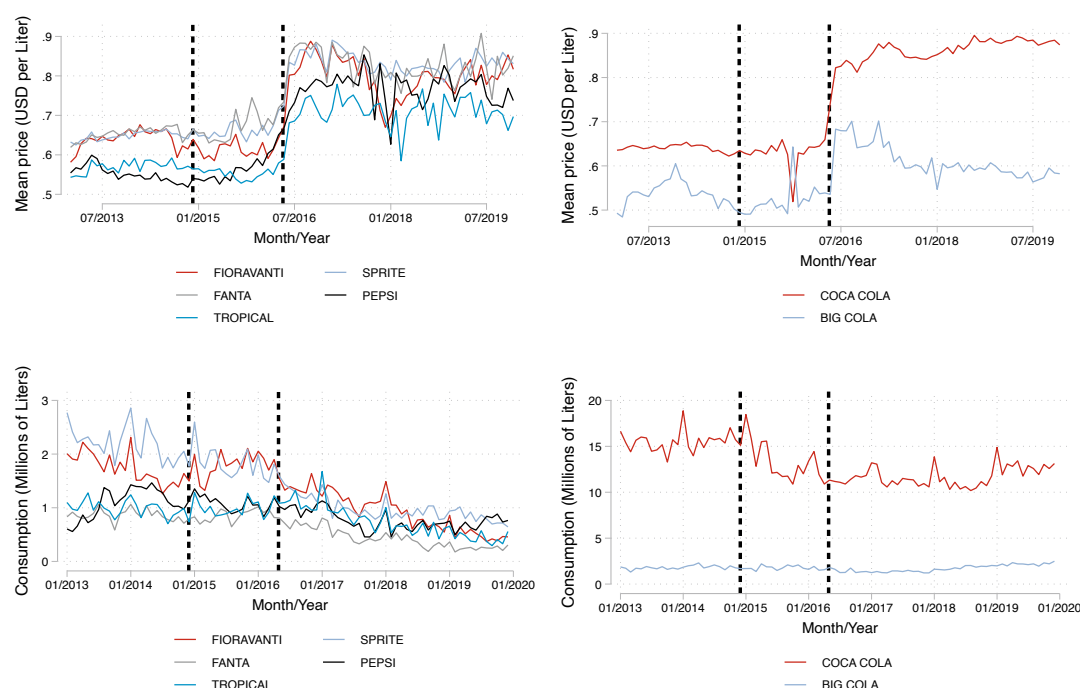
In relative terms, the reduction of CSD consumption after the introduction of the HSC tax scheme was highest among the low and very-low socioeconomic group. Reductions were 13%, 19%, and 23% across the high and middle-high, middle, and low and very-low socioeconomic groups, respectively. Budget constraints and price effects are likely to be the plausible mechanisms behind the impact of the HSC tax being the highest in the low and very-low socioeconomic group. Given more than half of the CSD consumption is driven by the low and very-low socioeconomic status group, this highlights the importance of targeting these groups when developing policies to reduce sugar intake associated with CSD consumption.

The evolution of prices and the consumption of the top seven CSD brands in Ecuador during 2013–2019 are presented in Figure 3. Again, we highlight the introduction of the TL label and HSC tax policies with



**Figure 2.** Soft drink consumption by socioeconomic group. The first dotted line corresponds to the introduction of the TL label, and the second corresponds to the high sugar content tax. Source: Authors' elaboration with data from Kantar World Panel (2020).





**Figure 3.** Soft drinks: mean prices and consumption by brand. The first dotted line corresponds to the introduction of the TL label, and the second corresponds to the high sugar content tax. Source: Authors' elaboration with data from Kantar World Panel (2020).

vertical dotted lines. A visual assessment shows no significant changes in prices after the introduction of the TL labels; however, there is a clear price surge in all brands after the introduction of the HSC tax scheme. Interestingly, none of the CSD brands analyzed in this paper pay the additional charge of US\$0.18/100 g sugar per liter of beverage. This is due to all of them reformulating their sugar content and having less than the limit (100 g/l) in their content after introducing the HSC tax scheme (see Table 1). Reports have documented that food and beverage manufacturers have increasingly replaced sugar with low-calorie substitutes and other sweeteners (stevia, aspartame, saccharin) as CSD ingredients (USDA Foreign Agricultural Service, 2018).

As expected, the visual assessment also shows no significant changes in consumption for most CSD brands only after introducing the TL labels; however, Coca-Cola and Sprite did experience statistically significant drops associated with this policy (see Table 2). The TL labels are associated with a 14% and 17% decrease in the consumption of Coca-Cola and Sprite levels, respectively. Before the introduction of the TL labels, Coca-Cola and Sprite were the top two brands in terms of market share of CSD, with 57.98% and 8.27%, respectively, followed by Big Cola with a share of 6.78% (see Table A3 in the Appendix).

Significant consumption reductions for most brands occurred after the HSC tax scheme (see Table 2). Estimated reductions in consumption levels associated with the HSC tax varied from 13% for Coca-Cola to 49% for Fanta. Interestingly, Big Cola did not experience a significant change in consumption levels after the HSC tax introduction and ended up climbing to second place in terms of market share with 8.47%, ahead of Sprite with 4.84% of market share (see Table A3 in the Appendix). As shown in Figure 3, pricing has been one of Big Cola strategies to gain market share. Its price has consistently been below the price of most important CSD brands in the country and has even decreased in relative terms compared to, for example, Coca Cola the leading brand in the country.



### 4.3 Counterfactual analysis: sugar intake linked to soft drinks consumption

We investigate the decrease in sugar intake from carbonated soft drinks (CSD) through two counterfactual scenarios: one focusing on reformulation efforts and the other on declining CSD consumption. Scenario one examines changes in sugar intake if no reformulation occurred while considering the observed decline in CSD consumption. Conversely, scenario two assesses the changes in sugar intake if reformulation occurred but CSD consumption remained constant. For both scenarios we calculated the total amount of sugar intake from consumption of the top seven brands of CSD sold in the country. We estimate total sugar intake (metrics tons) by multiplying the sugar content in each brand of CSD by its respective total consumption.

In table 3 we report the results of scenario one. As this scenario assumes no reformulation efforts, we hold constant the sugar content in CSD using the levels before introduction of the TL labels (column 2 in Table 1). Accounting for the observed changes in consumption, we estimate the total sugar intake before introduction of the TL labels and after the introduction of the HSC tax scheme and subsequently compare these estimates. Results show a reduction in the domestic consumption of sugar from CSD of about 736 MT.

In Table 4 we report the results of scenario two. This scenario assumes no changes in CSD consumption, thus we hold constant the consumption in each brand using the levels before introduction of the TL labels (column 2 of Brands in Table 2). Accounting for the observed reformulation efforts, we estimate the total sugar intake before introduction of the TL labels and after the introduction of the HSC tax scheme and subsequently compare these estimates. Results show a reduction in the domestic consumption of sugar from CSD of about 1112 MT. These counterfactual analyses suggests that reformulation activities were more effective in decreasing domestic consumption of sugar from CSD than the reduction in CSD consumption.

## 5. Discussion

The need to reduce or eliminate the costs to society imposed by unhealthy dietary patterns is driving initiatives around the globe to help food systems deliver healthier diets for the general population. To this end, lowering the levels of saturated fats, sugars, and salt/sodium in food is a popular target among policymakers. However, achieving this target requires the implementation of a coherent portfolios of policies, investments, and legislation that prioritize health (WHO, 2022a).

A growing number of countries are applying taxation and/or nutrition labeling policies to help to drive reformulation efforts that reduce sugar intake from food and beverage consumption. This paper documents CSD product formulation and consumption changes after the above policies were implemented in Ecuador.

**Table 3.** Counterfactual scenario 1: Reformulation activities did not occur, while CSD consumption changed

Brand	Sugar content (g/l, fixed)	Total consumption of sugar from CSD (MT)		
		Before TL	After HSC	Net change
Coca Cola	104.80	1625.13	1226.54	398.58
Fanta	124.50	107.48	53.75	53.72
Fioravanti	106.00	184.57	99.27	85.30
Sprite	100.00	221.24	97.88	123.37
Pepsi	119.00	129.63	90.67	38.96
Big Cola	94.00	170.36	161.08	9.28
Tropical	100.00	99.49	73.02	26.47
Total		2537.89	1802.21	735.68

TL, traffic-light nutritional labeling system; HSC, tax scheme on drinks with a high-sugar content. We estimated total sugar intake by multiplying the sugar content in each brand of CSD by its respective total consumption reported in Table 2.

**Table 4.** Counterfactual scenario 2: Reformulation activities occurred, while CSD consumption did not change

Brand	CSD consumption ( $\times 10^6$ liters, fixed)	Total consumption of sugar from CSD (MT)		
		Before TL	After HSC	Net Change
Coca Cola	15.51	1625.13	1163.02	462.11
Fanta	0.86	107.48	43.16	64.31
Fioravanti	1.74	184.57	87.06	97.51
Sprite	2.21	221.24	0	221.24
Pepsi	1.09	129.63	87.25	42.37
Big Cola	1.81	170.36	45.31	125.05
Tropical	0.99	99.49	0	99.49
Total		2537.89	1425.80	1112.09

TL, traffic-light nutritional labeling system; HSC, tax scheme on drinks with a high-sugar content. We estimated total sugar intake by multiplying the total consumption of each brand of CSD by its respective sugar content reported in Table 1.

Both policies were implemented in the past decade, with the nutrition labeling policy being implemented in 2014 and the tax policy in 2016. In line with the previous findings in the literature focusing in Ecuador (Peñaherrera *et al.*, 2018), we also found that the introduction of the labeling policy was initially followed by mixed reactions regarding sugar content reformulation of soft drinks (some brands increased the sugar content, and others decreased it), with an overall slight reduction in the sugar content. Possibly companies were uncertain about the final impact of the TL label on product demand and, in some cases, expected that an increase in sugar content with its effect on taste could counteract the presence of red labels.

Ganderats-Fuentes and Morgan (2023) provide a systematic review of the effect of nutrition labeling on food industry practices on reformulation. The review documents experiences from three countries where labeling was mandatory (Ecuador, Chile, and Iran). Most studies from Chile, focusing on the effect of a nutritional warning label introduced in 2016 on reformulation, report reductions of sugar content in products of 12% or less. This seems consistent with our finding of a relatively small reduction in sugar content (7.1%) in the CSD included in this study with the TL labeling system. The review of Ganderats-Fuentes and Morgan (2023) also includes examples from countries where supplementary labels were optional (Australia, United Kingdom, The Netherlands, New Zealand), however, comparisons are more difficult since uptake is voluntary and very few studies focused on CSD specifically. Nonetheless, most of these studies report reduced sodium and sugar content.

We also document a large reduction in CSD sugar content after introducing the tax policy in Ecuador (59.8% reduction immediately after their introduction). Recent evidence suggests that the introduction of a soft drink industry tax in the United Kingdom also incentivized food manufacturers to reduce soft drinks' sugar content by 38% (Scarborough *et al.*, 2020). Significant reductions in the total sugar content of sugary beverages have also been reported in Chile after the introduction of both a tax in 2014 and a warning labeling policy in 2016 (64%). As the sugar content reduction of food products not affected by the sugary beverages tax in Chile was smaller, this suggests that the tax had a higher impact in reducing the sugar content in sugary beverages. Thus, larger reductions in sugar content have been observed after introducing tax policies.

Another study finding is related to changes in CDS consumption after implementing the policies. Aggregate purchase levels of CSD did not change significantly after introducing the labeling policy (about 4.15% reduction) but accelerated after the HSC tax was implemented (about 21% reduction). We also estimated a slight decrease in the domestic consumption of sugar from CSD after implementing the labeling policy but a more considerable decline in the consumption of sugar from CSD after introducing the HSC tax scheme on soft drinks.

The recent review by Melo *et al.* (2023) summarizes research on the Latin American region evaluating the impact of tax and labeling policies on the purchases of targeted foods. Two studies cited in the review assessed the effect of labeling policies on food purchases. Sandoval *et al.* (2019) did not find evidence that the Ecuadorian TL labeling policy affected CSDs purchases one year after its implementation. On the other hand, a study from Chile reported a 23.7% reduction in sugar-sweetened beverages purchases 1.5 years after implementing a front-of-package warning nutritional labeling system. A limitation of this study is that the Chilean law also included marketing and sales restrictions, so the observed reduction may not have been only due to the introduction of the warning label. Additionally, some research suggests nutritional warning labels are more effective at reducing the purchase of unhealthy food products than nutritional TL labels (Song *et al.*, 2021).

Melo *et al.*'s (2013) review identified two studies from the Latin American region assessing the effect of taxes on sugar-sweetened beverages (SSBs) purchases one year after the policy came into effect. A study from Chile reported a slight reduction in purchases of these beverages one year after implementing a tax scheme on SSBs (3.4% reduction by volume; Caro *et al.*, 2018). The scheme created an 8 percent point spread in ad valorem taxes between high and low sugar SSB. A study in Mexico reported an estimated 6.3% reduction in the purchases of SSBs after putting in place an excise tax of one Mexican peso per liter (about a 10% price increase) (Colchero *et al.*, 2017). Thus, the reduction in purchases of CSD observed in Ecuador is larger than in other countries in the region, likely due to the larger impact of the tax policy on prices (see Figure 3).

Our results about the overall decrease in the total amount of sugar consumed from CSD, are consistent with the reported reduction in total sugar consumption in Ecuador by the USDA Foreign Agricultural Service (various reports) from 2013 to 2019 (see Table A4 in the Appendix). According to these reports, total sugar consumption in Ecuador decreased about 0.6% during that period. Moreover, as the country's population has been increasing by 1.7% per year, the per capita average annual reduction in sugar consumption is higher (about 2.3%). It is also interesting to note that the USDA Foreign Agricultural Service's data also show an acceleration in the reduction of sugar consumption starting in 2016 when the HSC tax was imposed.

The study has several limitations. First, given the data limitations, the study is descriptive, and we avoid making causal claims about the effects of the policies on reformulation and associated sugar consumption. Future work could consider including neighboring countries as "controls" and other research designs (e.g. difference-in-differences and synthetic control designs). Second, the staggered nature of the TL labeling and tax policies implementation makes it challenging to disentangle the separate effects of the policies. Third, the study only includes CSD consumed at home. Future studies should consider including other food products with high sugar content (e.g. other sugar-sweetened beverages and snacks) consumed at home and away from home to account for the potential substitution of CSD for other sweetened foods. Finally, the study only focuses on sugar content reformulation in CSD. Analyses can be expanded to include salt and fat content reformulations in different food product categories.

## 6. Summary and Conclusions

Aiming to improve the quality of its population's diet, the Ecuadorian government has implemented two policies: (1) a TL supplementary nutritional labeling requirement for processed foods, and (2) a special tax scheme for drinks with high sugar content. This study examines changes in CSD formulation and its associated impacts on sugar consumption after the government implemented these policies. We used monthly aggregated purchase data (total expenditures, quantities, and average prices) of carbonated soft drinks from January 2013 to December 2019 and sugar contents in soft drinks to achieve our objectives.

We found that the introduction of the TL system initially caused mixed reactions regarding the sugar content reformulation of soft drinks (some brands reduced it, and others increased it); however, the subsequent introduction of the HSC tax scheme was followed by extensive efforts to reformulate CSD and reduce their

sugar content. After the HSC tax scheme's introduction, brands decreased the sugar content in their drinks and, in some cases, they eliminated it. Analyses also show that overall consumption of soft drinks has decreased during the past decade across all socioeconomic status groups. After the introduction of the TL policy, consumption tended to follow the same long-term downward trend or remained stable across most brands. In contrast, after the HSC tax scheme's approval, there was a significant reduction in consumption for most brands.

Overall, the evidence presented here suggests that supplementary labeling and taxes on CSD can nudge food companies to reformulate their products. Changes in CSD formulation can result in a significant reduction in sugar consumption by the population. Evidence also suggests that CSD taxes are more effective than nutritional labels at reducing sugar consumption, as most of the industry reformulation efforts in Ecuador happened after the introduction of taxes; however, the available data does not allow us to disentangle the effects of each policy. In general, the combined and associated effects of these policies in Ecuador are positive from a social planner's point of view, as overall sugar consumption linked to soft drinks has decreased. A simple counterfactual analysis highlights that reformulation activities can be more effective in decreasing domestic consumption of sugar from CSD than other activities focused on cutting CSD consumption.

Although most of the analyses of obesity-related policies focus on outcomes on the population, these policies also affect the food industry. While there was initial opposition from the Ecuadorian food industry to these policies (e.g. Diaz *et al.*, 2017), it seems that the industry eventually made substantial adjustments, evident in the new CSD product formulations now present in the country's market. More industry efforts and investments in research and development are likely needed to make the industry proactive rather than reactive to policy and context changes (e.g. consumer preferences). The industry should also dialogue and collaborate with policymakers, public health advocates, and consumer groups to develop effective policies and promote mutual understanding.

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## Appendix

**Table A1.** Sugar contents of soft drinks in Kantar's dataset (in g/l)

Brand	Before TL (before 29 November 2014)	After TL but before the HSC tax scheme (between 29 November 2014 and 26 April 2016)	After HSC tax scheme (after 26 April 2016)
1. Coca-Cola Regular	104.8	106.8	104.2
2. Fanta	124.5	138.1	75.0
3. Fioravanti Fresa/Manzana*	105.3	75.0	37.5
4. Sprite Regular	100.6	88.5	0.0
5. Inca Cola	77.4	0.0	0.0
6. Pepsi Regular	113.5	107.0	108.3
7. 7Up	NA	108.0	0.0
8. Mas Manzana	NA	NA	66.7
9. Kola Gallito	74.3	76.0	0.0
10. Big Cola	94.0	102.3	83.3
11. Tropical	100.0	91.4	20.8
12. Manzana	NA	91.7	20.8
13. Quintuples	NA	70.8	70.8
14. Orangine	NA	83.0	83.0
15. Fox Cola	122.0	103.2	NA
16. Coca-Cola Zero	0.0	0.0	0.0
17. Coca-Cola Light	2.0	0.0	0.0
18. Sprite Zero	0.0	0.0	0.0
19. Barrilitos O-Key	0.0	0.0	0.0
20. Oro	NA	NA	NA
21. Ecuador Fruit	NA	NA	NA
22. Coca Cola Life	NA	NA	NA
23. Other	NA	NA	NA

NA, not available; TL, traffic-light nutritional labeling system; HSC, high sugar content.

\* Average of Fioravanti Fresa and Manzana.

**Table A2.** Total consumption of sugar from carbonated soft drinks (CSD)

Brand	Sugar content (g/l)	Total consumption of CSD ( $\times 10^6$ l)	Total consumption of sugar from CSD (MT)
Before TL (before 29 November 2014)			
Coca Cola	104.80	15.51	1625.13
Fanta	124.50	0.86	107.48
Fioravanti	106.00	1.74	184.57
Sprite	100.00	2.21	221.24
Pepsi	119.00	1.09	129.63
Big Cola	94.00	1.81	170.36
Tropical	100.00	0.99	99.49
Total			2537.89
After TL but before HSC tax scheme (between 29 November 2014 and 26 April 2016)			
Coca Cola	106.80	13.38	1429.51
Fanta	138.10	0.85	118.01
Fioravanti	75.00	1.79	134.36
Sprite	75.00	1.83	137.01
Pepsi	107.00	1.08	115.77
Big Cola	102.30	1.77	180.77
Tropical	91.00	0.98	89.63
Total			2205.07
After HSC tax scheme (after 26 April 2016)			
Coca Cola	75.00	11.70	877.78
Fanta	50.00	0.43	21.59
Fioravanti	50.00	0.94	46.82
Sprite	0.00	0.98	0.00
Pepsi	80.10	0.76	61.03
Big Cola	25.00	1.71	42.84
Tropical	0.00	0.73	0.00
Total			1050.06

MT, metric ton. Reduction in the domestic consumption of sugar from CSD after the introduction of the traffic light (TL) but before the high sugar content (HSC) tax scheme =  $2537.89 - 2205.07 = 332.82$  MT. Reduction in the domestic consumption of sugar from CSD after HSC tax scheme =  $2205.07 - 1050.06 = 1155.01$  MT.

**Table A3.** Share of the carbonated soft drink (CSD) market by brand

Brand	Share of the CSD market (%)		
	Before TL (before 29 November 2014)	After TL but before HSC tax scheme (between 29 November 2014 and 26 April 2016)	After HSC tax scheme (after 26 April 2016)
Coca Cola	57.98	52.21	57.84
Fanta	3.23	3.33	2.13
Fioravanti	6.51	6.99	4.63
Sprite	8.27	7.13	4.84
Pepsi	4.07	4.22	3.77
Big Cola	6.78	6.89	8.47
Tropical	3.72	3.84	3.61

TL, traffic-light nutritional labeling system; HSC, tax scheme on drinks with high sugar content.



**Table A4.** Annual and per-capita consumption of sugar in Ecuador 2013–2022

Year	Total consumption (×1000 MT)	Population estimate	Per capita consumption (kg)
2013/2014	599	15 707 473	38.13
2014/2015	599	15 951 832	37.55
2015/2016	619	16 212 022	38.18
2016/2107	594	16 491 116	36.02
2017/2018	593	16 785 356	35.33
2018/2019	587	17 084 359	34.36
2019/2020	580	17 373 657	33.38
2020/2021	560	17 643 060	31.74
2021/2022	530	17 888 474	29.63
2022/2023	562	18 001 000	31.22

Population estimates are from the World Bank and the United Nations. Total sugar consumption is from the USDA Foreign Agricultural Services Sugar Annual Ecuador reports 2014–2022. The 2022/2023 total consumption corresponds to a predicted value.