Evaluating Canada's First Sugar-Sweetened Beverage Tax in Newfoundland and Labrador

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Executive Summary

Background

The World Health Organization has called for reducing sugar-sweetened beverage (SSB) consumption to minimize excessive sugar intakes, lower calorie consumption, improve nutrition, and reduce the prevalence of diet-related diseases. Taxing SSBs is a recommended public health policy to reduce sugar intake. By increasing SSB prices, taxes are expected to decrease the purchasing and consumption of SSBs, improve health and reduce diet-related health care costs, and enhance overall societal well-being through reinvestment of tax revenues. To maximize their impact on population health, SSB taxes should be part of a comprehensive approach that works in synergy with other policy measures and public health initiatives that aim to create a healthier food environment, including improving access to healthier alternatives.

In Canada, the province of Newfoundland and Labrador (NL) has some of the highest rates of obesity in both sexes and all age groups, along with some of the highest rates of cardiovascular diseases and cancers that are directly related to obesity and diet. Consumption of sugar, salt, and saturated fat are known to be also very high in the population. Addressing these alarming public health factors has become a high priority for governmental and community agencies focused on the population's health.

On September 1, 2022, NL became the first Canadian province to introduce an excise tax on SSBs. The $0.20 per litre tax targets ready-to-drink beverages with sugar added by the manufacturer, including soft drinks, fruit-flavoured beverages, sports drinks, energy drinks, and dispensed fountain and slush drinks. It also includes concentrated drink mixtures with added sugar. Sweetened beverages excluded from the tax are beverages made to order (i.e. smoothies, frappuccinos), 100% fruit and vegetable juices, chocolate-flavoured milk, and yogurt beverages. At the time of this report, the Government of NL has announced its intention to repeal the NL SSB tax.

Objectives & Methods

We evaluated the impact of the NL SSB tax by assessing changes in a series of outcomes, including beverage prices, marketing, purchasing, and consumption, before and after the NL SSB tax was implemented. We reflected on the NL SSB tax design and implementation to interpret the results.

We aimed to:

1. Identify whether, and to what extent, the NL SSB tax impacted beverage pricing, marketing, purchasing, and consumption one year after the tax was implemented.

2. Identify equity impacts of the NL SSB tax, by exploring its impacts on consumers by income level, food insecurity status, and presence of boil water advisories.

3. Discuss features of the NL SSB tax design and implementation that may contribute positively or negatively to promoting healthy beverage choices.

In NL and regions in Canada without any SSB tax, we collected data from consumers, retail stores, and industry before (2021-2022) and after (2022-2023) the tax was implemented in NL. Through multiple analyses, we described the initial impacts of the tax to estimate its likelihood of altering beverage intake and improving the health of Newfoundlanders and Labradorians.

Results and Discussion

Beverage Prices

- There was no difference detected in posted prices of taxable SSBs, compared to non-taxed beverages, on shelf tags in NL stores in the years before and after the NL SSB tax was implemented.

- There was no difference detected in beverage prices posted on online grocery store websites three months after the NL SSB tax was implemented, compared to three months before, in NL and non-tax regions.

SSB Tax Implementation

- The SSB tax was explicitly displayed on shelf price tags for fewer than one in four taxable SSBs. Most retailers displayed this tax as a "small print" additional fee similar to deposit fees not in the retail price.

- When shown, the SSB tax was almost always displayed at the correct rate of $0.20/L.

- The SSB tax increased regular prices of taxable SSBs by 9% and sale prices by 12%, on average.

Beverage Marketing

- Promotions for taxable SSBs were more frequent than for non-taxable beverages.

- The proportion of taxable SSBs that were discounted was significantly greater the year after the SSB tax was implemented compared to the year before (pre-tax: 38.0%, post-tax: 40.5%). In contrast, there were no differences for non-taxable beverages.
- There appeared to be trends towards the increasing frequency of promotions of taxable SSBs, following the implementation of the SSB tax, however this was not statistically significant.

Beverage Purchasing

- Comparing the years before and after the tax was implemented in NL, per capita taxable SSB sales by volume decreased more in NL (-12%) than in a non-tax region (Maritime provinces) (-7%).
- Regular pop is the top-selling taxable SSB. Litres of regular pop sold per capita decreased more in NL (-13%) compared to the Maritime provinces (-8%) between the years before and after the tax implementation. Per capita sales by volume of diet pop slightly increased in NL (+1%) but decreased in the Maritime provinces (-3%).

Beverage Consumption

- The average consumption of taxable SSBs in NL was high before and after the NL SSB tax was implemented, nearly three litres per week.
- The likelihood of consuming any taxable SSBs in a given week significantly decreased by 24% after the tax was implemented, after controlling for other factors. However, the likelihood of consuming any non-taxable drinks in a given week significantly increased by 52% after the tax was implemented, after controlling for other factors.
- There were no differences in the mean amount consumed for taxable SSBs, non-taxable SSBs, and unsweetened beverages among consumers. However, there was a significant increase in the volume of diet beverages consumed between pre-tax and post-tax periods.

Equity Impacts

- The likelihood of consuming any taxable SSBs differed by population subgroups: (a) respondents from food secure households were less likely to consume taxable SSBs one year later, but there was no change in households with food insecurity; (b) all income groups were less likely to consume taxable SSBs one year later, but there was a greater reduction in likelihood in respondents above the poverty threshold.

- When people thought there was a boil water advisory-but in fact there was not a government-reported boil water advisory - they consumed less water, but not less SSBs.
- Negative attitudes towards water significantly predicted intakes of both SSB and water. However, after fully adjusting for sociodemographic factors and boil water advisories, attitudes towards water no longer predicted SSB intakes

Discussion

This study examined the first-year impacts of the NL SSB tax on beverage pricing, marketing, purchasing, and consumption. While posted retail prices of taxable SSBs remained unchanged, there was evidence of increased discounting and promotion (not statistically significant) of taxable SSBs the year after the tax was implemented. The SSB tax was usually applied at the correct rate when it was visibly displayed on the shelf, but this only occurred for fewer than one in four taxable SSBs. Invisible and inconsistent displays of the SSB tax to consumers at the point-of-decision making may reduce consumers' knowledge of the financial burden of the tax and reduce the ease with which consumers can compare prices between taxable and non-taxable beverages. The NL SSB tax increased regular prices of visibly taxed SSBs by an average of 9%, which is less than the 20% price increase recommended by the World Health Organization for SSB taxes. As a result, the NL SSB tax may have been less effective at influencing consumer behaviour than intended.

Nevertheless, per capita SSB sales declined more in NL than in non-taxed regions, and in preliminary evidence from convenience samples indicate that the likelihood of weekly consumption also fell significantly in NL. Changes in SSB intake were more visible among food-secure and higher income households, raising equity concerns. All population groups showed increases in the likelihood of weekly consumption of non-taxed SSBs, demonstrating that the tax was effective at steering consumers away from the taxed products. However because the NL SSB tax excluded some sugary drinks (e.g. made-to-order beverages, 100% fruit juice, chocolate milk), behavioural shifts towards other sugary beverages, rather than only unsweetened beverages.

The World Health Organization concludes that SSB taxes support health equity and human rights for health. Studies have shown that those with the lowest incomes gain the greatest health benefits from SSB taxes. Concerns of the financial regressivity of a SSB tax must be weighed against the expected health benefits. To improve health equity in jurisdictions with an SSB tax, it is critical to carefully design and implement the SSB tax for maximum impact and use complementary health promotion initiatives that prioritize supporting vulnerable groups.

The SSB tax has generated more than $11 million per year on average, totalling $35.5 million since its implementation in 2022. The Government of NL stated that the revenue was to be used for school breakfast and lunch programs, a prenatal infant nutrition supplement, a glucose-monitoring pilot program, and the Physical Activity Tax Credit. Combined with equitable healthy living initiatives, the potential for the NL SSB tax to support healthy eating practices, especially among vulnerable populations, is greater. Further dietary improvements can be achieved by other supportive interventions such as healthy food subsidies targeted to low-income populations (rather than subsidies for the general population). Additionally, interventions to address water quality and safety in NL may be necessary to enable and encourage consumers to adopt water as their drink of choice. If the maximum benefit of health promotion initiatives is to be realized, broad physical, economic, and sociocultural factors that influence eating practices cannot be ignored when designing, implementing, and evaluating such interventions.

Policy Recommendations & Conclusions

This evaluation highlights three opportunities for policy action to support reduced sugar intake, improved diets and better health:

1. Continue to tax SSBs in NL and adopt SSB taxes across Canada.
2. Maximize the benefits of the NL SSB tax through tax redesign (magnitude, scope, and communication).
3. Reinforce efforts to reduce SSB intake and improve health by strategic reinvesting of revenue.

While the NL SSB tax has begun to shift purchasing and consumption patterns in the expected direction, its full potential is constrained by its exclusion of many sugary drinks, low tax rate, invisibility in stores, and limited effectiveness in vulnerable populations. To maximize public health benefits, NL should continue the SSB tax with clear communication to consumers, expand the product scope subject to the tax, index the SSB tax rate to inflation, and embed the policy within a broader chronic disease prevention strategy. If sustained and refined, the NL SSB tax holds promise to reduce SSB intake and serve as a model for other Canadian jurisdictions aiming to combat diet-related chronic disease through fiscal policy.

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Introduction

On September 1, 2022, Newfoundland and Labrador (NL) became the first Canadian province to introduce an excise tax on sugar-sweetened beverages (SSBs). The province has some of the highest rates of obesity in both sexes and all age groups, along with some of the highest rates of cardiovascular diseases and cancers that are directly related to obesity and diet. Consumption of sugar, salt, and saturated fat is also known to be very high in the population. Addressing these alarming public health factors has become a high priority for governmental and community agencies focused on the health of the population. Taxing SSBs is a recommended public health policy to reduce sugar intake. By increasing SSB prices, taxes are expected to decrease the purchasing and consumption of SSBs, improve health, reduce diet-related health care costs, and enhance overall societal well-being through reinvestment of tax revenues. The $0.20 per litre tax targets ready-to-drink beverages with sugar added by the manufacturer, including soft drinks, fruit-flavoured beverages, sports and energy drinks, as well as dispensed sugary options such as soda fountain drinks, slush drinks, and fruit juices (1). It also includes concentrated drink mixtures with added sugar (1). Beverages exempt from the tax are 100% fruit and vegetable juices, beverages prepared at the time of purchase, chocolate-flavoured milk, and yogurt beverages (1).

Sugar-Sweetened Beverages

In the last number of decades, there has been a significant increase in the consumption of SSBs globally, continuing to persist at alarming rates (2). In Canada, SSBs are primary contributors of added and free sugar to our diets (3, 4). Due to excess worldwide sugar consumption, the World Health Organization (WHO) has set guidelines for maximum intake of dietary free sugars to be less than 10% of total daily energy intake and ideally less than 5% of total energy intake (5). SSBs are a key target in public health efforts to reduce excessive sugar intake due to their significant contribution to this issue (6). This discussion will explore the patterns of SSB consumption, their links to adverse health outcomes, the policies aimed at curbing their consumption, and the broader factors associated with their use.

Global SSB Consumption Patterns

While data from the US indicates a decrease in SSB consumption since the early 2000s, levels remain high, with data collected from 2014 to 2016 showing that US adults were estimated on average to consume 145 kcal per day from SSBs (7). This intake corresponds to 6.5% of daily calories solely coming from SSBs, which is close to the USDA recommended daily intakes for all added sugar of no more than 10% of

total energy (7). Similar decline or plateau patterns have been observed globally in high-income countries (7). However, low-income, and middle-income countries are experiencing increased SSB consumption due to urbanization and economic development, contributing to the increased availability of SSBs (7). Overall, it is evident that there is a high consumption of SSBs globally, above recommended levels, with a steady rise in low and middle-income countries (7).

Canadian SSB Consumption

It is widely accepted that SSBs significantly contribute to total sugar intake in children and adults in most jurisdictions (8). Specifically, regarding Canadian SSB consumption, findings from the 2015 Canadian Community Health Survey-Nutrition (CCHS) show that SSBs were a major source of total sugar intake (9). According to the CCHS, Canadians consume, on average, 204 mL of SSBs per day with a mean daily energy intake of 99 kcal from SSBs, which is the highest of all beverage categories measured (3). Additionally, adolescents aged 9-18 consume the highest quantity of SSBs, with 22.4% of their daily calories coming from such drinks (9). The association between SSB consumption and elevated added sugar intakes in Canada is of concern, given that SSBs consumption is a crucial behavioral risk factor for developing chronic non-communicable diseases (NCDs) (10). Enhancing the understanding of the factors and predictors influencing SSB consumption is essential to identify effective strategies for reducing sugar intake and limiting the role of SSBs in the risk of NCDs (10).

SSB Consumption and Adverse Health Outcomes

SSB and Type 2 Diabetes Mellitus and Cardiovascular Diseases

As a leading global source of added sugars, SSBs have been consistently linked to an increased risk of obesity, type 2 diabetes mellitus (T2DM), and cardiovascular diseases (CVD). For every additional 250 mL of SSB consumed daily, the risk of obesity increases by 12%, T2DM by 27%, and CVD by 17%, even after accounting for differences in body weight (8). Habitual consumption is also associated with incremental annual weight gain in adults and increases in BMI among children (7). These effects are driven by biological mechanisms including insulin resistance, systemic inflammation, and increased hepatic fat synthesis, which are promoted by the rapid metabolism of fructose—a major component of many SSBs. Notably, these metabolic disturbances can occur independently of weight gain. Given this strong and biologically plausible evidence base, reducing SSB intake is a critical target for chronic disease prevention efforts globally.

SSB and Body Weight

Studies consistently link SSB consumption to weight gain and obesity, primarily due to their high sugar content, low satiety, and poor caloric compensation (9, 11, 12). A comprehensive review found that regular SSB intake increases the risk of being overweight or obese (12).

Randomized controlled trials (RCTs) further confirm that free sugars from SSBs directly contribute to body weight (13). Notably, a recent review of RCTs found that replacing SSBs with non-caloric alternatives in regular consumers led to a long-term BMI reduction and weight loss of 0.5–1.0 kg (14).

SSB and Metabolic Syndrome

Research has increasingly focused on the effects of SSB consumption on metabolic health. Metabolic syndrome, a cluster of metabolic abnormalities, increases the risk of T2D and CVD (15). A meta-analysis of prospective cohort studies found that higher SSB intake is associated with a 20% increased risk of T2D and a 26% increased risk of metabolic syndrome (16). Additionally, a recent cohort study revealed that individuals with high SSB consumption face a greater risk of CVD, regardless of their physical activity levels, compared to those who rarely or never consume SSBs (17).

SSB and Oral Health

SSBs have been identified as significant risk factors for adverse oral health outcomes due to their high sugar content and acidity (18). SSBs play a role in the onset of dental caries and tooth erosion (18). Likewise, the effect of limiting sugar intake to <10% and <5% of total energy (E) has been evaluated to determine the impact of free sugars on dental caries and help guide WHO recommendations (19). This provided consistent evidence supporting a relationship between the quantity of free-sugar intake and the incidence of dental caries across various age groups (19). The results showed moderate evidence supporting free-sugar restriction to <10% E and the reduction of dental caries (19). An even more significant relationship was observed when free sugar was reduced to <5% E, resulting in a greater decrease in dental caries (19). Additionally, a 4-year prospective study that assessed the association between SSB consumption and dental caries found that daily SSB consumption is associated with a greater risk of dental caries (20).

Demographics of SSB Consumption

Global SSB Consumption and Associated Demographics

Numerous population-based studies have established significant sociodemographic links to SSB consumption across diverse

demographics globally (21-23). The overall findings supported the importance of effectively identifying the demographic determinants of SSB consumers to target public health interventions (18). For instance, one study examined sociodemographic distinctions between those who consumed SSBs daily and those who did not (21). It was identified that age, BMI, income, smoking status, and dietary habits were indicators of SSB consumption (17). A UK study found a positive association between SSB consumption and the following characteristics: younger age, being male, lower level of education, having a lower household income, higher BMI, less frequent alcohol consumption, and eating meals or snacks while in front of the television (22).

Canadian SSB Consumption and Associated Demographics

A study on SSB intake in Canada examined 24-hour recall (24 HR) data from the 2004 CCHS and 2015 CCHS (3). The findings indicated elevated SSB consumption among males, adults aged 19 to 30, and individuals of Indigenous ethnicity (3). Provincial assessments indicated variations in the number of SSBs consumed across several provinces; assessments were done using both volume (in millilitres) and energy content (in kilocalories) (3). For instance, British Columbia had the lowest mean reported intake of SSBs and diet beverages, while Alberta and Manitoba had the highest intake of SSB energy and SSB volume, respectively (3). Interestingly, NL reported the highest intake of diet beverages by volume and the lowest intake of milk and water (3).

At the local level, initial findings from our research team indicate that having an education level of high school or less to some post-secondary education, BMI classification of "overweight," and reporting severe household insecurity were significant predictors of higher SSB intake (23). In summary, establishing populations with strong predictors of high SSB consumption is essential to assess the risk of adverse health outcomes associated with high SSB consumption and to determine the efficacy of public health interventions.

Taxing of SSBs

Rationale for a Tax on SSBs

The WHO has called for reducing SSB consumption to minimize excessive sugar intake, lower calorie consumption, improve nutrition, and reduce the prevalence of NCDs (25). In order to achieve this recommendation, the WHO proposes taxation of SSBs as a possible public health policy for reducing sugar intake and preventing chronic diseases (26). By increasing SSB prices relative to other foods, taxes should decrease consumption, lower societal costs, and enhance overall societal well-being (27).

Promisingly, a study that utilized a comprehensive model to estimate the impact and cost-effectiveness of an SSB tax in Canada has indicated its potentially beneficial effect on reducing SSB consumption (28). The simulated $0.015/oz or $0.05/100 ml tax on SSBs estimated that after a year of implementation, the tax would increase the price by 15% and decrease SSB consumption by 17% (28). The researchers concluded that implementing an SSB tax in Canada could be a cost-effective policy option for reducing SSB consumption and rates of related chronic diseases (28).

Taxing Models

Taxes on SSBs have been implemented in at least 36 countries, including the UK, Ireland, Mexico, France, Hungary, Norway, and some US jurisdictions, such as Berkeley (California), Philadelphia (Pennsylvania), Seattle (Washington), Boulder (Colorado), and San Francisco (California) (29). Different sugar tax models, such as excise or production-level tax, are used worldwide. The model being implemented in NL is the excised model, which is currently enforced in many jurisdictions such as Philadelphia, California, Boulder, and Mexico (30). Notably, after Mexico implemented a sugar tax in January 2014, there was a 6.3% reduction in SSB purchases and a 16.2% increase in bottled water purchases in 2014 compared to previous years (31).

Excise taxes on SSBs can be based on either volume or sugar content, and create impacts by increasing the retail price of SSBs thus raising public awareness of health effects, incentivizing industry response, and generating government revenue (32). However, several factors affect the extent of the impact of SSB taxes, including tax design, tax pass-through, and allocation of additional revenue (32). The pass-through of the tax (the proportion of the tax that consumers pay versus the absorption of the tax by manufacturers, distributors, or retailers) dictates the change in beverage price which directly affects the magnitude of behaviour change (33, 34). Overall, there is strong evidence that SSB taxes increase retail prices of taxed beverages (35,36), with pass-through rates varying from 50% (37) to almost 100% (38). Additionally, several SSB taxes worldwide have been shown to reduce SSB purchasing and consumption patterns (39).

NL SSB Tax

The NL tax is an excise tax designed to increase the retail price of targeted beverages by intervening earlier in the supply chain under the assumption that increased costs are eventually passed through to consumers. The regulations indicate that the $0.20/L tax is levied on wholesalers (1), assuming that retailers will pass the tax onto consumers at the point-of-sale. Retailers are not required to indicate the SSB tax on the customer receipt (1). Since the wholesalers pay the SSB tax to the

Government of NL based on the number of litres of SSBs they sell, this tax will generate revenue regardless of the extent to which the tax is passed from wholesalers to retailers to consumers (pass-through rate). However, the lower pass-through rate (i.e., price change), the less likely the SSB tax would encourage reduced purchases or intakes of SSBs.

According to NL Health Accord findings, residents of NL, when compared to residents across all ten provinces, exhibited elevated rates of heart disease, cancer, and stroke-related fatalities (40). Additionally, they experienced reduced life expectancy, more complex health needs in children, and an elevated proportion of older individuals with three or more chronic illnesses (40). Such outcomes illustrate the motivation for the NL government to introduce a tax on SSBs to encourage residents of NL to choose healthier beverage options without added sugar, aiming to promote health-conscious lifestyles in NL (40).

Canada's Food Guide

Canada's Food Guide was revised in 2019 to support healthier eating patterns and reduce dietary risks associated with chronic diseases, which account for roughly one-third of direct healthcare costs in NL (40, 41). Unlike its 2007 predecessor, which emphasized age- and sex-specific serving sizes, the 2019 guide adopts a more flexible, pattern-based approach that encourages the consumption of fruits, vegetables, whole grains, and a variety of protein sources from both animal and plant origins (41). The updated recommendations are less prescriptive and focus on guiding Canadians to make food and beverage choices that improve overall health and reduce chronic disease risk (41). One of the central messages of the 2019 guide is to "make water the beverage of choice," a key recommendation that explicitly discourages regular consumption of SSBs in favour of water (41). This emphasis aligns with broader public health efforts to reduce sugar intake and support chronic disease prevention through simple, sustainable dietary changes (41).

Objectives & Methodological Summary

Objectives

A province-wide study was conducted to evaluate the impact of the NL SSB tax aiming to:

1. Identify whether, and to what extent, the NL SSB tax impacted beverage pricing, marketing, purchasing, and consumption one year after the tax was implemented.
2. Identify equity impacts of the NL SSB tax, by exploring its impacts on consumers by income level, food insecurity status, and presence of tap water boil orders.
3. Discuss features of the NL SSB tax design and implementation that may contribute positively or negatively to healthy beverage choices.

Conceptual Model

Real life SSB taxes exist within a complex system of political, economic, and social factors that impact how the tax is designed and implemented, and its effects on behaviour and health (Figure 1). A well-designed SSB tax is expected to reduce disease risk by increasing SSB prices, which leads to reduced SSB, sugar and calorie intake, improved energy balance, and reduced obesity rates. (40)

A tax serves as a signal to both consumers (warning consumers of the risks of consuming SSBs) and industry (encouraging the production of healthier beverages) (40). Visible SSB prices, with the tax included, help communicate the tax to consumers. The beverage industry may respond to a tax in various ways that may support (e.g., reducing sugar content of beverages) or oppose (e.g., using marketing to increase or maintain awareness and appeal of SSBs) the intention of the tax. An SSB tax may have different impacts on different groups of people, such as low-income, food insecure, Indigenous peoples, or people living in rural communities.

It is difficult to anticipate all the impacts of an SSB tax. Monitoring changes across multiple outcomes, from beverage price to dietary intake, along with equity impacts and unintended consequences, is crucial to understanding policy impacts.

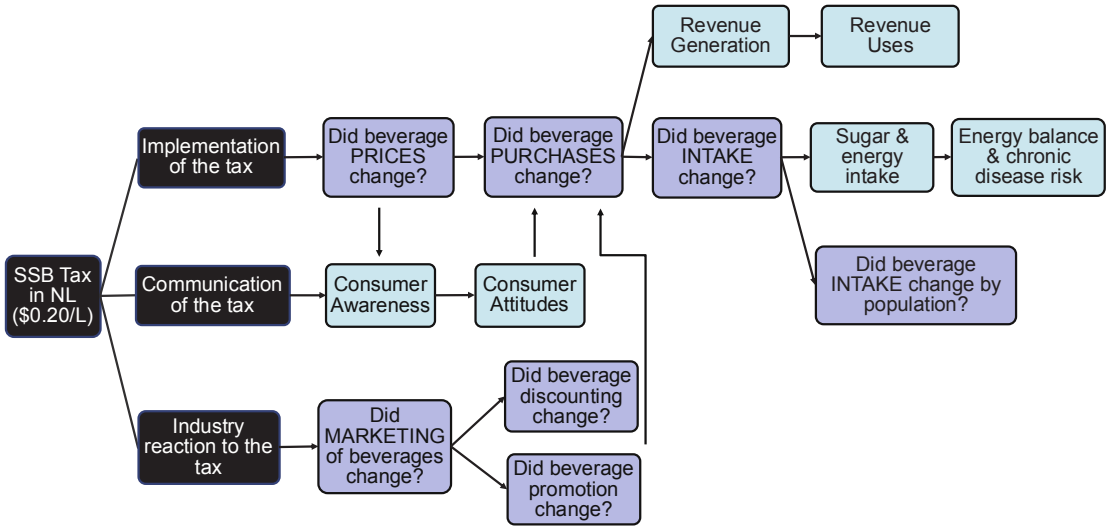

Figure 1. Adapted Conceptual Model with Evaluation Questions (40). Black boxes are the features evaluated. Purple boxes are the research questions. Blue boxes are other related outcomes not included in this evaluation.

Study Design

We used a quasi-experimental study to evaluate the NL SSB Tax. This study type allows us to explore the impact of the NL SSB tax - an intervention designed by policymakers without the input of researchers. It allowed us to understand a real policy in real life.

In this study, we looked at a series of outcomes that help illustrate the impacts of the NL SSB tax. Specifically, we evaluated the impact of the NL SSB tax by assessing changes in beverage prices, marketing, purchasing, and consumption (Figure 1). We reflected on the NL SSB tax design and implementation to interpret the results.

In NL and regions without any SSB tax, we collected data from consumers, retail stores, and industry during periods before and after the tax was implemented in NL. Through multiple analyses, we describe the initial impacts of the tax to estimate its likelihood of altering beverage intake and improving the health of Newfoundlanders and Labradorians.

Timeline

This study took place between 2021 and 2023 (Table 1). The NL SSB tax was implemented on September 1, 2022. We collected baseline (pre-tax) data in the year prior to this date; we collected follow-up data (post-tax) data in the year following this date. Depending on the research question, data was collected from different regions or at other times (see methods). At the time of this report, the Premier of the Government of NL announced the intention to repeal the NL SSB tax as of May 12, 2025.

Table 1. Timeline of data collection and policy implementation	
May 31, 2021	NL SSB tax is announced by the Government of NL as part of Budget 2021.
Sept 2021 – Aug 2022	Baseline (pre-tax) data is collected from consumers (intake), stores (prices, marketing), and from industry (sales).
Sept 1, 2022	**NL SSB tax is implemented.**
Sept 2022 – Dec 2023	Follow-up (post-tax) data is collected from consumers (intake), stores (prices, marketing), and from industry (purchasing).

Data Collection Overview

Study methods are reviewed below. Figure 2 summarizes the data we collected to evaluate the NL SSB Tax.

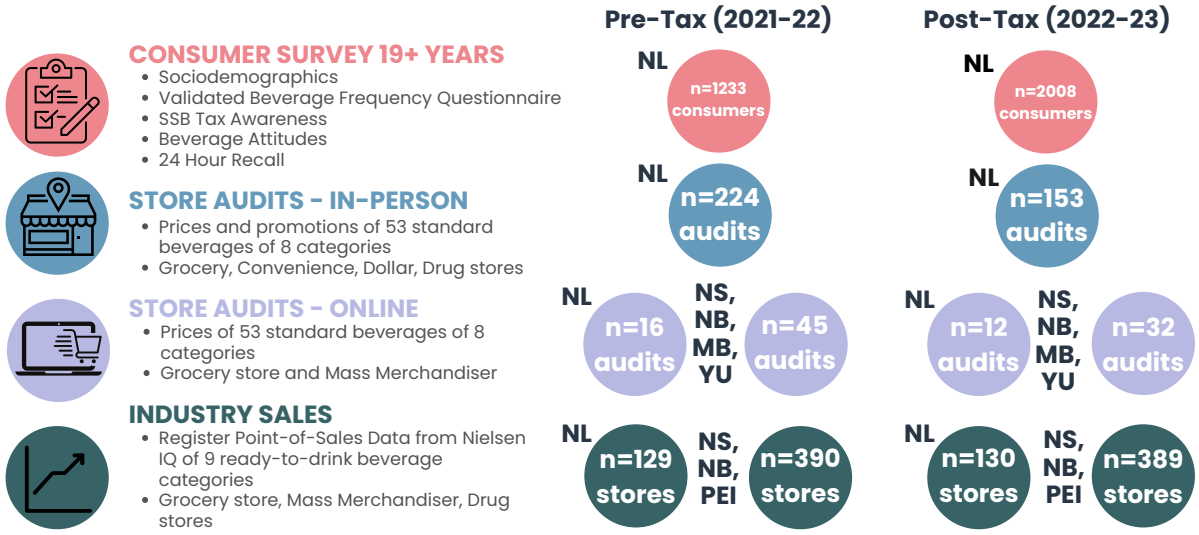

Figure 2. Summary of data collected to evaluate the NL SSB tax.

Beverage Pricing and Marketing in Stores

To measure changes in beverage prices and marketing (price discounts, product placements, promotional signs), we conducted audits of stores in-person in NL and online (in NL and non-tax regions).

In-Store Audits

A total of nine rounds of in-store beverage data collection were completed by trained research assistants in NL, with five occurring before September 1, 2022 (pre-tax, December 2021 to August 2022) and four occurring after the tax was implemented (October 2022 to August 2023) across 80

grocery, dollar, drug, and convenience stores. The stores were selected by stratified random sampling, with the majority in St. John's metro (81%) due to resource restrictions. Fifteen rural stores on the Burin, Bonavista, and Northern Peninsulas were included.

The prices of beverages posted on the shelf were recorded for 53 beverage products across eight categories: soft drinks, sports drinks, energy drinks, juice and fruit drinks, iced teas/lemonades, bottled coffees, waters, and milk and soy beverages. We collected the prices of all purchase units, including single items (i.e. 355 mL, 591 mL, 1 L) and bulk items (e.g. 2 L, 12 cans of 355 mL). After the tax was implemented, we recorded the value of the SSB tax posted on the product shelf label, if visible. Regular and sale (discount) prices, when applicable, were recorded. We converted all beverage prices to the price per 100 mL for comparability across products and time.

Research assistants also recorded product placement of any ready-to-drink beverages (not limited to the 53 beverages), such as placement at check-out, as 'islands', or on the ends of aisles in stores. Further, any promotional signs for ready-to-drink beverages (not limited to the 53 beverages) or beverage brands posted within the store or outside on the store property were recorded. For product placement and promotional signs, the research assistants recorded the product, brand, purchase unit, and sale price (when applicable). Photos were taken to verify the data.

We completed a total of 377 store audits (n=224 pre-tax; n=153 post-tax) across 80 stores. From these audits, we collected 18,882 beverage prices, of which 10,605 (56%) were for taxable SSBs and 7,968 (42%) non-taxable beverages. A total of 8,056 promotions were recorded, with 3,979 (49.4%) occurring before the tax and 4,077 (50.6%) occurring after the tax was implemented.

Online Store Audits

In NL and non-tax regions, online store audits were completed before and after the tax was implemented (pre-tax: July-August 2022; post-tax: September 2022–December 2023) across 16 grocery stores. Four stores were located in NL, and 12 stores were in non-tax regions (Nova Scotia, New Brunswick, Manitoba, and Yukon). The same beverage products collected for in-store audits were recorded for online audits, as the beverage product, purchase units, and prices were posted on grocery store websites prior to check-out. No promotion data was collected during online store audits.

We completed 105 audits of online grocery websites and collected retail prices from 7,531 beverages subject to the SSB tax, of which 24% (n=1,788) were from NL stores.

Beverage Purchasing

To measure changes in beverage purchasing, we licensed two years of purchasing data from ACNielsen Company of Canada (pre-tax [Sept 4, 2021-Sept 3, 2022]; post-tax [Sept 3, 2022- Sept 2, 2023]) for NL, as well as the Maritime provinces as a comparison region (comprised of Nova Scotia, New Brunswick, and Prince Edward Island) for nine ready-to-drink beverage categories. AC Nielsen Company of Canada obtains data directly from retailers from the checkout scanners allowing them to capture consumer purchasing. The purchasing data included the total sales of beverages in volume (litres) and dollars ($CAD) from 591 grocery stores, drug stores, and mass merchandisers (25% in NL, 75% in the Maritime provinces) The data was reported by Nielsen-defined beverage categories, separated into sales of sugar-containing and non-sugar containing beverages and sales of taxable and non-taxable beverages as defined by researchers, within each beverage category.

We obtained sales data for over 300 million litres of ready-to-drink beverages sold annually across NL and the Maritime provinces. Total beverage sales amounted to $545 million in the year before the tax was implemented and $588 million in the year after, without adjusting for inflation.

Beverage Intake

To measure changes in beverage intake, we surveyed adults (19 years old and older) in NL at two timepoints – one pre-tax (August 2022) and the second post-tax (October – December 2023). The survey included a validated beverage frequency questionnaire (41), questions about tax awareness and attitudes, and demographic factors, including age, sex, income, education, food insecurity, location of residence, and self-reported boil water advisory status. The beverage frequency questionnaire asks participants how many times during the past week they consumed a specific beverage, and for those who did consume it, what usual amount was consumed using pictures of typical beverage sizes for each respective beverage. We also obtained government-reported boil water advisories for both survey periods from the Government of NL. Based on their postal code, we categorized respondents as having or not having a government-reported boil water advisory at pre-tax and/or post-tax.

We collected data from convenience samples of 1,233 adults in our pre-tax survey and 2,008 adults in our post-tax survey. Sociodemographic information for both groups is summarized in Table 2.

Table 2. Demographic characteristics of adults ages 19 years and older in Newfoundland and Labrador before and after implementation of the SSB tax

Characteristic	Study Sample[1]			Estimates (%)[2]
	Overall n = 3,241	Pre-tax n = 1,233	Post-tax n = 2,008	
Age group				
19-29 years	19.0% (617)	19.2% (237)	18.9% (380)	11.8%
30-44 years	30.8% (999)	25.0% (308)	34.4% (691)	21.0%
45-59 years	28.1% (910)	32.2% (397)	25.5% (513)	28.4%
60+ years	22.1% (715)	23.6% (291)	21.1% (424)	38.7%
Sex at birth, % (n)				
Female	67.6% (2,179)	65.2% (799)	69.1% (1,380)	51.6%
Male	32.4% (1,042)	34.8% (426)	30.9% (616)	48.4%
Education, % (n)				
Some/all high school	15.3% (492)	15.8% (193)	15.0% (299)	56.4%
Some post-secondary	46.9% (1,512)	44.2% (541)	48.6% (971)	27.0%
Bachelor's or higher	37.8% (1,218)	40.0% (489)	36.5% (729)	16.9%
Employment status, % (n)				
Currently working	59.0% (1,884)	58.8% (715)	59.1% (1,169)	47.1%
Not currently working	41.0% (1,310)	41.2% (502)	40.9% (808)	52.9%
Poverty threshold, % (n)[3]				
Above	68.9% (2,154)	66.9% (747)	70.1% (1,407)	69.4%
Below	31.1% (971)	33.1% (370)	29.9% (601)	30.6%
Race/ethnicity, % (n)[4]				
White	91.5% (2,928)	93.8% (1,140)	90.1% (1,788)	90.4%
Non-White	8.5% (272)	6.2% (75)	9.9% (197)	9.6%
BMI categories, % (n)[5]				
Not overweight/obese	28.9% (806)	28.8% (306)	29.0% (500)	25.1%
Overweight/obese	71.1% (1,985)	71.2% (758)	71.0% (1,227)	74.9%
Food security status, % (n)[6]				
Secure	55.5% (1,766)	59.9% (730)	52.7% (1,036)	77.5%
Not secure	44.5% (1,417)	40.1% (488)	47.3% (929)	22.5%
Non-rural vs. Rural, % (n)7				
Non-rural	46.8% (1,421)	55.2% (643)	41.5% (778)	60.0%
Rural	53.2% (1,618)	44.8% (522)	58.5% (1,096)	40.0%

[1]Estimates from observed data within convenience sample.
[2]Sources: 2021 Canadian Census, 2021 Canadian Community Health Survey.
[3]Based on self-reported annual income and Statistics Canada 2022 Market Basket Measure thresholds for reference families in NL.

[4]All self-reported non-white categories collapsed due to very small cell sizes; overall sample includes 3.2% Indigenous, 1.3% East/Southeast Asian, 1.8% Black, and <1% each South Asian, Latino/a, Middle Eastern, or those who reported "other".

[5]Based on BMI calculated from self-reported height and weight; respondents with BMI≥25 kg/m2 considered to have overweight or obesity.

[6]Calculated using Statistics Canada Household Food Security Survey Module; food insecure includes marginal (10.5%), moderate (20.0%), and severe (14.0%) food insecurity.

[7]Defined using forward sorting codes with those in the Northeast Avalon Peninsula (St. John's, Paradise, Torbay, Portugal Cove-St Phillip's, Mount Pearl, Goulds, Manuels, Conception Bay South) considered non-rural and those elsewhere considered rural.

Data Analysis Overview

We calculated means with standard deviations or 95% confidence intervals for continuous variables, including regular and discount prices, the number of times beverages are promoted, and the volume of beverages purchased and consumed. For categorical variables, such as beverage type (i.e. soft drink, energy drink, water), tax status (taxable, non-taxable), and food security status (food secure, food insecure), we calculated proportions.

We analyzed differences in beverage prices (regular price $/100mL), beverage marketing (% of beverages discounted), beverage purchasing (litres sold, $CAD sold), and beverage consumption (% of survey respondents who consume SSBs in a given week; mL consumed per week) comparing pre-tax measures to post-tax measures. In cases where a control or comparison was available, we assessed the change in the target region (NL) compared to non-tax regions (control), or the change in the target beverages (taxable SSBs) compared to non-taxable beverages (i.e. diet beverages, water).

Beverage Categorization

We grouped beverage types as sugar-sweetened, diet, and unsweetened. Not all SSBs are included in the scope of the NL SSB tax therefore we separated taxable SSBs from non-taxable SSBs. The main categories of beverages included across analyses are summarized in Table 3. Individual beverage types (e.g. soft drinks, energy drinks, sports drinks, chocolate milk, plain milk, 100% juice, and water) are reported for some analyses.

The primary outcome of interest in this report is taxable SSBs as these beverages were the target of the NL SSB tax policy. Non-taxable beverages are included as a comparison. In other words, in the presence of a SSB tax, we would expect prices, promotion, purchasing, and intake of taxable SSBs to change differently than other beverages not targeted by the tax, when comparing outcomes before and after the tax was implemented.

Table 3. Categorization of beverage types for analysis with examples of each type.

Tax Status	Category	Beverage Types	Examples
Subject to NL SSB tax 	**Taxable SSBs** 	Regular soda/pop	Regular Pepsi, Coca-Cola
		Sugar-sweetened juice drinks	Fruit punch, 5-Alive
		Regular sports drinks	Gatorade, Powerade
		Regular energy drinks	Red Bull, Monster
		Sugar-sweetened water	Vitamin Water
		Specialty coffee drinks	Starbucks Frappuccino, bottled
Not subject to the NL SSB tax 	**Non-taxable SSB** 	Specialty coffee drinks	Starbucks Frappuccino, made-to-order
		Flavoured/sweetened milk	Scotsburn Chocolate Milk
		Sweetened smoothies/ shakes	Boost, Booster Juice
	Diet Beverages 	Diet soda/pop	Diet Pepsi, Diet Coke
		Diet flavoured water	Vitamin Water Zero
		Diet juice drinks	Ocean Spray Diet Cranberry Juice
		Diet sports drinks	Gatorade Zero
		Diet energy drinks	Red Bull Sugar Free
	Unsweetened Beverages 	Plain water	Dasani plain water
		Plain unflavoured milk	Scotsburn Milk
		100% fruit juice	Tropicana orange juice

There may be substitution effects or other associated impacts affecting other beverages, however, they may be associated with the implementation of an SSB tax. For example, consumers may choose an alternative to a taxable SSB, such as a non-taxable SSB, a diet beverage, or an unsweetened beverage like water.

Beverage Prices

We conducted an interrupted time series of regular beverage prices per 100mL collected at multiple time points before and after the tax was implemented. For in-store data, which was collected in NL only, we evaluated prices of taxable SSBs compared to all non-taxable beverages in the year prior to the tax (December 2021 to August 2022) and the year after the tax (October 2022 to August 2023). For online store audits that were collected in NL and non-tax regions (comparison), we evaluated prices of taxable beverages only in the three months immediately before (June to August 2022) and after (September to November 2022). For both analyses, we adjusted for other factors (inflation, overall market sales, region size, store, product, and neighbourhood characteristics) that may affect beverage prices within regions.

Beverage Marketing

To assess changes in proportion of taxable SSBs and non-taxable beverages (comparison) that were discounted (i.e. on sale), and the frequency of 'promotions' (product placements and promotional signs) of taxable SSBs and non-taxed beverages, before and after the tax was implemented, we used Pearson $\chi 2$ tests of independence. We ran tests overall, and by beverage type, comparing the years before and the year after the tax (pre-tax year versus post-tax year).

Beverage Purchasing

The volume (L) and sales revenue ($CAD) for each beverage category were grouped into broader beverage groups: taxable SSBs, diet beverages, plain water, plain milk, chocolate milk, and 100% juice. To account for inflation, the average price per litre of beverages during the pre-tax period was adjusted using the mean Consumer Price Index for food in each region across the study periods. We then calculated the absolute difference (post-tax minus pre-tax) and percent change for these beverage groups in both NL and the non-tax region.

Beverage Consumption

We calculated the usual weekly consumption in litres for each beverage by multiplying the number of times it was consumed by the amount reported. We then grouped beverage types into broader categories as per Table 2.

We ran two-part regression models adjusted for potential sociodemographic confounders and weighted using inverse probability weights generated from a representative sample of adults in NL to explore changes in the likelihood of (i) being a consumer of taxable SSBs (and other categories, separately), and (ii) changes in the mean weekly amounts consumed, among consumers. At baseline, taxable SSB consumption was associated with several sociodemographic factors, including age, sex, education, income, employment status, and food security status (23). As a result, adjusted analyses that account for these factors provide more reliable estimates, as unadjusted results could be influenced by demographic changes between the pre-tax and post-tax periods.

We examined equity impacts by testing whether the impacts of the NL SSB tax differed based on household food security status and income level. We tested for significant interaction effects between food security status and income and ran stratified analyses to evaluate differential changes by group. We compared changes in adults who live in food insecure (minimal, moderate, and severe) households to those in food secure households, as well as changes in adults with a household

income above the poverty threshold ($50,000 per year) to those with an annual household income below $50,000. We also evaluated how SSB intake differed between adults living in communities with and without boil water advisories. Due to the low prevalence of boil water advisories, we created a combined sample of pre-tax and post-tax survey respondents for statistical power to assess the association between boil water advisories and water attitudes (n=3,093 respondents, excluding the post-tax responses from any person who answered both surveys). We used latent class analysis to determine groups of respondents with common attitudes towards water (negative, neutral, positive), and then used ANOVA with LSD post-hoc tests to determine significant differences among water attitudes and intakes of SSB and water. To examine predictors of water and SSB intake, two separate linear regressions were conducted using a block model to assess the effect of boil water advisory and water attitudes on beverage consumption, first in isolation and then controlling for sociodemographic factors including sex, age, income, education, urbanicity, and household food security status.

Strengths and Limitations

Features of the study are listed below as strengths and limitations.

Strengths

- **First of its kind in Canada:** This is the first evaluation of Canada's first SSB tax. This evaluation is an early look at how this policy may be working.
- **Real-world design:** The study uses a quasi-experimental (also called a natural experiment) approach, which improves the relevance of the findings to everyday settings and behaviours.
- **Comprehensive evaluation:** Multiple components of the impact of the SSB tax were assessed. Assessing the changes in beverage pricing, purchasing, marketing, and consumption patterns provides a fuller picture of the impacts of the tax.
- **Focus on equity:** The study also examined whether the tax had different effects across income and food security levels.
- **Policy-relevant insights:** The findings offer practical information on how the tax was implemented, how consumers and retailers responded, and how the policy could be reenvisioned in light of the announcement that the tax will be repealed.

Limitations

- **Sampling and survey challenges:** The study used convenience (non-random) sampling and different recruitment methods for the pre-tax and post-tax surveys. These recruitment approaches have been known to possibly introduce bias. Additionally, the majority of surveys (>99%) were conducted online. Therefore, some groups may have been excluded due to lack of internet and technology access.
- **Comparability issues:** The repeat cross-sectional nature of the study means that the same individuals were not surveyed before and after the tax was implemented.
- **Self-reported intake:** Beverage consumption was based on participant recall, which can be prone to inaccuracy.
- **No control group:** Because cross-sectional surveys were used without a formal comparison group, it can be harder to separate the effects of the tax from other factors that might influence SSB consumption.
- **Timing of data collection:** The results reflect only one year of follow-up, which may be too soon to observe the full impact of the policy. Also, there were differences in the collection period between the pre- and post-tax surveys. The pre-tax survey was collected in August while the post-tax survey was collected in November and December. These differences in season could contribute to behaviours observed in some of the data collected.
- **Market data limitations:** While changes in purchasing behaviour were observed, it's difficult to say exactly how much was due to the tax versus broader shifts in consumer trends over the same time frame. Sales data is group-level data for which individual behaviour change conclusions should not be made.
- **Retail data variability:** In-store data collection was time-intensive and may have included some human error. The sampled stores (both in-person and online) may not fully represent all stores in Newfoundland and Labrador or in comparison provinces.
- **Incomplete price pass-through data:** Shelf prices were used to assess how clearly the tax was communicated to consumers, but this does not necessarily reflect the final price paid or how much of the tax was passed on to the customer. While every indication points toward high pass-through to the consumer, receipt data from actual consumers would be needed to confirm the pass-through rate for every taxed beverage type.
- **Detection limits:** Because store-level promotions varied widely and the sample size was modest, the study may not have been able to detect some smaller, yet meaningful, effects specifically in relation to the promotions data.

Results & Discussion

Impact of NL SSB Tax on Beverage Prices

Key Findings

- **There was no difference detected in posted prices of taxable SSBs, compared to non-taxed beverages, on shelves in NL stores in the years before and after the SSB tax was implemented.**
- **There was no difference detected in beverage prices posted on online grocery store websites three months after the SSB tax was implemented, compared to three months before, in NL and non-tax regions.**

In-Store Prices

Beverage prices showed no difference in the pre-tax price (β=-0.0002, 95%CI −0.009 - 0.0005, p=0.605), price when the tax was implemented (β=0.004, 95% CI -0.022 – 0.03, p = 0.77), nor any difference in the post-tax price (β=0.0001, 95% CI -0.0009 – 0.0012, p = 0.783). Figure 3 displays trends of posted prices before and after the tax, comparing taxable SSBs to non-taxable beverages in NL.

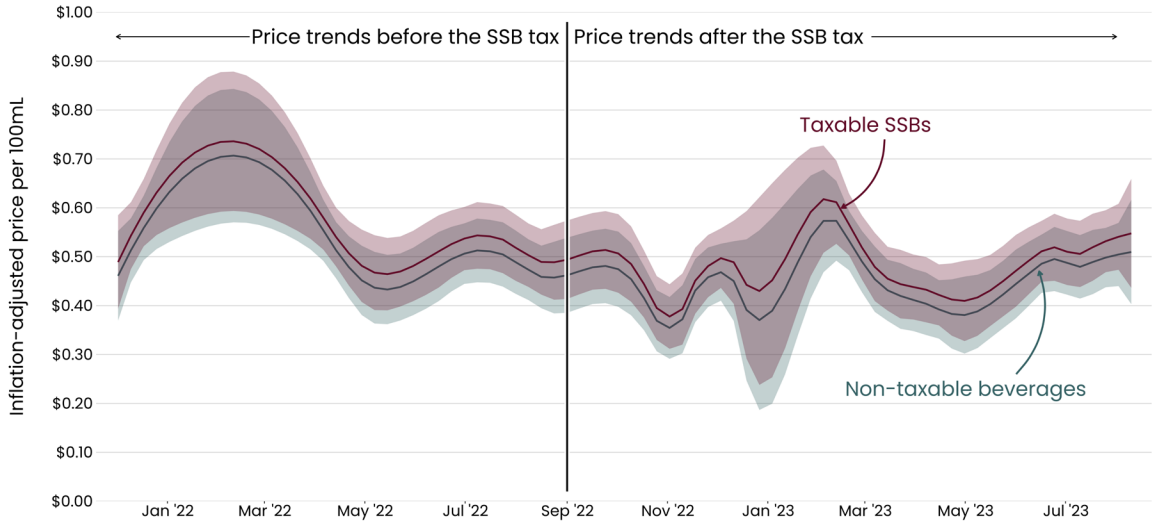

Figure 3. In-store posted retail prices of SSBs in NL before and after implementation of the SSB tax in NL. The trends in posted prices, represented by lines, are comparable between taxable SSBs and the comparison, displaying that the patterns of posted beverage prices changes are similar between taxable SSBs and non-taxable beverages in NL.

Online Prices

Beverage prices collected from grocery store websites in NL and non-tax regions for three months before and after the implementation of the tax, showed no difference in the pre-tax price (β=0.002, 95%CI −0.012 - 0.016, p=0.761), price when the tax was implemented (β=-0.024, 95% CI -0.15 – 0.10, p = 0.70, nor any difference in the post-tax price (β=0.00, 95% CI -0.02 – 0.02, p = 0.99). Figure 4 displays trends of posted prices of taxable SSBs in NL compared to taxable SSBs in non-tax regions, before and after the tax was implemented.

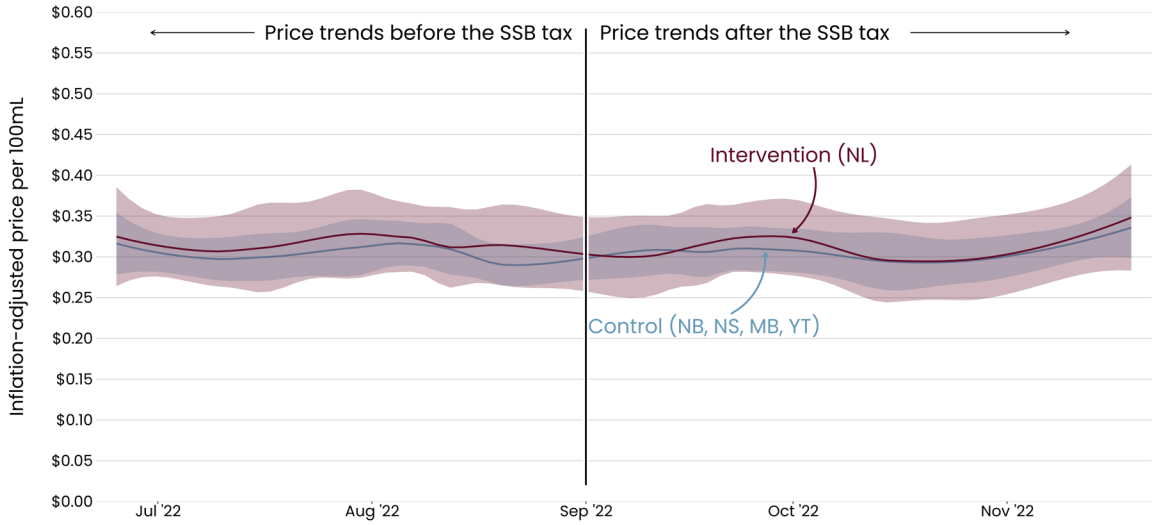

Figure 4. Online retail prices of SSBs in intervention (NL) and control (NB, NS, MB, YT) locations before and after implementation of the SSB tax in NL. The trends in prices, represented by lines, are comparable between taxable SSBs and the comparisons, displaying that the patterns of beverage prices changes are similar between taxable SSBs in NL and taxable SSBs in non-tax regions.

Description of SSB Tax Implementation

Key Findings

- **The SSB tax was explicitly displayed on shelf price tags for fewer than one in four taxable SSBs.**
- **When shown, the SSB tax was almost always displayed at the correct rate of $0.20/L.**
- **The SSB tax increased regular prices of taxable SSBs by 9% and sale prices by 12%, on average.**

Visibility of SSB Tax to Consumers

Shelf audits revealed that the SSB tax was rarely visible to consumers at the point of purchase in stores. Of the 4,877 taxable SSBs with regular prices visible during the post-tax period, only 24.4% (n=1,189) displayed the SSB tax explicitly on the shelf tag. These visible tax labels were found in just 15 stores, all owned by two parent companies. The vast majority (75.6%) did not display the tax on shelf tags at all. For beverages being sold at a discount (n=2,601), tax visibility was even lower. Only 15.7% (n=409) of discounted taxable SSBs displayed the tax on the shelf, while 84.3% (n=2,192) did not. Figure 5 shows example mock-up of shelf tags displaying the NL SSB tax in different ways.

Figure 5. Mock-up versions of shelf tags displaying the NL SSB tax in retail locations.

Tax Rate and 'Visible Pass-through' of SSB Tax to Consumers

Without access to point-of-purchase data such as sales receipts, the exact pass-through rate of the $0.20/L tax remains unknown. However, by reviewing price tags, we can estimate a 'visible pass-through' rate based on the tax amount clearly communicated to the consumer on shelf tags.

Among the 1,189 taxable SSBs with the tax explicitly displayed, 95.2% (n=1,132) accurately reflected the correct tax amount, calculated based on the $0.20/L rate for ready-to-drink beverages. When limiting the analysis to only these beverages with a visible tax label, the average 'visible pass-through' rate on shelf tags was high at 96.7%. If all taxable SSBs for which the SSB tax should be applied are included (n=4,878), the average 'visible pass-through' rate would drop sharply to 23.6% due to the large proportion of products with no visible shelf-tag tax information. The true economic pass-through rate will sit between these two estimates knowing that some stores added the SSB tax at the point-of-purchase (i.e. check-out) without displaying the SSB tax on the shelf tag. Data on the total cost paid by consumers is needed to more fully estimate the true economic pass-through rate.

Value of SSB Tax based on Price Tag

Among taxed beverages with visible regular prices (n=1,189), the SSB tax represented an average of 8.5% of the product's price, ranging from 1.4% to 46.8%. For discounted taxable SSBs (n=399), the tax accounted for an average of 11.8% of the discounted price, ranging from 1.7% to 32.0%.

Discussion: Beverage Prices and SSB Tax Implementation

There is moderate certainty in the scientific literature that SSB taxes have a large effect on prices of taxed beverages, but evidence shows a slight under shifting of SSB taxes to consumers with a pass-through rate of 82% (95%CI: 66% to 98%) (43). For the NL SSB tax rate of $0.20/L, an 82% pass-through rate would mean an expected price increase of $0.16/L. Our findings suggest a low rate of 'visible pass-through' on shelf tags at 24% of the tax amount, however, the total economic pass through to consumers has yet to be calculated due to the SSB tax often being applied at check-out rather than visibly displayed on price tags. Regardless of the pass-through of the SSB tax to consumers, however, the NL SSB tax generated revenue since the wholesalers pay the tax directly to the Government of NL (1).

Studies of real-life SSB taxes showed that implementation varies widely by region, with pass-through rates ranging from 0% to more than 100% (30, 44) and by beverage and store type (45, 46). Berkeley, California, for example, introduced a 1 cent per ounce excise tax on SSBs in 2014, applied at the distributor level. One year after its implementation, only 47% of the tax was passed through to the retail price of SSBs (37), meaning beverage prices changed by less than half of what was intended by the tax. The city provided little guidance to businesses on how to implement the tax, generally only engaging with self-distributors. Thus, individual retailers chose (i) how to pass the tax through to consumers and (ii) how to display the tax in-store. Inconsistencies were found concerning what products were deemed taxable by stores.

Among 34 retailers, 71% raised beverage prices, and the remaining 29% absorbed or delayed price increases. Of the stores that increased beverage prices, 75% did so to SSBs only, while 21% raised prices of SSBs and non-taxable beverages, or raised SSB prices inconsistently (47). Some retailers displayed the SSB tax on shelf tags, while others opted to apply the surcharge at the register. Similar inconsistencies in tax display and pass through are documented in other jurisdictions (46). Supports for retailers, particularly for small, independent retailers, may be necessary to reduce challenges experienced in implementing an SSB tax in stores.

Pass-through of the tax, and communication of the tax value to consumers, are not guaranteed. Policymakers could consider ways to support high pass-through to consumers, minimize absorption of the SSB tax by manufacturers, distributors, or retailers, and require displays of the financial cost of the SSB tax at point of decision making. Without clear price changes near the recommended 20% increase (33), an invisible or absorbed SSB tax will simply rely on consumer awareness and knowledge to shift behaviour.

Impact of NL SSB Tax on Beverage Marketing

Key Findings

- **Promotions for taxable SSBs were more frequent than non-taxable beverages at both the pre-tax and post-tax times.**
- **The proportion of taxable SSBs that were discounted was significantly greater the year after the SSB tax was implemented than the year before. In contrast, there were no differences in the proportion of non-taxable beverages that were discounted in the years before and after the SSB tax was implemented.**
- **There appeared to be trends towards increasing frequency of promotions of taxable SSBs, immediately after the tax was implemented, and the year following, however, this was not statistically significant.**

Pricing Promotions (Discounts)

Across both time points, 38.3% of beverages recorded through in-store audits were being sold at a discounted price. Discounts were applied to 39.1% of taxable SSBs compared to 37.2% of non-taxable beverages.

The proportion of taxable SSBs on sale increased significantly after the tax was implemented, rising from 38.0% before the tax to 40.5% after the tax ($\chi^2 = 9.693$, $p = 0.002$) (Figure 6A). In contrast, there was no significant change in the proportion of non-taxable beverages that were discounted (36.9% pre-tax vs. 37.7% post-tax, $\chi^2 = 0.874$, $p = 0.358$) (Figure 6A).

Product Placement and Promotional Signage ('Promotions')

Of the 8,056 promotions recorded, the majority of promotions (61.9%) involved product placement, while the remainder consisted of promotional signs. More than half (53.0%) of all promotions were combined with price discounts.

In both pre-tax and post-tax periods, taxable SSBs were promoted more frequently than non-taxable beverages. Between the years before and after the tax, the average number of promotions increased more for taxable SSBs than for non-taxable beverages. The number of taxable SSB promotions per store increased on average by 5 promotions (mean

difference: +5.2 (-0.1, 10.5), F = 3.789, p = 0.053) from 26 (95% CI: 22.4, 29.5) pre-tax to 31 (95% CI: 27.3, 35.0) post-tax (Figure 6B), but this change was only approaching statistical significance. Non-taxable beverage promotions showed a smaller, non-significant increase of 3 promotions per store (mean difference: +3.4 (-1.0, 7.7), F = 2.268, p = 0.134) from 17 (95% CI: 13.7, 19.6) pre-tax to 20 (95% CI: 16.8, 23.3) post-tax (Figure 6B).

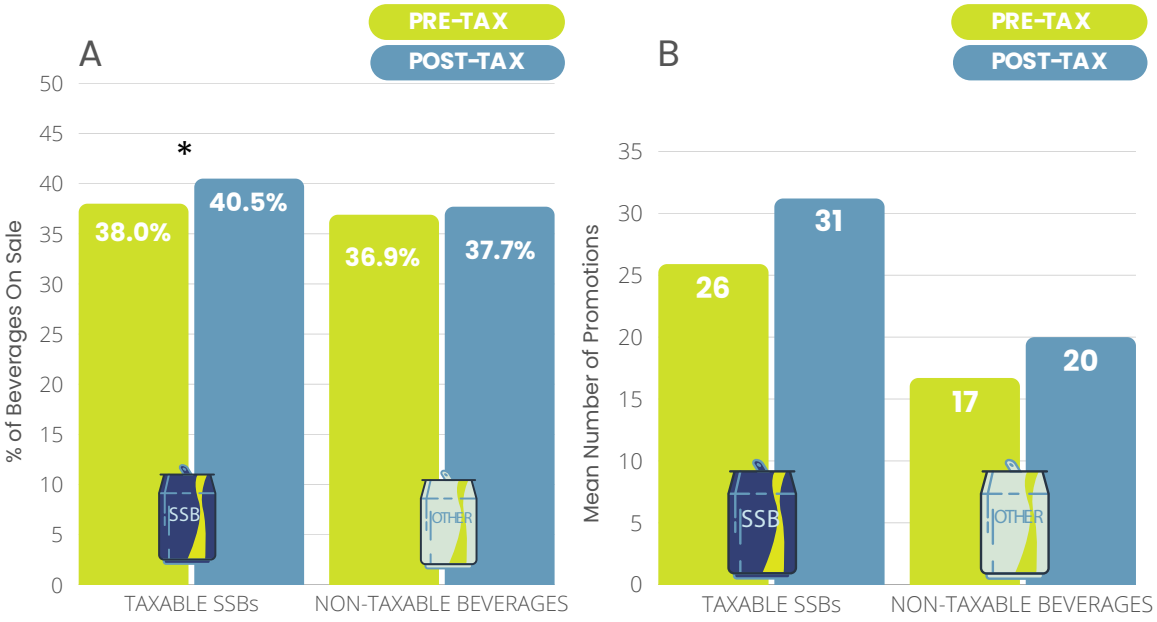

Figure 6. (A) Proportion of taxable SSBs and non-taxable beverages sold at a discount and (B) mean number of product placement and promotional signs per store, for taxable SSBs and non-taxable beverages, during the pre- and post-tax data collection periods for the year before (2021-2022) compared to the year after (2022-2023) the SSB tax was implemented. *indicates statistically significant differences $p<0.05$.

Discussion: Beverage Marketing

SSBs are among the most marketed products globally (48) and advertising strategies have been shown to drive consumption (49). Soft drink marketing has been linked to changes in beverage preferences, choices and consumption (50-52). It has previously been shown that the beverage industry may use strategies to try to lessen the impacts of SSB taxes on consumers (53), though literature describing these changes post-tax implementation is scarce (52), and promotional changes are one of the least studied effects (53).

Results from other studies on changes in SSB marketing following implementation of SSB taxes are mixed; some show reductions in prevalence of price promotions for SSBs (54), increases in depth of discount (45), or decreases in promotional frequency, promotional depth, and flyer features (55). Some hypothesize that these changes were used strategically by industry to counteract the impact of SSB taxes, but

also that differences may be partially explained by individual company context along with many other factors which influence decision-making for marketing practices (52).

Research has also shown that SSB taxes themselves influence the effectiveness of marketing tactics, and that real-life SSB marketing changes made in response to SSB taxes may not always align with strategies known to be most effective on consumer purchasing behaviour (55). Industry responses to SSB taxes, including changes in pricing and promotion, mediate the influence of price changes from taxes on consumption, thus influencing the effectiveness of SSB taxes as public health interventions (53).

Impact of NL SSB Tax on Beverage Purchasing

Key Findings

- Comparing the years before and after the tax was implemented in NL, per capita taxable SSB sales by volume decreased more in NL (-12%) than in non-tax regions (Maritime provinces) (-7%).
- Regular pop is the top selling taxable SSB. Litres of regular pop sold per capita decreased more in NL (-13%) compared to the Maritime provinces (-8%) between the years before and after the tax. Per capita sales by volume of diet pop slightly increased more in NL (+1%) but decreased in the Maritime provinces (-3%).

Changes in Overall Market Sales

Sugar-containing beverages accounted for almost half (43%) of the 657 million litres of ready-to-drink beverages sold in Atlantic Canada in the years before and after the tax. Taxable SSBs made up most of the sugar-containing beverages sold (Figure 8). Following the start of the NL SSB tax, there was a small decline in the total volume of sugar-containing beverages sold in NL, while the proportion remained largely unchanged in the Maritime provinces (Figure 7).

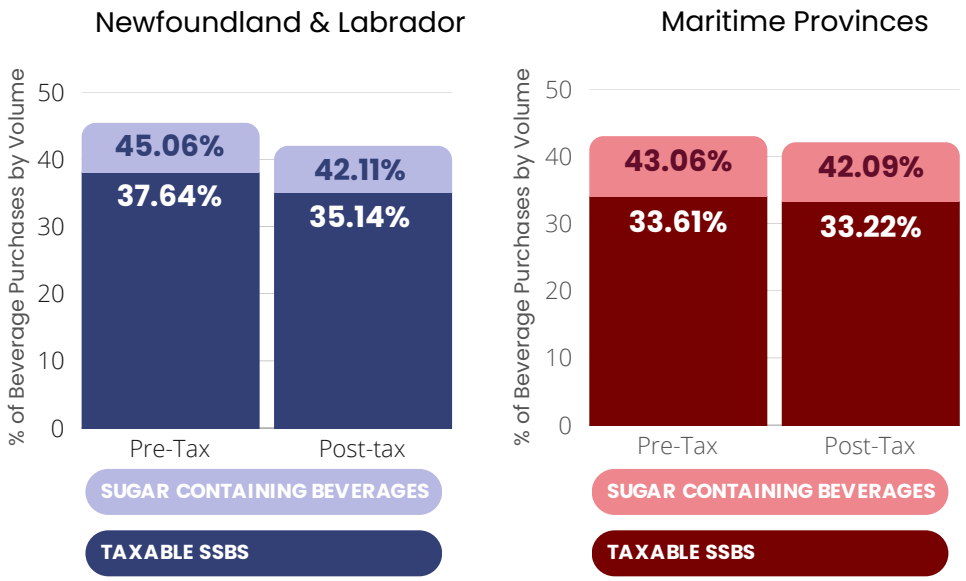

Figure 7. Percentage of each beverage category purchased in terms of volume. Data based on actual sales data for the measurement period.

Changes in Per Capita Beverage Sales by Beverage Category

Between the pre-tax and post-tax periods, per capita sales of taxable SSBs declined more sharply in NL (-11.6%) compared to the Maritime provinces (-6.7%). In NL, per capita sales of diet beverages increased by 4.4% and bottled water by 2.2%. Whereas in the Maritime provinces, diet beverage sales remained largely unchanged (+0.3%), and bottled water sales declined (-3.8%). Sales of chocolate milk and 100% fruit and vegetable juice decreased in both regions during the same period (Figure 8).

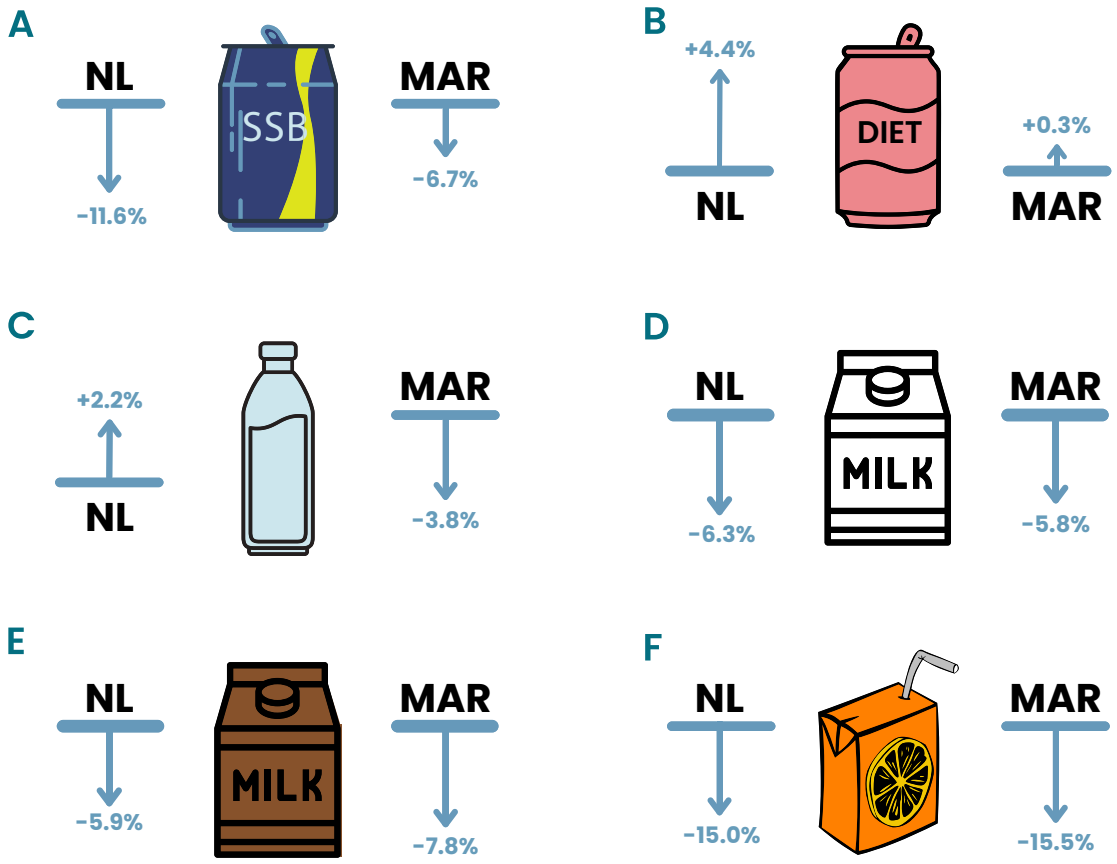

Figure 8. Change in beverage sales, per capita, by beverage type between the pre- and post-tax period in Newfoundland and Labrador (NL) and the Maritime Provinces (MAR). (A) taxable SSB, (B) diet beverages, (C) unsweetened white milk, (D) sweetened chocolate milk, (E) bottled plain water, (F) 100% fruit and vegetable juice.

Changes in Per Capita Beverage Sales by Beverage Type

Overall, per capita beverage sales were higher in the Maritime provinces than in NL for most beverage types. However, NL had substantially higher per capita sales of regular and diet soda/pop than the Maritime provinces. Notably, regular soda/pop sales declined more in NL (-13.0%) compared to the Maritime provinces (-7.6%), while diet soda/pop sales increased slightly in NL (+1.3%) but decreased in the Maritime provinces (-3.2%) (Figure 9).

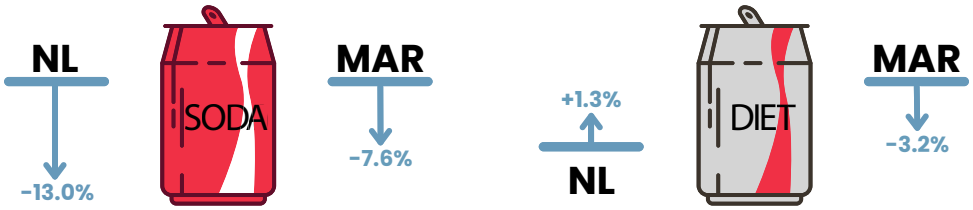

Figure 9. Change in (A) soda/pop and (B) diet soda/pop sales, per capita, between the pre- and post-tax period in Newfoundland and Labrador (NL) and the Maritime Provinces (MAR).

Sales of plain water increased slightly in both regions, with a larger increase in NL (+3.3%) compared to the Maritime provinces (+2.4%) (Figure 10A). For flavoured water, trends differed by sugar content. Sugar-containing flavoured water sales increased in NL (+3.4%) but declined in the Maritime provinces (-1.0%). (Figure 10B). Non-sugar-containing flavoured water sales remained stable in NL (+0.1%) but decreased in the Maritime provinces (-3.2%) (Figure 10C).

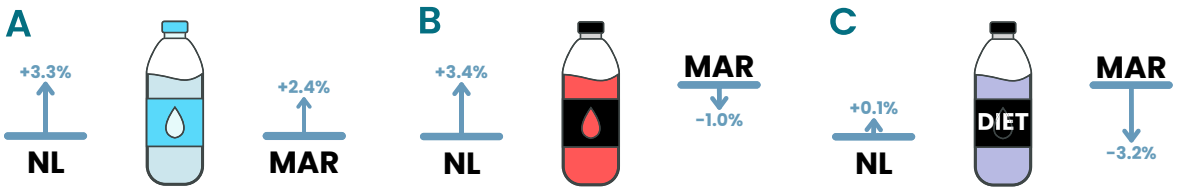

Figure 10. Change in (A) plain water, (B) sugar-containing flavoured water, and (C) non-sugar-containing flavoured water sales, per capita, between the pre- and post-tax period in Newfoundland and Labrador (NL) and the Maritime Provinces (MAR).

Discussion: Beverage Purchasing

International evidence shows that introducing taxes on SSBs consistently leads to reduced purchasing of taxed drinks, although the magnitude of change varies by country and tax design. Across 33 studies evaluating 16 SSB tax policies, a 10% price increase in taxed beverages reduced purchases of taxed beverages by 16% (43). The total effect of an SSB tax will depend on many contextual factors, however, and so it is useful to look at regions individually.

In Mexico, a 1 peso/L excise tax (about a 10% price increase) in 2014 was associated with a 7.3% decline in per-capita SSB sales over the first two years, alongside a 5.2% increase in bottled water purchases (56). These data suggest many consumers may have substituted sugary drinks with healthier options like water. This would be a positive trend if also realized in NL given the relevance to the province's push for healthier beverage choices. It should be known, however, that Mexico has implemented complementary public policies to support healthy eating including taxes on junk food, front-of-pack warning labels, and a ban on junk food in schools (57); these policies can be mutually reinforcing to support behaviour change. In Chile a smaller tax adjustment (raising the tax rate from 13% to 18% on high-sugar beverages) produced only a modest drop in SSB buying. Household purchases of higher-sugar drinks fell by

roughly 3–4% in volume (and calories) after the tax, while purchases of lower-sugar drinks (tax cut from 13% to 10%) rose by about 11% (58). In other words, Chilean consumers shifted somewhat from heavily sugared beverages to drinks with less or no sugar, but overall SSB intake declined only slightly, reflecting the limited impact of a small tax differential. This aligns with research indicating that minor tax increases are unlikely to generate large enough consumption changes to significantly affect obesity or disease rates (58). NL can infer that a more substantial tax, beyond the legislated $0.20/L which increased prices by 9-12%, will be more likely to drive meaningful reductions in sugary drink consumption.

Several European countries have reported larger declines in SSB sales following tax implementation. For instance, Catalonia (Spain) introduced an SSB tax in 2017 with rates tiered by sugar content; after 3.5 years, sugary drink purchases had dropped by 16.7% (59). England's 2018 Soft Drinks Industry Levy (tiered by sugar level) prompted many manufacturers to reformulate products, resulting in an average reduction of about 3.6 litres per person in annual SSB consumption within three years (59). France initially applied a small volume-based tax (€0.07/L in 2012) with minimal effect, but after increasing the rate to €0.20/L (for high-sugar drinks) in 2018, per capita sugary drink intake began to fall, and the tax is credited with accelerating this decline (59). On the other hand, Denmark's experience underscores the importance of sustaining such policies: an SSB tax hike in 2010 cut beverage sales by 13.4% the next year, but when Denmark repealed its soda tax in 2013, demand rebounded by over 30% and quickly surpassed previous consumption levels (59). This reversal suggests that if NL's tax were removed or weakened, consumption could revert to old patterns, undoing potential health benefits.

Overall, the European cases suggest that NL can expect a noticeable drop in SSB purchases from its tax, especially if the tax structure incentivizes product reformulation. Adoption of an SSB tax in other Canadian jurisdictions or nationally across Canada is likely to put greater pressure on industry to reformulate; an SSB tax in a single, small province is unlikely to influence reformulation by national beverage companies. They also highlight the need for long-term commitment, evaluation, and policy redesign to ensure the SSB tax achieves its intended outcomes.

Impact of NL SSB Tax on Beverage Consumption

Key Findings

- **The average consumption of taxable SSBs in NL was high both before and after SSB tax implementation, nearly three litres per week.**
- **Both at pre-tax and post-tax time points, more than half of survey respondents reported consuming some taxable SSBs in the last seven days.**
- **The likelihood of consuming any taxable SSBs in a given week significantly decreased by 24% after the tax was implemented, after controlling for other factors.**
- **The likelihood of consuming any non-taxable SSBs in a given week significantly increased by 52% after the tax was implemented.**
- **Among consumers, there were no differences in the mean amount consumed for taxable SSBs, non-taxable SSBs, and unsweetened beverages. However, there was a significant increase in the volume of diet beverages consumed between the pre-tax and post-tax periods.**

Intakes of Taxable SSBs

Before and after the tax was implemented, 57-58% of respondents reported consuming taxable SSBs at least once per week, in weighted prevalence (Table 4). However, after adjusting for age, sex, education, employment status, income, household food insecurity, BMI category, and urbanicity, the odds of reporting any weekly taxable SSB consumption decreased by approximately 24% following the tax (OR=0.76, 95%CI 0.67, 0.86; p<0.001) (Table 5). This suggests that individuals were less likely to consume taxable SSBs weekly after the tax was introduced.

Among individuals who consumed taxable SSBs, the average weekly intake remained similar between the pre-tax and post-tax periods. The weighted mean (SD) intake was 3.0 (4.0) litres before the tax and 3.1 (4.3) litres after (Table 4). There was no significant difference in the amount of taxable SSBs consumed among those who continued to drink them, with an adjusted mean difference of 110 mL (-90, 310) (p = 0.292) (Table 5).

The most commonly consumed taxable SSB was regular soda/pop, with an average weighted weekly intake of 2.3 litres at both time points (pre-tax: 2.3 L (3.5 L); post-tax: 2.3 L (3.5 L). The adjusted odds of consuming regular soda/pop decreased by 17% after the tax was implemented (OR = 0.83, 95% CI: 0.73, 0.94; p = 0.005), along with a 27% decrease in regular sports drinks (OR = 0.73, 95% CI: 0.62, 0.87; p < 0.001). On the other hand, intakes of regular energy drinks increased by 47% (OR = 1.47, 95% CI: 1.13, 1.91; p = 0.004).

Table 4. Estimates of beverage consumption before and after implementation of a SSB tax in Newfoundland and Labrador (n=3,241)

Beverage	Prevalence (% (n) any weekly consumption)		Mean non-zero consumption (L/week)	
	Pre-tax Wt. %[2]	Post-tax Wt. %[2]	Pre-tax Wt. mean (SD)[2]	Post-tax Wt. mean (SD)[2]
SSBs, taxable[3]	57.3%	58.3%	3.0 (4.0)	3.1 (4.3)
SSBs, not taxable[4]	22.0%	34.4%	1.4 (1.9)	1.5 (1.7)
Diet beverages[5]	47.7%	54.6%	3.6 (5.1)	4.0 (5.8)
Unsweetened beverages[6]	86.3%	92.3%	9.1 (8.1)	9.3 (8.5)

[1]Observed data are unadjusted and unweighted

[2]Inverse probability weights calculated for each study participant using 2021 Canadian Census

[3]Includes ready-to-drink beverages and prepared dispensed beverages that contain added sugars (e.g. sugar, fructose, glucose, glucose-fructose, sucrose, honey, molasses, syrups etc.), including sugar-sweetened soda/pop, fountain drinks, juice drinks, sweetened waters, sports drinks, energy drinks, iced teas, and lemonades. Does not include beverages made at point-of-service.

[4]Includes sweetened milks and point-of-service smoothies and blended coffee drinks made on site.

[5]Includes all beverages containing non-nutritive (non-caloric) sweeteners and no caloric sweeteners

[6]Includes all beverages with no added sugars or sweeteners and 100% fruit juice which contains free but not added sugars

Table 5. Adjusted differences in beverage consumption one year after the implementation of a sugar-sweetened beverage tax ($0.20/litre) in Newfoundland & Labrador (n=3,241)[1,2,3,4]

Beverage[7]	Any weekly consumption[5]		Mean L/week, among consumers[6]	
	Odds ratio, 95% CI	p[7]	Estimate 95% CI	p[7,]
SSBs, taxable	**0.76 (0.67, 0.86)**	**<0.001**	0.11 (-0.09, 0.31)	0.292
SSBs, not taxable	**1.52 (1.34, 1.73)**	**<0.001**	0.02 (-0.13, 0.17)	0.785
Diet beverages	0.98 (0.87, 1.1)	0.698	**0.49 (0.19, 0.78)**	**0.001**
Unsweetened beverages[8]	—	—	0.1 (-0.39, 0.58)	0.697

[1]Beverage intake measured via 7-day semi-quantitative food frequency questionnaire among cross sectional samples of adults ages 19 years and older living in Newfoundland & Labrador before (n=1238) and 1 year after (n=2008) tax

[2]Results from multivariable regression models adjusted for age, sex, education employment status, income, food security, BMI class, and urbanicity. Unless otherwise noted, results are from two-part hurdle models which estimate (1) the binary outcome of zero versus any weekly consumption and (2) the semi-continuous mean weekly amount consumed, among those who reported any consumption.

[3]Estimates and variances computed within multiply imputed datasets and combined using Rubin's rule.

[4]Weighted regression using inverse probability weights calculated for each participant using 2021 Canadian Census.

[5]Binary portion of two-part hurdle model fitted using a binary distribution and logit link function. Estimates are exponentiated and then inverted for easier interpretation. Odds ratios correspond to the difference in odds of reporting any consumption of the beverage, comparing the post-tax to the pre-tax sample.

[6]Semi-continuous portion of two-part hurdle mode fitted using a gamma distribution and identity link function. Estimates are mean changes and correspond to the marginal mean difference in beverage consumption (L/week) comparing those with any consumption after the tax to those with any consumption before the tax.

[7]All p-values are adjusted for multiple hypothesis testing using the Benjamini-Hochberg method.

[8]When aggregated, study participants reported near ubiquitous weekly consumption of unsweetened beverages. We therefore fit a linear model with a gaussian distribution and identity link function to estimate mean weekly differences in consumption. Estimates corresponding to the disaggregated beverages within this category are derived from the two-part models previously described.

Non-Taxable SSBs

After the tax was implemented, the adjusted odds of reporting weekly consumption of non-taxable SSBs increased by approximately 52% (OR = 1.52, 95% CI: 1.34, 1.73; $p < 0.001$) (Table 5).

However, among individuals who consumed non-taxable SSBs, the average weekly intake remained unchanged between the pre-tax and post-tax periods. The adjusted mean difference in intake was not significant (20 mL, 95% CI: -130, 170; $p = 0.524$) (Table 5).

Diet Beverages

There were no statistically significant differences in the prevalence of diet beverage consumers, though the amount of diet beverages consumed between the pre-tax and post-tax periods increased on average (weighted) (490 mL, 95% CI: 190, 780; p=0.001) (Table 5).

However, the odds of consuming specific diet beverages increased after the tax, including diet energy drinks (OR = 1.84, 95% CI: 1.42, 2.4; $p < 0.001$), diet sports drinks (OR = 1.27, 95% CI: 1.01, 1.58; $p = 0.037$), and diet pop (OR = 1.14, 95% CI: 1.01, 1.29; p=0.041).

Unsweetened Beverages

Both before and after the tax, unsweetened beverages remained the most commonly consumed category, with 86–92% of respondents reporting consumption (Table 4). There was an increase in the adjusted odds of consuming plain, unflavoured milk by 20% (OR = 1.20, 95% CI: 1.06, 1.35; $p = 0.003$) and a decrease in the adjusted odds of consuming plain bottled water by 15% (OR = 0.85, 95% CI: 0.75, 0.95; $p = 0.005$). There was no change in the adjusted odds of consuming 100% fruit juice nor tap water. There were no significant changes in the volume consumed for any unsweetened beverages.

Equity Impacts of NL SSB Tax on Beverage Consumption

Key Findings

- **The likelihood of consuming any taxable SSBs differed by population subgroups: (a) respondents from food secure households were less likely to consume taxable SSBs one year later, but there was no change in households with food insecurity; (b) all income groups were less likely to consume taxable SSBs one year later, but there was a greater reduction in likelihood in respondents above the poverty threshold.**
- **Neither perceived (self-reported) boil water advisories, nor government-reported boil water advisories, predicted SSB intake. Only the presence of perceived (self-reported), not government-reported, boil water advisories predicted water intake.**
- **Negative attitudes towards water significantly predicted intakes of both SSB and water. However, after fully adjusting for sociodemographics and boil water advisories, attitudes towards water no longer predicted SSB intakes.**

Food Insecurity Status

At both time points, individuals living in households with severe food insecurity were more likely to consume taxable SSBs weekly, based on unadjusted data (Table 6). Half or fewer of those in food-secure households reported weekly taxable SSB consumption. Before adjusting for other factors, individuals in severely food-insecure households consumed more than twice the volume of taxable SSBs compared to those in food-secure households (Table 6).

There was a significant interaction effect suggesting that changes in taxable SSB intake depend on food security status ($p=0.020$). After adjusting for confounders, there was a statistically significant decrease in the likelihood of being a consumer of taxable SSBs among those whose who were food secure (OR = 0.66, 95% CI: 0.56, 0.78; <0.001), but not those who were food insecure (OR = 0.92, 95% CI: 0.76, 1.10; 0.537). Mean intakes of taxable SSBs by consumers did not change for either group, and did not differ between groups ($p > 0.05$).

There were no significant interaction effects by food security status for consumption of other beverage groups (non-taxable SSBs, diet

beverages, or unsweetened beverages) ($p > 0.05$). The likelihood of being a consumer of non-taxable SSBs increased by about 50% in both food secure (OR = 1.49, 95% CI: 1.24, 1.79; $p < 0.001$) and food insecure (OR = 1.54, 95% CI: 1.28, 1.86; $p < 0.001$) groups. Mean intakes of diet beverages among consumers increased in both food secure (410 mL, 95% CI: 85, 735; $p = 0.049$) and food insecure (763 mL, 95% CI: 180, 1,347; $p = 0.044$) groups, but there were no changes in likelihood of being a consumer in either group ($p > 0.05$).

Table 6. Impact of NL SSB Tax on Population Subgroups.

Sociodemographic characteristic	Unadjusted prevalence of Taxable SSB Consumption (%)		Unadjusted amount consumed of Taxable SSBs (non-zero) (mL/week)	
	Pre-tax	Post-tax	Pre-tax	Post-tax
Food Security Status				
Food Secure	51.2%	45.4%	2271 (2913)	2198 (3313)
Marginal Food Insecurity	64.0%	55.9%	2233 (2358)	2179 (2685)
Moderate Food Insecurity	61.4%	68.1%	2522 (2409)	3131 (4317)
Severe Food Insecurity	67.4%	73.4%	4856 (5937)	4262 (5200)
Income				
Above Poverty Threshold	55.0%	52.0%	2312 (2860)	2445 (3736)
Below Poverty Threshold	60.8%	63.9%	3412 (4422)	3673 (4516)

Income

The unadjusted prevalence of being a taxable SSB consumer during a given week was higher in respondents who reported incomes below the poverty threshold than in those above the poverty threshold (Table 6). The observed changes in the prevalence of being a consumer of taxable SSBs were opposite of each other, where those above the poverty threshold decreased (-3.0%) and those below the poverty threshold increased (+3.1%) from pre-tax to post-tax, unadjusted for other factors. Those below the poverty threshold consumed more taxable SSBs before and after the tax, compared to those above the poverty threshold (unadjusted estimates) (Table 6).

There were no significant interaction effects with income, suggesting that changes in beverage intake did not depend on being above or below the poverty threshold for being a consumer of any beverage category, nor did the mean amount reported by consumers depend on income level ($p > 0.05$). Stratified analyses show a 26% reduced likelihood of being a weekly consumer of taxable SSBs among those with household incomes above the poverty threshold (OR = 0.74, 95% CI: 0.63, 0.88; $p = 0.004$). Similar reductions were seen among those with household incomes below the poverty threshold but these were no longer significant after correcting for multiple statistical tests (OR = 0.76, 95% CI:

0.61, 0.95; p = 0.095). Both income groups showed statistically significant increases in the likelihood of being a weekly consumer of non-taxable SSBs (data not shown); neither group showed any changes in likelihood of being a weekly consumer of diet beverages. There were no changes in the mean amounts consumed by beverage category for either income group in stratified analyses.

Boil Water Advisories

Of the survey responses with location information, 315 (15.8%) respondents lived in communities with a government-reported boil water advisory at the time of the survey (Table 7). Self-reported boil water advisories were mismatched (incorrect) with government reports for almost one in five respondents (n=327, 17.9%). In most cases (74.6%), respondents self-reported that their community did not have a boil water advisory, but government reports indicated that their community did have one at that time. The remaining (25.4%) self-reported a boil water advisory when there was no government-reported boil water advisory.

Table 7 Cross tabulation of boil orders in NL during the pre- and post-tax study period (n=1823)

		Government-Reported Advisory	
Self-		***Boil Water Advisory***	***No Boil Water Advisory***
Reported	Boil Water Advisory	42 (2.3%) (correct)	83 (4.6%) (incorrect)
Advisory	No Boil Water Advisory	244 (13.4%) (incorrect)	1454 (80.0%) (correct)

SSB intake was not predicted by living in a community with a current government-reported boil water advisory (unadjusted β=-2 (40) mL/week), p=0.959; adjusted β=7 (41) mL/week, p=0.861) or self-reported boil water advisory (unadjusted β=89 (57) mL/week, p = 0.114; adjusted β=21 (57) mL/week; p = 0.720).

Approximately 20% of respondents reported having negative attitudes towards their tap water (dislike the taste, smell, colour of the water; feel as though the water is not safe; feel the need to add juice/flavouring to drink it; limits the foods they can prepare). The remaining had neutral (25%) or positive (55%) attitudes towards their tap water. Significant differences were found in daily water intake (F (2, 2956) =22.54, p < 0.001) and SSB consumption (F (2, 2940) = 14.88, p < .001) between groups with positive, neutral, and negative attitudes towards water (Figure 11). Post-hoc test showed gradients in attitudes and beverage intake where more negative attitudes towards water were associated with lower water intakes and higher SSB intake (Figure 11).

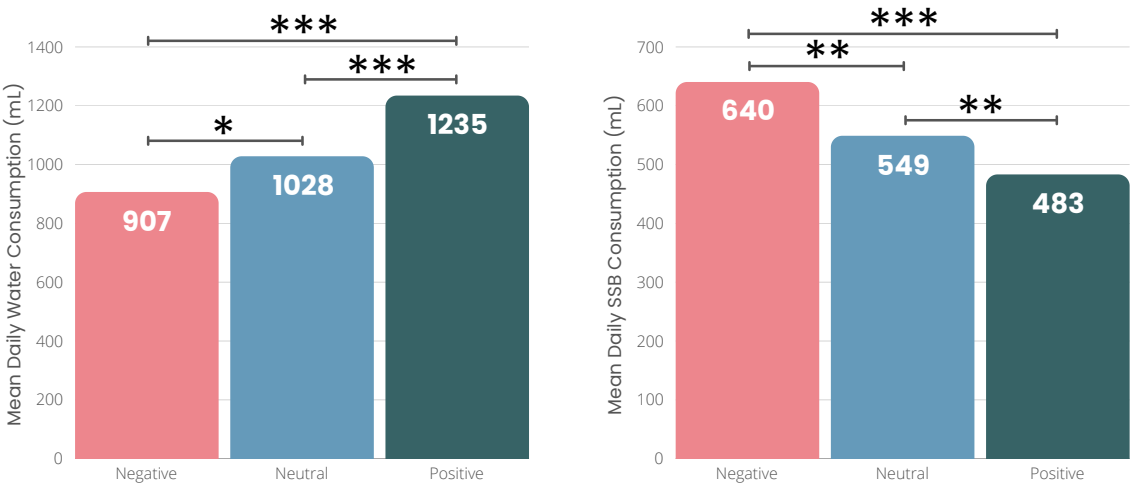

Figure 11. Mean daily intake of (A) water and (B) SSBs among those with negative, neutral, and positive attitudes towards their tap water, unadjusted for other factors. Significance is denoted by * for p <0.05, ** for p<0.01, and *** for p<0.001 .

Negative attitudes towards water predicted greater SSB intake (β =133 (39) mL/week, p <0.001 mL), unadjusted for other factors. However, after fully adjusting for sociodemographic characteristics, there were no effects of negative water attitudes, nor effects of boil water advisories (self-reported or government-reported), on SSB intakes (p >0.05). In a fully adjusted model, we found significant impacts of negative (β = -221 (73) mL/week, p = 0.002) and neutral (β =-168 (64) mL/week, p = 0.009) attitudes (compared to positive attitudes) on water intake, as well as self-reported boil water advisories (β=-213 (105) mL/week, p = 0.042). There was no effect of government-reported boil water advisories on water intake (= β -20 (76) mL/week, p = 0.797) in the model.

Discussion: Beverage Consumption and Equity Impacts

Our preliminary findings suggest that the SSB tax may have been associated with a reduced prevalence of consumption of targeted (i.e., taxed) beverages, but may also have unintentionally increased consumption of exempt (i.e., non-taxed) SSBs, in convenient samples of Newfoundlanders and Labradorians. While changes were detected in the likelihood of consuming SSBs (i.e., reporting any versus no weekly intake), we did not observe significant differences in the average quantity consumed among those who reported any (non-zero) intake. This contrast suggests a nuanced impact of the tax. For some individuals, SSB consumption is episodic (e.g., occasional or infrequent), whereas for others, it is habitual (e.g., daily or more). The health implications of SSB consumption are relevant both in terms of prevalence (any vs none) and intensity (more vs less) (12, 16, 18, 60). Therefore, when evaluating tax effects we should consider both reductions in the proportion of consumers and changes in the amount consumed among those who continue to drink SSBs.

In our analysis, the observed effects were confined to prevalence, suggesting that the tax may have been more effective among less frequent or irregular consumers. This is consistent with previous research by Ng et al. (2018), which posited that habitual or high-volume consumers may be "relatively unresponsive to price changes…due to habituation to [SSBs]" (61). This phenomenon remains underexplored, and future research should investigate whether baseline consumption levels modify the effect of the NL SSB tax—particularly considering ongoing debates about differential price elasticities among heavier versus lighter consumers (61-63). In addition to consumption intensity, differential impacts across population subgroups warrant attention. Individuals with lower income, for instance, are generally more sensitive to price increases and may respond more strongly to SSB taxes (34), however this was not seen in our data.

Current scientific evidence cannot conclude with certainty that SSB taxes significantly change taxable or untaxed beverage consumption (33). Additionally, there is insufficient evidence to assess the pooled effects of SSB taxes on energy intake (33). Mixed results have been seen for the effects of SSB taxes on population subgroups (33). In Mexico, studies have consistently found that groups with lower income and lower socioeconomic status reduced their purchases of taxed beverages more than their higher income and socioeconomic status counterparts (33). In Chile, Spain, and the United Kingdom, opposite effects were observed (33).

A modelling study showed that a Canadian SSB tax may decrease mean per capita energy intake from sugary drinks (-29 kcal [-18 to -41]) and may improve dietary equity in males, those with lower incomes and education, and those who are food insecure (64). Our research showed unexpected trends by population subgroups in that food secure groups and higher income groups appeared to react more to the SSB tax. There are multiple potential factors that may help explain these findings: (a) unclear communication of the SSB tax to consumers may have resulted in differential levels of awareness in groups and thus differences in consumer response; (b) a lower frequency (non-habitual) consumption of SSBs in food secure and higher income groups may make it easier to move from being a weekly consumer of taxable SSBs to a non-consumer; (c) prohibitive or undesirable cost of alternative options (bottled water, milk) for food insecure or low income groups may have prevented behaviour change; (d) affordable options within beverage category alternatives (e.g. store brand cola) may have encouraged price sensitive consumers to switch to a cheaper variety to offset the cost of the SSB tax; and (e) increased discounting and promotions of taxable SSBs following the implementation of the SSB tax may have encouraged continued purchasing and consumption of these products.

At the time of the study, 138 communities in NL were listed in government records as having a boil water advisory, some of which have been affected for over three decades (65, 66). While perceptions of a

boil water advisory and a non-positive attitude towards water were predictive of lower water intake, we did not find an effect of having perceived or government-reported boil water advisory, nor water attitudes, on SSB intake, after controlling for other factors. It could be that high SSB intakes are the cultural norm in NL, regardless of current water environments. It is unclear whether or to what extent water is an acceptable or accessible substitute for SSBs for consumers in NL. As recommended by Canada's Food Guide and the Government of NL's 'Rethink Your Drink' campaign, switching from SSBs to plain water would yield the greatest caloric benefit. We observed an increase in the weekly consumption of other SSBs not subject to the NL SSB tax along with an increase in the per capita sales and mean consumption of diet beverages which may indicate some preference for these beverage types as substitutes for taxable SSB. The evidence on how SSB taxes impact the purchasing and consumption of other beverages (i.e. substitution effects) is still emerging (33). Understanding the effect of SSB taxes on beverage intake, and dietary intake as a whole, is a critical consideration when estimating health impacts.

Summary & Recommendations

Summary

Key Findings

- Posted retail prices of taxable SSBs remained unchanged post-tax, but there were trends of increased discounting and promotion (the latter, was not statistically significant) for these beverages.
- The NL SSB tax was not widely communicated to consumers on shelf price tags.
- Sales of taxable SSBs declined in NL, consistent with expectations for an SSB tax. However, a smaller decline was also observed in the Maritime provinces which do not have a tax on SSBs.
- The likelihood of consuming taxable SSBs in a given week significantly decreased one year after the NL SSB tax was implemented, after adjusting for other factors.
- Among those who continued to consume taxable SSBs, intake levels remained unchanged between pre-tax and post-tax periods.
- Average taxable SSB intake in NL remained high, nearly three litres per week, after the implementation of the NL SSB tax.
- The likelihood of consuming any taxable SSBs differed by population subgroups one year after the NL SSB tax was implemented: (a) respondents from food secure households were less likely to consume taxable SSBs one year later, but there was no change in households with food insecurity; (b) all income groups were less likely to consume taxable SSBs one year later, but there was a greater reduction in likelihood in respondents above the poverty threshold.
- Intakes of taxable SSBs did not differ between respondents who experienced a perceived (self-reported) or actual (government-reported) current boil water advisory in their community.

This quasi-experimental study evaluated the real-life implementation and impact of the NL SSB tax. We examined whether, and to what extent, the tax influenced beverage pricing, marketing, purchasing, and consumption one year after its implementation. Additionally, we explored equity considerations, particularly whether the tax had differential effects on individuals living in households experiencing food insecurity, individuals with annual household incomes less than $50,000, and individuals living in communities with boil water advisories.

This evaluation highlights three opportunities for policy action to support reduced sugar intake, improved diets, and better health:

1. Continue to tax SSBs in NL and adopt SSB taxes across Canada.
2. Maximize the benefits of the NL SSB tax through tax redesign (magnitude, scope, and communication).
3. Reinforce efforts to reduce SSB intake and improve health by strategically reinvesting revenue.

Recommendation #1: Continue to tax SSBs in NL and adopt SSB taxes across Canada.

NL was the first province in Canada to introduce an excise tax on SSBs. Data trends in beverage purchasing and consumption one year after its implementation show small population-level shifts away from taxable SSBs. Ongoing research is needed to assess long-term effects and potential strategies to enhance the effectiveness of the tax in reducing SSB consumption, particularly among vulnerable populations. Health improvements from reduced SSB intakes will take time to achieve; SSB taxes are an investment in the future health of people and society. A repeal of the NL SSB tax is a repeal of potential health benefits. We recommend that the NL SSB tax be continued (i.e. not repealed), or reinstated if repealed, as a health promoting policy for Newfoundlanders and Labradorians. We recommend that other regional, provincial, or national jurisdictions in Canada adopt a tax on SSBs, considering tax design and implementation factors discussed in this report.

Recommendation #2: Maximize the benefits of the NL SSB tax through tax redesign (magnitude, scope, and communication).

There is a general consensus that a tax that increases SSB prices by 20% is an effective public health measure, capable of significantly curbing consumption (59). The NL SSB tax's current rate ($0.20 per litre) represented a moderate average price change (8.5%). With inflation, the percentage increase caused by the SSB tax would decrease. The NL SSB tax would have to be increased to closer to $0.50 per litre to reach a 20% price increase, and should be periodically adjusted based on inflation to maintain the effective price hike.

For optimal dietary and health improvements to be gained from an SSB tax, it is important that the tax covers the large majority of sugar-containing beverages. The observed increase in the odds of weekly consumption of non-taxed beverages following the tax's implementation is concerning since the added sugars in these exempted beverages are metabolically equivalent to those in taxed products. Further, fruit juices can be just as high in free sugar (and calories) as soda/pop. It is possible that leaving fruit juices untaxed may lead consumers or manufacturers

to substitute soda with juice – undermining the intended sugar reduction. For example, after Poland implemented an SSB tax, some beverage producers increased the juice content in their drinks, presumably to reclassify them and avoid higher taxes (59). To counter such shifts, NL could consider taxing beverages based on total sugar content regardless of source. Broadening the scope of SSB taxation in Canada is expected to yield substantial health and economic benefits. A simulation by Kao et al. (2020) estimated that implementing a 20% excise tax on all sugary beverages—including both those currently taxed and those exempt under NL's policy—could prevent approximately 690,000 disability-adjusted life years and reduce healthcare expenditures by nearly $11 billion over a lifetime (67). NL might consider expanding its tax to cover juice drinks or sweetened milk-based beverages. At minimum, public health messaging should make clear that "no-added-sugar" does not automatically mean "healthier". Ensuring broad coverage closes loopholes and maximizes the policy's impact on reducing sugar intake.

Inconsistencies in the implementation of the SSB tax between stores, including how they communicate the tax to consumers, display the tax amount, and apply the tax have potentially significant implications on the effectiveness of the tax at a population level and interpretation of research findings. Discrepancies in implementation may hinder the intended public health impacts of the NL SSB tax. The effectiveness of an SSB tax depends on visible price increases at the point of decision-making (e.g., shelf tags) (6). If consumers do not see the price increase before purchasing, the tax may not effectively reduce SSB consumption and health benefits are unlikely to be realized. Displays of the SSB tax in small font, hidden behind sales tags, combined with other fees, or only documented on store receipts do little to raise awareness of the SSB tax to consumers. Prices that include the value of the SSB tax would more clearly communicate the additional financial cost of purchasing an SSB. If the goal of the tax is to discourage purchases, consumer awareness of the SSB tax at the point of decision-making should be a priority and the tax policy should be designed to best ensure that the consumer is informed.

Recommendation #3: Support reduced SSB intake and improved health by strategically reinvesting revenue

SSB taxes are aligned with human rights by their support for individuals achieving optimal health (33). SSB taxes are not assumed to achieve optimal health alone, but combined with a mix of reinforcing health promotion initiatives which can be funded through tax revenues. SSB tax revenue can be effectively used to support social and health promotion interventions to improve diet and health equity (33). Studies have shown that those of the lowest income reap the greatest health benefits from SSB taxes. Concerns of the financial regressivity of a SSB tax must be weighed against the expected health benefits (33).

There is potential to support health in lower income and food insecure groups, even in light of lesser behaviour changes in these groups after the first year of the tax. The SSB tax revenue in NL was said to be used for school nutrition programs, pre-natal infant nutrition supplements, physical activity tax credits, and a continuous glucose monitoring pilot. Ensuring that complementary health promotion initiatives are equity-promoting will be critical in securing broader health changes for Newfoundlanders and Labradorians. Further dietary improvements can be achieved by other supportive interventions such as healthy food subsidies targeted to low-income populations (rather than subsidies for the general population). Additionally, interventions to address water quality and safety in NL may be necessary to enable and encourage consumers to adopt water as their drink of choice.

Revenue generated from SSB taxes should be clearly defined for public health initiatives, with a focus on reducing inequity. SSB tax revenue used for health promotion can help alleviate public discontent for SSB taxes and continue to shift the needle on public acceptability of upstream health interventions.

Conclusion

While the NL SSB tax has begun to shift purchasing and consumption patterns in the expected direction, its full potential is constrained by its exclusion of many sugary drinks, low tax rate, invisibility in stores, and its limited effectiveness in vulnerable populations. To maximize public health benefits, NL should continue the SSB tax with clear communication to consumers, expand the product scope subject to the tax, index the SSB tax rate to inflation, and embed the policy within a broader chronic disease prevention strategy. If sustained and refined, the NL SSB tax holds promise to reduce SSB intake and to serve as a model for other Canadian jurisdictions aiming to combat diet-related chronic disease through fiscal policy.

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