SUGAR-SWEETENED BEVERAGES: TAXATION EVIDENCE FROM SEVEN EUROPEAN COUNTRIES AND RECOMMENDATIONS FOR IMPLEMENTATION IN OTHER EU REGIONS

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SUMMARY

Objectives: Higher-than-recommended sugar consumption (< 10% of total energy intake; WHO) leads to negative health impacts and the development of serious diseases. Sugar-sweetened beverages (SSBs) proved to be among the leading sources of free sugar intake, as they contain large amounts of added sugar. Our article aims to propose tax measures that will help change consumer behaviour and reduce SSBs consumption.

Methods: For a comparison of the forms of taxation, the experience of seven countries (Denmark, France, Hungary, Italy, Poland, Catalonia – Spain, and the UK) were analysed. The evolution of sugar consumption, consumption of sweetened drinks and obesity before and after the introduction and/or abolition of the sugar tax were reviewed.

Results: States that implemented a tax on SSBs were able to reduce SSBs consumption in the first year after the tax was introduced when states with a sugar-content-based tax have implemented it more effectively than states with a volume-based tax. Based on this finding, we propose basic design assumptions for the tax that can be used in European countries that have not yet introduced the tax. Progressive taxation divides beverages into 3 bands. The basic assumption is to encourage the desired consumer behaviour, i.e., consumption of SSBs with lower sugar content. The proposed tax design is applied to the conditions of the Czech Republic as a model case study.

Conclusions: The results of our study suggest that SSBs taxation could be an effective policy intervention to improve population health by reducing the health impacts of SSBs among children and adolescents, although further studies are needed to prove the causality of the described associations.

Key words: sugar-sweetened beverages, taxation, health impact, obesity, diabetes mellitus type 2

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INTRODUCTION

The implementation of excise taxes as a strategy to reduce the affordability of sugar-sweetened beverages (SSBs) has been effective in decreasing their consumption. SSBs, known to be significant contributors to free sugar intake, are linked with the rise of various non-communicable diseases. Initially intended for revenue generation, these taxes are increasingly being adopted by countries to promote healthier eating habits and improve the health-related quality of life of their inhabitants. However, the design and rates of these taxes vary considerably around the world, and many do not optimally align with public health objectives (1).

SSBs include a variety of drinks, such as regular sodas, fruit-flavoured beverages, and sports and energy drinks. The high sugar content, low satiety, and limited energy compensation of SSBs are recognized as significant factors contributing to the obesity epidemic. The consensus acknowledges that high sugar intake adversely affects public health, with SSBs being a primary dietary source (2). A notable trend is the high consumption of these drinks among adolescents and young adults globally indicating their popularity in younger demographic groups (3, 4).

Epidemiological studies consistently indicate that the consumption of SSBs has adverse health impacts, including increased risks of obesity (4, 5), type 2 diabetes, (4) tooth decay (6), cancer (e.g., colorectal and kidney cancer) (7), cardiovascular disease (4), or hyperactivity disorder (8). This risk is particularly pronounced among adolescents and young adults, the largest consumers of SSBs worldwide (5). Research also highlights growing socioeco-

nomic disparities in SSBs consumption (9), necessitating targeted public health interventions.

Chatelan et al. (10) notes a significant decline in the daily consumption of both sugary and diet soft drinks among teenagers aged 11 to 15 in Western and Northern Europe since the early 2000s. Countries like Ireland, England and Norway have seen quite substantial decreases, evidence of the effectiveness of their public health policies and programmes. The British Soft Drinks Association (11) has confirmed changes in the industry with a trend towards healthier beverage choices.

While taxation is a crucial measure to tackle health issues related to sugary drinks, a more comprehensive and multifaceted approach is vital for successful intervention. In this context, the recent WHO report (1) offers a global assessment of the impact of SSBs taxes, supporting the diverse strategies employed by organizations like UNESDA[a] representing the European soft drinks industry in promoting healthier choices. Public health policies must adapt and include strategies that are effective and equitable for all socio-demographic groups to achieve better health outcomes and reduce health disparities (9).

The aim of this paper is to propose a form of SSBs taxation in Europe in general, and to assess the impact of this tax on SSBs and sugar consumption based on the experience of selected European countries with various experience with and effects of sugar taxes. As a case study, we have chosen the Czech Republic, which exceeds the limit for sugar consumption recommended by the WHO (12) by almost four times and has not yet introduced any form of such taxation. Our aim is therefore to design the tax in such a way that it is simple to construct; can be universally applied to other (particularly European) countries; progressively reflects the sugar content, but allows to waive the tax for those with acceptable sugar content; and motivates producers to reduce the sugar content of SSBs. Our paper will also identify risks that could jeopardise or prevent the introduction of the new tax.

MATERIALS AND METHODS

For a comparison of the forms of taxation, we selected Denmark, France, Hungary, Italy, Poland, Catalonia (Spain), and the UK. These countries were selected for the comparison, because they introduced taxation of SSBs at different points in time and with different initial conditions. Denmark represents countries that introduced the taxation almost hundred years ago, having thus extensive experience with the impact of various changes on producer and consumer behaviour. It is also an example of a country that has abolished the tax. France is an example of a country that has changed the concept of taxation from flat to progressive. Hungary is a country that has set two bands for taxation, but very broadly without the intended effect. Although Italy does not suffer from high consumption compared to other countries, it is an example of a country that plans to introduce this tax in order to improve the dietary habits of its population. We use the example of Italy to illustrate the current approach to implementing the tax. Poland is a country that has also struggled with high sugar consumption and introduced this tax relatively recently. Thus, they could already reflect modern trends in taxation. Catalonia and UK are countries that have introduced the tax based on the amount of sugar in the drink, and they seem to have succeeded in reducing SSBs consumption.

In the short-listed countries, we assessed in particular the evolution of sugar consumption, consumption of sweetened drinks and obesity before and after the introduction and/or abolition of the sugar tax. We obtained the data available from official statistics. To find the trend in obesity in individual countries between 2010 and 2021, we used data on 'obese population, self-reported' available from the OECD database (13). To determine sugar consumption, we used statistics available from the Food and Agriculture Organization of the United Nations[b], we used data for all the available years in the 2010–2020 period. The annual data of soft drinks consumption and the Harmonized Index of Consumer Prices (HICP) regarding non-alcoholic beverages and the gross domestic product (GDP) in the selected countries between 2016 and 2020 were taken from UNESDA, and for the Czech Republic from the Czech Statistical Office[c].

The individual statistical indicators were processed into comparison tables. The years in which the tax was introduced in selected countries (abolished in the case of Denmark) were highlighted as they show the subsequent development. For Poland that introduced this tax after 2020 some of the statistical values are missing. We were interested in checking whether or not there are any trends in individual parameters (especially tax rates) so that we could formulate competitive taxation conditions within other European countries, where the sugar tax has not been introduced yet. This setting was consequently one for which we created a comparison table, with national currencies converted to EUR for consistency.

The AI tool (ChatGPT, Version 4.0) was used in line with recommended guidelines on Artificial Intelligence and Authorship, it was used to correctly formulate ideas and conclusions without affecting the substance of the message or the content of the data.

RESULTS

This section will provide a comparison of the short-listed European countries, i.e., Denmark, France, Hungary, Italy, Poland, Catalonia (Spain), and the UK.

Denmark

Denmark introduced a tax on SSBs in 1930. The tax was based on the principle that it was levied at a flat rate per volume of product without taking into account the sugar content. In 2010, the tax rate was increased to EUR 0.22 per litre for SSBs and EUR 0.08 per litre for artificially sweetened beverages; however, the tax was abolished shortly afterwards in 2013. The Danish government justified this on economic grounds, e.g., job concerns and administrative costs. The country also had a fat tax in place at that time, which increased food prices and made Denmark

[a]www.unesda.eu
[b]www.fao.org/faostat/en/#data/FBS
[c]www.czso.cz/csu/czso/food-consumption-2022

less competitive compared with the neighbouring countries (14). After the tax increase in 2010, the average volume of purchased SSBs with high tax decreased by 13.4% compared to the year before. However, after the tax repeal in 2013, demand increased on average by 31.0%. Although it is not possible to determine the exact baseline value of SSBs consumption before the abolition of the tax due to purchases abroad at that time, we can conclude from the increase in the following years (Table 1) that there was an increase in sales in the Danish market. According to Ridder (15), SSBs annual consumption increased by 19 litres per individual between 2011 and 2020. At the same time, the annual prevalence of obesity began to increase by 4.3 percentage points (Table 2). Economic factors thus outweighed the health risks, increasing consumption of SSBs to 137.2 litres per individual (Table 3).

The results confirm that consumption habits do not change in the short term, and repealing the tax carries the risk that consumption will return to the original or even higher levels (16). In other words, it can be said that short-term fiscal policies may have a reversible impact on consumption habits. The experience of Denmark with the tax on sugary drinks highlights the importance of simple administration, clear definition of taxed products, careful assessment of impacts on consumer behaviour, and obtaining public support for the successful introduction and sustainability of the tax on sugary drinks.

France

France introduced a sugar tax in January 2012 and set a rate of EUR 0.0716 per litre. However, the design of this tax was not considered optimal as the rate was the same for both SSBs and artificially sweetened beverages (17). In 2018, the act was amended to increase the rate to EUR 0.20 per litre for products containing 11 g of sugar in every 100 ml. Thanks to this change, per capita consumption started to decline. Between 2018 and 2021, it was 5.4 litres per individual and the obese population fell by one percentage point (Tables 2 and 3).

The tax on sugary drinks introduced in January 2012 was not immediately shifted to prices, as most models of its impact on consumption assume. However, after six months of its introduction, the tax was already fully shifted to soda prices and almost fully to the prices of fruit drinks, while the pass-through for flavoured waters was incomplete (18). Although the tax led to a slight decrease in sales of sugary drinks and increased sales of juices and particularly bottled water, suggesting a shift in consumer demand patterns (19), its actual impact on health is difficult to determine. Critics, such as the Institute for Fiscal Studies, argue that the effectiveness of the tax depends on which products consumers switch to and how firms change their prices, warning that the tax could lead to consumers switching to unhealthier products or an increase in the prices of diet drinks, thereby weakening its impact on health (20). The tax incidence was slightly higher for

Table 1. *Comparison of annual consumption of sugar and sweeteners in 2010–2020 (kg/capita)*

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Denmark	54.35	56.84	55.46	56.23[b]	54.79	54.85	54.94	55.27	56.01	54.38	59.21
France	37.99	37.72	38.04[a]	39.22	37.25	38.63	38.71	38.78	38.80	34.08	36.22
Hungary	34.39	35.63[a]	35.38	34.75	40.49	41.55	40.90	40.61	40.21	52.14	55.29
Italy	30.03	30.75	31.53	32.12	32.72	32.47	32.46	32.40	33.21	33.44	34.57
Poland	44.93	45.60	45.84	45.52	44.78	40.86	45.54	45.99	46.29	44.16	47.11
Spain	30.41	32.22	32.67	32.43	33.25	33.26	33.49	32.97[a]	33.69	32.49	31.22
United Kingdom	39.04	40.72	41.05	44.73	39.01	37.46	36.99	37.83	38.01[a]	39.69	35.37
Czech Republic	50.78	60.57	65.02	66.17	56.32	48.22	46.66	49.13	43.66	41.71	35.48

[a]The year when the tax was introduced
[b]The year when the tax was abolished
Source: Food and Agriculture Organisation of the United Nations: Food Balances (2010). https://www.fao.org/faostat/en/#data/FBS (2023). Accessed 2 July 2023

Table 2. *Comparison of obese populations (self-reported) in 2010–2021 (%)*

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Denmark	13.40	x	X	14.2[a]	14.90	x	x	16.80	x	x	x	18.50
France	12.90	x	14.5[a]	x	15.30	x	x	15.40	x	14.40	x	x
Hungary	x	x[a]	x	x	21.20	x	x	20.00	x	23.90	x	x
Italy	x	x	x	x	20.10	x	x	21.00	x	x	x	x
Poland	x	x	x	x	16.70	x	x	16.90	x	18.50	x	x[a]
Spain	x	16.60	x	x	16.70	x	x	16.90[a]	x	x	14.90	x
United Kingdom	x	x	x	x	20.10	x	x	21.00	x[a]	x	x	x
Czech Republic	x	x	x	x	18.70	x	x	x	x	19.30	x	x

[a]The year when the tax was introduced
Source: OECD.: Non-Medical Determinants of Health. https://stats.oecd.org/Index.aspx?DataSetCode=HEALTH_LVNG (2023a). Accessed 2 July 2023

Table 3. *Comparison of sugar-sweetened beverage consumption per individual in 2016–2021 (litres)*

Country	2016	2017	2018	2019	2020	2021
Denmark	126.2	125	132.2	137.3	126.8	137.2
France	64.4	64.8	64	62.4	58.1	58.6
Hungary	118.9	127.8	144.5	148.6	141.7	153.9
Italy	51.8	51.6	50.7	50.7	44.1	48.8
Poland	99.9	98.2	101.3	103.1	99.2	91.4[a]
Spain	95.8	94.3[a]	91.3	91.4	82.4	83.4
United Kingdom	106	106.8	108.5[a]	108.9	102.7	104.9
Czech Republic	128.3	130.3	134.4	137.5	128	129.5

[a]The year when the tax was introduced
Source: UNESDA (www.unesda.eu)

low-income and high-consuming households, suggesting some concerns about the regressivity of the tax, although the negative income gradient in tax incidence was offset by a positive gradient in expected health benefits (21).

Hungary

In September 2011, Hungary introduced a tax of EUR 0.013 per litre on food and drinks containing more than 8 g of sugar per 100 ml. From 2012 onwards, the rate was increased to EUR 0.019 EUR per litre for drinks containing more than 8 g of sugar and EUR 0.54 per litre for sweetened concentrates and syrups (19). The introduction of the tax had only a minimal impact, as there was only a decline in the first two years and subsequently an increase in sales of SSBs (19), as shown in Table 2. Over 10 years, there was an increase in sugar consumption of 19.66 kg/capita. Thus, the Hungarian sugar tax has failed to prevent both the rise in obesity in the Hungarian population and the consumption of SSBs; the latter increased by 35 litres per individual between 2016 and 2021 (Table 3). Although the tax aimed to change dietary trends and reduce sugar consumption, the analysis suggests that the fiscal goal of generating revenue was achieved without fully realizing the health objective of changing consumer habits, as evident in the stable and growing tax revenues for the Health Insurance Fund (22). This highlights the complexity of designing effective food taxes to influence health outcomes and underscores the necessity of careful consideration of tax rates and structures to avoid unintended consequences.

Italy

Italy introduced a sugar tax in 2019 to be effective from 1 January 2020. The objective was to incentivize producers to reformulate and decrease the sugar content in their products and, vice versa, to deter consumers from consuming SSBs enhancing thus their health-related quality of life. However, the entry of the tax into force has been several times postponed, for the sixth time until mid-2024. Thus, there is no experience with effects of such a tax in the beginning of 2024. The tax rate is set to be EUR 0.10 per litre for finished products and EUR 0.25 per kilogram for products intended for use after dilution (23). Italy has long been a country with low obesity rates compared to the other short-listed countries. Although sugar consumption has been increasing in the country (Table 1), there was a decline in consumption of SSBs between 2016 and 2021 (Table 3).

The sugar tax aims to encourage producers to reduce the sugar content in sweetened beverages and address health problems associated with excessive sugar consumption, especially among children and young people. The effects of this tax in Italy will be only observed in the coming years and currently rely only on predictions from trade associations. The tax is said not to be a means to penalize unhealthy products, but rather to incentivize a shift towards healthier alternatives, as food education alone may not be sufficient to address health issues caused by obesity and poor nutrition (23).

Poland

Poland introduced a sugar tax on 1 January 2021, when not only SSBs, but also drinks with added artificial sweeteners are subject to the tax. The tax rate has been set at EUR 0.11 per litre, if the sugar content is equal to or less than 5 g/100 ml. If the sugar content exceeds 5 g/100 ml, the tax is increased by an additional EUR 0.011 for each gram of sugar above the limit. The introduction of the tax led to a significant reduction in sugar content driven by manufacturers' efforts to avoid higher tax burdens (24). This decrease was not as pronounced as in the United Kingdom, indicating that the extent of reformulation in response to the tax may vary between countries. The increase in added juice content in Poland following the taxation suggests manufacturers' efforts to create healthier alternatives. Despite the positive changes in Poland, Mazurek-Chwiejczak (25) raised questions about the limited impact of the sugar tax on reducing SSBs consumption, calling into question the effectiveness of the tax itself as a public health tool.

Catalonia (Spain)

In Catalonia, a tax on SSBs has been introduced on 1 May 2017; from the beginning, producers anticipated a 7% price increase. The tax rate was set based on the amount of sugar in 100 ml of the drink. The act has stipulated that the payer (producer) is obliged to pass on the tax to the final consumer (26). Perhaps for this reason, awareness of the tax was relatively widespread among consumers (83.7%); 37.4% of those who were aware of the tax reduced their consumption of SSBs during the first two years

(27). These changes were also reflected in a two-percentage-point reduction in the prevalence of obesity.

United Kingdom

In 2016, the UK Government announced the introduction of a sugar tax, officially named the "Soft Drinks Industry Levy". The sugar tax was introduced on 6 April 2018 and the tax was based on the amount of sugar in the drink. However, fruit juices and milk drinks were exempted from the tax due to their health benefits (28). The expected profit was EUR 604 million, but the actual amount was half of that (EUR 279 million in 2019 and EUR 392 million in 2020) according to HM Revenue & Customs[d]. This was probably due to the fact that more drinks with lower sugar content started to be produced (29). Between 2015 and 2018, the number of drinks sold with a sugar content of 0.1–4.9 g/100 ml increased from 150 million to 212 million litres. On the other hand, the number of drinks sold containing 5 grams or more dropped from 106 million to 50 million litres. In year three of introducing the tax, there was a reduction in consumption amounting to 3.6 litres per person. This had a positive effect on reducing obesity and overweight, particularly in children (30).

The main benefit of introduction of the tax in the United Kingdom has therefore been the change in the composition of sugary drinks already at the point of manufacture. The early reaction of producers to the (planned) taxation changes and the early reformulation of beverages has reduced the consumption of SSBs and shifted them from higher to lower bands (31). This means that the overall benefit may not be based only on tax revenues, but on reducing the risk of potential health problems, including prolonging the working life of people, and the associated increase in lifetime income tax revenue. At the same time, it can be assumed that there will also be a reduction in expenditure on the health care of patients.

DISCUSSION

Taxation on SSBs has been increasingly adopted as a strategic measure to address the surge in non-communicable diseases mentioned, particularly obesity and diabetes. A global overview of SSBs taxes in force has been recently published (1, 32) when the WHO accents that existing taxes on SSBs should be further expanded to decrease SSBs affordability and thereby reduce their consumption (1).

Hajishafiee et al. (33) and Nguyen et al. (34) reached a consensus that a 20% taxation on SSBs can be an effective public health measure. Hajishafiee et al. (33) pointed out that such a tax can modestly reduce the incidence of dental caries across diverse economic regions, while Nguyen et al. (34) observed that when the tax is specifically tailored to the sugar content of beverages, it can lead to even more significant health benefits, underscoring the importance of tax structure in maximizing the positive health-related outcomes of SSBs taxes. The Oakland study by White et al. (35) further confirms the decline in SSBs purchases, with the effects persisting beyond two-year post-tax implementation, indicating the potential for long-term health improvements and cost savings. In Ireland, the work of Crosbie et al. (36) highlights the successful reduction of sugar consumption following introduction of the SSBs tax, attributing the success to the combination of health advocacy, political backing, and policy creation. This example demonstrates the importance of strong political will and public health advocacy in the enactment of effective taxation policies. The analysis by Jones-Smith et al. (37) reveals that despite the sweetened beverage tax being higher in Seattle (Washington, USA) than in other regions, the full cost of the tax was passed to consumers, which is considered an essential step for the tax to result in decreased SSBs consumption.

Table 4 summarizes the main information concerning the countries studied above and their sugar taxation effects. We are aware of some simplifications in the year-on-year results, nevertheless, it has been shown that all countries that have introduced a tax graduated according to the added sugar content have achieved both a reduction in sugar consumption and a reduction in SSBs consumption.

The industry's response to taxation can vary significantly, with potential adjustments to product pricing and marketing strategies (38). The WHO (39) shows that SSBs taxes were strongly opposed by actors in the food and beverage industry, both before and after implementation, in all countries they included to their study. Industry made strong public statements regarding the alleged negative economic impact, particularly in relation to employment. Industry actors often claim that the taxes are ineffective and poorly designed, threaten to withdraw or reduce investment, initiate legal action, or cease participation in public health programmes. This analysis underscores the necessity for governments to predict and steer industry reactions to ensure alignment with public health objectives. On the other hand, media in Finland, France, Portugal, and the United Kingdom reported that SSBs taxes have had little economic impact on the industry (39).

In the context of a global trend towards implementing taxes on sweetened beverages, it is clear that the effect of the tax depends on the specific design of the tax and accompanying public health measures (25, 40). Reyes-García et al. (41) agree that sugar taxes should not be the sole intervention for reducing sugar intake and combating type 2 diabetes, but rather be integrated into a comprehensive policy approach that includes public awareness campaigns and the strategic use of tax revenues for health promotion. According to Allais et al. (29), sugar reduction in new SSBs have been larger in countries that have adopted specific policies to promote decrease in SSBs consumption including their taxation. Peñalvo (42) supports this holistic view, emphasizing that WHO-backed health taxes on SSBs could reduce preventable mortality and generate government revenue for health measures, with effectiveness hinging on public awareness and industry response. Overall, these studies coalesce around the idea that while SSBs taxation is a key policy tool for improving public health, its success is contingent on being part of broader, synergistic strategies that involve multiple sectors and stakeholders working collaboratively to address the complex challenges of modern public health concerns.

A survey carried out in the neighbourhood of Barcelona in November 2019 (43) showed that consumption of SSBs is still

[d]https://www.gov.uk/government/statistics/soft-drinks-industry-levy-statistics

Table 4. *Comparison of tax rates and their impact on annual average sugar and sugar-sweetened beverage consumption*

Country	Introduction year	Abolition year	Tax rate initial/changes	Impact on SSB consumption	Δ Sugar consumption[a]	Δ SSB consumption[b]
Denmark	1930	2013	0.22 EUR/litre (SSB), 0.08 EUR/litre (artificially sweetened beverages)	Increase by 19 litres/person from 2011 to 2020	+0.4257	+1.8333
France	2012	N/A	0.0716 EUR/litre, in 2018 increased to 0.20 EUR/litre for > 11 g/100 ml	Decline by 5.4 litres/person from 2018 to 2021	−0.2275	−0.9666
Hungary	2011	N/A	0.013 EUR/litre, increased to 0.019 EUR/litre and 0.54 EUR/litre for concentrates in 2012	Increase by 35 litres/person from 2016 to 2021	+2.1844	+5.83
Italy	N/A	N/A	0.10 EUR/litre, 0.25 EUR/kg for dilution products	Decline between 2016 and 2021	N/A	N/A
Poland	2021	N/A	0.11 EUR/litre, additional 0.011 EUR/g above 5 g/100 ml	Decline by 7.8 litres/person from 2020 to 2021	N/A	−7.8
Catalonia (Spain)	2017	N/A	Varies based on sugar content	Reduction by 16.7% after 3.5 years	−0.5833	−2.725
United Kingdom	2018	N/A	Based on sugar content; fruit juices and milk drinks exempt	Reduction by 3.6 litres/person after 3 years	−1.32	−1.20

SBB – sugar-sweetened beverage; N/A – not applicable
[a]Average year-on-year change between tax introduction or abolition and 2020
[b]Average year-on-year change in 2016–2021, the given value is either for the whole period or from the introduction of the tax until 2021
Source: compiled by the authors

the rule particularly among the youngest and poorest individuals. The authors stressed that awareness of SSBs' health risks was a key factor for reduced consumption, while only 10.6% of respondents declared that the higher price was the consumption-reducing factors. SSBs taxes participate to the "denormalization" of the act of drinking SSBs on a regular basis, acting as "alarm signal" in society. This is called a signalling effect and informs consumers that sugary drinks are harmful (28, 43). Many populations show high levels of SSBs consumption. Particularly in low-income and middle-income countries, increased consumption patterns are associated with urbanization and economic growth, however, they are less sensitive to SSBs taxes (1, 43). Moreover, in these disadvantaged environments, higher prices of SSBs can lead to increased consumption of non-sugar sweetened beverages (44).

The WHO has stated that the price of the drink should raise by at least 20 percent to deter consumption (45). Dal and Yagüe (43) asked respondents how much the price of a 1-litre bottle of SSBs should increase to deter its consumption, on a scale from 10 cents to 1 euro per litre. Around 16% of the respondents declared that the price should rise at least by 50 cents (i.e., around 20%), and 41% said 1 euro per litre (around 40%).

Recommendation for Implementation of SSBs Taxation in European Countries

There is rich evidence that taxation of SSBs has been beneficial for the health state of population and has met the expectations concerning the impact on SSBs consumption (1, 46). Based on the experience of countries that have already introduced the sugar tax, we can summarize the lessons learned from the successful implementation of the SSBs tax:

- The effect of the tax depends on the specific design of the tax and accompanying public health measures;
- Systems with scaling the tax according to the sugar content (a sugar-based tax) are more effective than those with a volume-based tax;
- Excessively high taxation might lead to a counterproductive effect (compare the US prohibition times);
- The signalling effect of the taxation is to be considered and exploited; this is an opportunity to educate the public about the harms of SSBs;
- It is important that the true purpose of the tax was communicated transparently;
- Inconsistencies between identified beliefs among both public and politicians and scientific literature are to be addressed;
- The tax is better accepted if the raised revenue is fully used for health purposes;
- Support from non-governmental actors can counter industry opposition and encourage the adoption of taxation;
- Producers should be allowed to optimize for tax purposes, this pressure on manufacturers has had a positive effect, e.g., in the United Kingdom;
- Sugar reductions in SSBs have been larger in countries that have adopted specific policies to promote them;
- The tax can have also a negative impact, overly high taxes could negatively impact the consumption of healthy, beneficial beverages such as dairy products, or lead to increased consumption of artificially sweetened beverages;
- Some countries have faced an increase in cross-border purchases partially or completely cancelling out the positive effect of the tax;
- The tax design and administration require adaptation to a country's legislation, revenues, economic situation, and healthcare system.

Following the recommendations above, we can proceed to the actual construction of the SSBs tax. Our recommendation is to base the taxation of SSBs on the following principles (Table 5):

Table 5. *Proposal for taxation of sugar-sweetened beverages*

Taxation	Sugar content (S_g)	Sugar tax rate	VAT rate
1st band	< 5 g	Exempt	Reduced rate
2nd band	5–10 g	TR_{5+}	Reduced rate
3rd band	> 10 g	TR_{5+}	Standard rate

Source: authors' own tax design

- Exempt from the tax all beverages that do not exceed a sugar limit of 5 g/100 ml. This is intended to motivate consumers to choose them more often, at least initially, as their price will be lower than that of beverages with higher sugar content. Except for the reduced VAT rate, no other taxes will be levied on them.
- Following Poland's example, introduce progressive taxation for content above 5 g/100 ml, with two separate bands proposed. For calculating the specific tax amount, we use the following formula

$$TR_{5+} = TR_B \times S_g$$

where:

TR_{5+} – tax rate for SSBs;

TR_B – basic sugar tax rate, i.e., the tax for 1 gram of sugar in 100 ml SSBs;

S_g – sugar content in grams per 100 ml of the beverage.

Exact rate TR_B is to be set according to local conditions in the particular country and may differ.

- Following France example, significantly tax beverages with higher sugar content. Our defined limit is set at 10 g/100 ml, with the main difference between the 2nd and 3rd bands being that the 3rd band also applies the standard value-added tax (VAT) rate. The standard VAT rate is typically applied, among other, to products harmful to health, such as cigarettes and alcohol. For beverages exceeding the sugar content limit of 10 g/100 ml, it is not possible to speak of a better impact on human health compared to drinks with lower content.

Case Study: Czech Republic

In the Czech Republic, the average annual sugar consumption is reported to be around 35 kg per person, which is about 91.5 g per day (47), exceeding the WHO recommendation that adults and children should reduce their daily intake of free sugars to less than 10% of their total energy intake (12) almost four times. Moreover, the number of Czech patients with type 2 diabetes increased by 23.5% between 2010 and 2021, reaching more than 10% of the country's population (48), while there is also a rapidly increasing number of children with obesity and type 2 diabetes (49). According to a statistical prediction, there will be about 1.3 million (12.26% of the population) diabetics in the Czech Republic in 2030 (48).

Similarly to other countries, the main source of sugar in diet is in SSBs, while SSBs are popular especially among children and adolescents in the country. Moreover, the Czech Republic belongs to the countries where the share of the population aged 15 and over drinking at least one SSB drink daily (men 14.0%, women 8.8%, both sexes 11.4%) is above the European Union average (11.7%, 6.7%, and 9.1%, respectively) (50). Table 6 provides official data of the Czech Statistical Office concerning consumption of non-alcoholic beverages in 2012–2022. Although soda water means unsweetened water in the Czech Republic, mineral waters are partly sweetened and the other two categories (lemonades and other non-alcoholic drinks) present products with a high sugar content. Therefore, it is essential to change consumer behaviour and preferences, leading to improving health state of both adults and children. Thus, the Czech Republic is a valid candidate for introduction of the SSBs taxation.

For reasons of social acceptability, we propose to set the basic sugar tax rate TRB equal to the base rate of excise duty on beer. In the Czech Republic, this rate is CZK 32 per hl (ca EUR 1.28 per hl), which corresponds to EUR 0.0128 per L. In France, Poland, Spain, and the United Kingdom (the countries with sugar-based tax rate), the SSBs consumption declined in average by 3.10% during the first year after the sugar tax was introduced. Based on these results, an initial decrease in SSBs consumption from 129.5 to 125.5 litres per individual can be expected for the Czech Republic.

Limitations of the Study

The effectiveness of the tax on SSBs can be influenced by broader social and economic factors, including income level, income inequality, the availability of healthy alternatives, and public awareness of health risks. These factors can vary regionally and culturally, meaning the impacts of the tax are not uniform and may have unintended social consequences, such as increased financial burdens on low-income groups.

One of the limitations of the study is that it may not fully reflect the dynamics of the particular market and the potential changes in behaviour of producers and consumers induced by the introduction of the tax. This includes possible strategic changes by producers, such as product redefinition to reduce sugar content or an introduction of new, healthier options to avoid the tax. Consumer behaviour may not be uniformly affected; some may switch to untaxed alternatives, while others may not change their consumption habits due to brand loyalty or lack of awareness of

Table 6. *Annual consumption of non-alcoholic beverages in the Czech Republic (L/capita)*

Unit	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Mineral waters	63.0	59.0	55.0	56.4	57.5	55.3	62.5	56.8	54.3	53.8	51.7
Soda waters	35.0	32.0	28.0	31.2	30.9	30.2	31.4	29.6	28.3	29.6	28.9
Lemonades	104.0	98.0	94.0	92.8	89.2	89.3	92.9	93.8	90.7	87.7	85.4
Other non-alcoholic drinks	76.0	75.0	72.0	69.5	70.2	67.0	64.7	66.7	64.9	65.5	64.5

Consumption of mineral waters and other non-alcoholic beverages (in L) comprises consumption of soda water, mineral water (sweetened and non-sweetened, flavoured and non-flavoured), soft drinks and lemonades (made of fresh water and concentrates, usually carbonated) and other non-alcoholic drinks (fruit and vegetable juices, syrups, etc.).
Source: Czech Statistical Office, Food consumption – 2022, Published 1 December 2023, https://www.czso.cz/csu/czso/food-consumption-2022 (Accessed on 1 March 2024)

health risks. New purchasing behaviour patterns may also emerge, such as cross-border shopping (e.g., in Denmark or Poland) or activities within the informal economy to evade the tax. These complex interactions can significantly influence the expected impacts of the tax on consumption, health outcomes, and tax revenues, making predicting the overall impact of the tax challenging without considering these dynamic responses.

Although the literature has shown correlations between the SSBs taxation, SSBs consumption and health outcomes, they lack any analyses of the causality of these correlations. This is due to a general lack of data, especially in the medium or long term. A considerable lack of data also makes it impossible to better estimate the (health and budgetary) consequences of the introduction of the SSBs tax in the Czech Republic.

CONCLUSIONS

The results of our study suggest that subjecting SSBs to taxation could be an effective political measure to improve population health by reducing the health impacts of SSBs in children and adolescents.

Designing the tax, however, necessitates setting the effective tax zones based on the sugar content in 100 ml of SSB. Examples of good practice from abroad show that countries that exempted beverages containing up to 5 g/100 ml and then progressively taxed those with a higher sugar content achieved better results than, for example, Hungary, which set the first limit at 8 g/100 ml.

Progressive taxation motivated the producers themselves to reduce the sugar content of beverages to reach a lower tax zone (part of tax optimisation). While this reduced the amount of predicted tax revenues, the reduced sugar consumption has many benefits (e.g., reduced public health spending). These benefits cannot be ignored, although they are difficult to quantify.

The existence of the tax as such has also had a positive effect as the mere fact that the negative effects of excessive sugar consumption were discussed in public led to changes in consumer eating habits. Conversely, after the tax was cancelled (Denmark), there was a significant increase in SSBs consumption in a relatively short time. Yet further studies are needed to prove this mutual causality.

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Conflicts of Interest

None declared

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