



# Do taxes on unhealthy foods and beverages influence food purchases?

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## Abstract

**Purpose of Review** Interest in taxes on unhealthy foods and beverages as a public health tool has increased in recent years. This paper aimed to summarise recent evidence of the impact of taxes on unhealthy foods and beverages on food purchases, and discuss opportunities to advance knowledge and policy impact.

**Recent Findings** Evaluations of taxes on unhealthy foods and beverages have shown reductions in purchases of targeted unhealthy products and nutrients. Similarly, data from multiple sources demonstrate that as prices of unhealthy foods and beverages increase, purchase volume decreases. However, studies indicate potential for substitution to non-taxed unhealthy foods, which needs to be factored into taxation design.

**Summary** Taxes on unhealthy foods and beverages are a promising strategy to improve population diets. Further research is required to understand food industry responses to tax implementation, as well as the impact of taxes on population and planetary health outcomes.

**Keywords** Food tax · Consumption · Obesity prevention · Food policy

## Introduction

Unhealthy diets and obesity are leading contributors to poor health worldwide [1, 2]. Moreover, there are prominent socio-economic inequalities in the distribution of dietary risks and associated non-communicable diseases (NCDs) [3]. A wide spectrum of interventions has been identified to address unhealthy diets and related NCDs. As part of a comprehensive societal response, there is global consensus that there needs to be a transition to healthy food environments, in which, foods, beverages and meals that contribute to a healthy diet are widely available, promoted and affordably priced, and availability, accessibility and marketing of unhealthy foods and beverages is substantially reduced [4].

An important component in the transition to healthier food environments that is widely recommended by health authorities and public health experts is the use of fiscal policies to disincentivise consumption of unhealthy foods and beverages, including by making unhealthy foods and beverages relatively more expensive and less affordable than healthy foods and beverages [5]. For example, in the Global Action Plan for the Prevention and Control of Noncommunicable Disease 2013–2020, WHO encouraged member states to adopt economic tools, such as food taxes and subsidies, to increase accessibility and desirability of healthier food choices, and discourage consumption of less healthy options [6]. In addition, as part of a comprehensive policy approach to tackle childhood obesity, the WHO Commission on Ending Childhood Obesity recommended implementation of a tax on sugar-sweetened beverages (SSBs). Food and nutrient taxes have also been advocated for as part of calls for taxes on harmful commodities (e.g. sugar, tobacco and alcohol) more generally [7], including by the Bloomberg Task Force on Fiscal Policies for Health [8].

While taxes on unhealthy food and beverages remain underutilised globally as a public health strategy [5], consideration and implementation of food and beverages taxes by national and sub-national governments has increased

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substantially in recent years. In particular, taxes on SSBs have now been introduced in over 40 countries, with most of those taxes first implemented in the last decade [9, 10•, 11]. Internationally, taxes on unhealthy foods have been adopted less frequently than SSB taxes [12•]. Since 2011, both Mexico and Hungary have adopted taxes on a range of unhealthy energy-dense foods [13, 14]. A small number of countries have implemented taxes on specific food categories, including confectionery (Norway, Bermuda), ice cream (French Polynesia) and high sugar foods (Dominica) [15]. A now repealed saturated fat tax was also in place in Denmark between October 2011 and December 2012 [16]. Adopted taxes vary considerably in their design [17, 18], with some countries introducing specific excise taxes based on volume (for example, in Berkeley, California SSBs are taxed at USD0.01 per ounce) or nutrient quantity (for example, in Denmark the saturated fat tax was applied at a rate of 16 Danish Kroner (about USD2.7) per kilogram of saturated fat). In other countries, such as Mexico, taxes have been typically implemented as an *ad valorem* tax, calculated as a percentage of the product price. The scope of taxed items also varies with differing food and beverage products and nutrient criteria used to define taxable items [15]. For example, while most taxes on non-alcoholic beverages apply only to SSBs, some jurisdictions, including Philadelphia, Fiji, France and the Philippines, include artificially sweetened products in their respective taxes [15, 19].

From a public health perspective, taxes on unhealthy foods and beverages can be expected to have an impact in multiple ways, including influencing people to purchase a healthier set of products, incentivising food manufacturers to improve product healthiness (e.g. through reformulation of products to minimise associated taxes) [20] and by shifting social norms towards healthier diets (e.g. through public messaging associated with the implementation of taxes) [21]. This paper aimed to summarise recent evidence related to the impact of taxes on unhealthy foods and beverages on food purchases, and discuss opportunities to advance knowledge and policy impact.

## Evidence of the impact of changes in price of food and beverage on purchases

A key rationale underlying the use of food and beverage taxes to reduce consumption of unhealthy products and improve dietary outcomes is the influence of price on food choice. Economic theory posits that, for most goods, as the price of a product increases, demand and consumption falls [22]. The degree to which consumption shifts in response to price is known as price elasticity [23]. A consistent body of evidence from various data sources (including aggregate demand, household expenditure data and experimental studies) and

multiple regions and countries indicates that most foods are relatively price inelastic, meaning increases in the prices of particular foods result in modest reductions in the purchase of those foods [23–25]. Price elasticity varies by product category and by the income level of the country [23–25]. Across the board, food consumption is most sensitive to changes in prices in low-income countries [23, 24]. In general, animal-sourced foods (including meat, dairy and fish) and sweets (including confectionery and SSBs) are most responsive to changes in their own prices, whereas consumption of cereals, and fats and oils are least sensitive to changes in prices [23].

In considering the impact of food taxes on dietary intake, it is important to consider cross-price elasticities, which relate to the demand for alternate foods in response to price changes, thus indicating potential substitution behaviours in response to food taxes [24, 26••]. For example, in high-income countries, there is evidence that increases in the price of cereals leads to decreased consumption of cereals, but with a parallel increase in consumption of a range of products, including fruits and vegetables, meat, dairy and sweets [24]. In middle-income countries, an increase in the price of meat has been associated with a decrease in the quantity of meat consumption, along with a decrease in the consumption of fats and oils [24]. This is likely because these products are ‘compliments’, with fats and oils used in the process of cooking. There is also evidence that increases in the price of sweets in low-income and high-income countries are associated with less consumption of sweets and more consumption of all other foods, except fats and oils [24]. Overall, cross-price effects are estimated to be smaller than own-price effects [24]. The overall impact of price changes on diet quality depends on the baseline consumption of the various food categories and the nutrient profile of the foods [24]. Moreover, the impact of food price changes is also influenced by within-country demographic characteristics, including household income and the total budget that people allocate to foods and beverages [23–25, 27]. In general, the higher income is, the lower the level of responsiveness to price changes [28].

## Evidence of the impact of taxes on unhealthy foods and beverages on purchases and consumption

Table 1 provides an overview of the results of recent studies that have evaluated the impact of taxes on unhealthy foods and beverages on purchases and consumption. The majority of evidence of the impact of taxes on unhealthy foods and beverages on purchases and consumption relates to SSB taxes. Recent reviews [10••, 26••, 29•, 30••], including a systematic review and meta-analysis of ‘real-world’ SSB tax evaluations [30••], concluded that SSB taxes are effective in reducing SSB purchase and consumption, at least in the short term (typically

**Table 1** Overview of the results of recent studies that have evaluated the impact of taxes on unhealthy foods and beverages on purchases and consumption, adapted from, and extending, an evidence report on SSB taxes from the World Bank [10••]

Jurisdiction (year of implementation)	Taxed products	Tax value or rate	Length of follow-up	Outcome	Summary of findings	Greater impacts
Barbados (2015) [65]	Local and imported beverages with added sugar	10%	1 year	Average weekly sales of: - All SSBs - ‘Expensive’ SSBs - ‘Mid-range’ priced SSBs - Non-SSBs - Bottled water	↓ ↓ ↑ ↑ ↑	
Catalonia, Spain (2017) [66]	Pre-packaged beverages with added sugar	€0.08/L for SSBs with 5-8g sugar/100 mL; €0.12/L for SSBs with >8g sugar/100 mL	4 months	Sales of taxed beverages in one major supermarket chain	↓	High-income regions
Chile (2015) [32, 67]	Beverages with added sugar	10–18% with concurrent 3% reduction in existing taxes on non-SSBs	1 year	Monthly per capita purchase volume of: - High-sugar SSBs - Low sugar or untaxed beverages - Saturated fat intake - Salt consumption - Vegetable intake	↓ ↓ ↑ ↑ ↑	High-income households
Denmark (2011) [16, 68]	Saturated fat in meat, dairy products, animal fats that were rendered or extracted in other ways, edible oils and fats, margarine and spreads	16 DKK/kg (€2.14/kg) saturated fat if level of saturated fat exceeded 2.3 g/100 g	1 year		↓ Mixed <sup>a</sup>	
Hungary (2011) [13]	Broad range of food and drinks containing salt, sugar and/or caffeine	Variable across products	1 year	- Consumed quantities of processed foods - Consumed quantities of unprocessed foods	↓ ↔	Households in the lowest income quartile
Mexico (2014) [31, 34, 35, 48, 69]	SSBs	1 peso/L (approximately 10%)	1–3 years	Per capita sales of: - SSBs - Plain bottled water - Untaxed beverages	↓ ↑ ↑	Low-income households, residents living in urban areas (vs. rural areas), high-purchasing SSB households
Norway (2018) [49]	Non-essential energy-dense food Chocolate and confectionery	8% Increase of €1.73/kg Increase of €0.14/L	2 years 6 months	Per capita sales of non-essential energy-dense foods Mean weekly sales of: - Chocolate and confectionery - SSBs	↓ ↔ ↔	
Saudi Arabia (2017) [50]	Non-alcoholic beverages (including SSBs and artificially sweetened beverages) Carbonated SSBs Energy drinks	50% 100%	1 year	Sales of: - Carbonated SSBs - Energy drinks	↓ ↓	
UK (2018) [33, 70]	SSBs	18p/L for SSBs with 5–8 g added	1 year	Mean weekly purchased household volume of:	↓	

**Table 1** (continued)

Jurisdiction (year of implementation)	Taxed products	Tax value or rate	Length of follow-up	Outcome	Summary of findings	Greater impacts
USA, Berkeley [71]	Beverages with added sugar	sugar/100 mL; 24p/L for SSBs with >8 g added sugar/100 mL	1 year	- Levied beverages	↓	
				- No levy beverages	↔	
				- All soft drinks combined	↔	
				Mean weekly purchased household amount of sugar in:		
				- Levied beverages	↓	
				- No levy beverages	↑	
				- All soft drinks combined	↓	
		Sales of:				
		- SSBs			↓	
		- Untaxed beverages			↑	
		- Bottled water			↑	
		Sales of taxed beverages			↓	
USA, Cook County (July 2017 and repealed in October 2017) [72]	Sweetened beverages (with sugar or artificial sweeteners)	\$0.01/oz	4 months			
USA, Oakland (2017) [73]	Beverages with added caloric sweetener	\$0.01/oz	1 year	Self-reported SSB intake	↔	
USA, Philadelphia (2017) [74]	Sweetened beverages (with sugar or artificial sweeteners)	\$0.015/oz	1 year	Sales of taxed beverages	↓	
USA, Seattle [75]	Sweetened beverages (with sugar or artificial sweeteners)	\$0.0175/oz or \$0.01/oz	1 year	Sales of taxed beverages	↓	

SSB sugar-sweetened beverage

<sup>a</sup> Evaluations found different magnitude of effects, likely due to differences in statistical models used

evaluated for 1 year, up to ~4 years). In general, higher taxes on SSBs have been associated with larger declines in purchases of SSBs [10••]. Available evaluations have consistently identified increases in sales and purchases of untaxed beverages, particularly plain bottled water [10••], in response to implementation of SSB taxes. Nevertheless, reviews of the impact of SSB taxes highlight that further research is required to better understand the impact of the taxes on beverage substitution and overall diet quality.

There is some evidence that implemented taxes have had differential effects on SSB sales/purchasing in different socioeconomic groups [10••]. Overall, it is likely that taxes on SSBs will be most effective for lower socioeconomic groups, although these effects are context specific [10••]. For example, there is evidence from Mexico that lower-income groups have been more sensitive to SSB price changes [31], while in Chile, higher-income groups appear to have been most responsive [32].

Evidence of the impact of unhealthy food taxes on consumer behaviour is less comprehensive but still promising from a public health perspective. Real-world evaluations, including from Mexico and Hungary, have demonstrated decreased purchase of unhealthy foods, with reductions greatest among low socioeconomic households [13, 34, 35]. In Mexico, the volume of nonessential energy-dense foods declined by approximately 6% two years post policy implementation compared to what was expected based on pre-tax trends. For low-income households the decline was 10% compared to no change for higher-income households [35]. Declines in the purchase of taxed foods were also higher among ‘high’ consumers of taxed foods, in households with children and in urban areas [34, 35]. However, further evaluation of the Mexican tax also identified an increase in the purchase of sweet bread from small specialist bakeries, suggesting potential undesirable substitution behaviours [34]. Similarly, although the Danish saturated fat tax resulted in a reduction in the target nutrient, it also reportedly increased salt consumption (as a net effect of dietary substitutions made in response to the tax) in some population groups [16].

Evidence from modelling [36, 37] and simulated shopping experiments [38–40] provide further insight into the potential impact of unhealthy food taxes on consumer behaviour and diet outcomes. Studies in this area have consistently reported decreased purchase of taxed food and dietary risk nutrients (energy, saturated fat, sugar, sodium). Although, as with the evidence from real-world evaluations, some studies reported compensatory increases in unhealthy nutrients in response to taxes [37–39].

Thus, while emerging evidence suggests that taxes on unhealthy foods and beverages have potential as an effective public health measure [12•, 41•], actual impact on overall consumer behaviour and dietary outcomes depends on substitution effects and changes in total energy intake. Further, there is an absence of long-term evaluation (>4 years) of the impact of food and beverage taxes on consumer behaviour.

## The potential impact of taxation scheme design

Consumer responses to taxes on unhealthy food and beverages are likely to be strongly influenced by taxation scheme design [18, 42]. There are numerous factors that must be considered in the development of food taxes, including which products or nutrients the tax should be applied to, what taxation base (e.g. specific or *ad valorem*) should be applied and at what magnitude [17, 18, 43]. Of these, the object of the tax (i.e. which products or nutrients are taxed) is a particularly important consideration because it is likely to shape substitution behaviours [18, 43]. Some analyses have suggested that taxes based on nutrients are likely to have greatest public health potential as they produce a larger base of taxable products, thereby making it harder to substitute away from the target nutrient [42, 44]. However, because nutrient-based taxes impact a wider range of products, they are also likely to attract a broader base of industry opposition than more narrowly targeted taxes and may, therefore, be more politically difficult to implement [43]. In addition, there is evidence that taxation of a single nutrient may result in an unintended increase in an alternative risk nutrient, such as was reported with the Danish saturated fat tax [16]. The substitution effect has also been observed in experimental studies, with an online marketplace study finding increased selection of salty snacks in response to a tax on high-sugar foods [38]. Similarly, in a virtual supermarket study, an increase in sugar as a percentage of total energy was reported in response to both a saturated fat tax and a salt tax [39]. An alternate approach to defining products to be taxed that is emerging as promising is the use of multiple nutrient criteria. A recent modelling study in Chile found that a 30% tax on foods for which marketing is restricted (based on foods that exceed sodium, saturated fat and added sugar limits) was expected to significantly reduce consumption of unhealthy foods without increasing intake of any risk nutrients [36]. Another modelling study used an existing nutrient profiling model to define and apply a 20% unhealthy food tax [37]. The authors estimated that if the tax were applied across a broad range of food products, overall nutrient intake would be significantly improved, including decreased intake of energy, sugar, saturated fat and sodium, and increased protein and fibre intake. Real-world policy implementation and evaluation will be required to better understand the impacts of broad-based nutrient food taxes.

The taxation base (e.g. whether the tax is calculated on a quantity or value base) may also influence the impact of food taxes. Excise taxes targeting physical quantities (e.g. price per kg of the product or a particular nutrient) have been recommended by public health experts as preferable to *ad valorem* schemes as they minimise substitution towards lower cost, but equally unhealthy, alternatives [18, 44]. Excise taxes may also bring about additional benefits, such as reformulation to

reduce risk nutrients or product size in an attempt to minimise financial impact of the tax. Notwithstanding these arguments, empirical evidence from the *ad valorem* tax on nonessential energy-dense foods in Mexico suggests such taxes can effectively reduce purchases of targeted unhealthy products [34]. However, it is currently unknown what effect the Mexican tax has had on overall nutrient intake and diet quality. Importantly, other policy considerations, such as the administrative burden associated with different tax designs, are likely to be critically important in determining preferred designs, with *ad valorem* taxes commonly considered to be less complex to administer [45].

To be an effective public health tool, the rate and/or magnitude of food and beverage taxes must be large enough to elicit a change in consumer behaviour. Experts commonly suggest that, for the purpose of making meaningful changes to consumption, food taxation rates should be set at a minimum of 10% [44, 46, 47]. In regards to beverages, there is general consensus that price increases of at least 20%, applied to a broad range of beverages, are needed to effectively shift behaviour [10•, 39, 41•, 48]. Appropriate rates of taxation are likely to be influenced by contextual and political factors, and are likely to vary across products and regions. For example, while an 8% tax on nonessential energy-dense foods is reported to have reduced purchase of taxed foods in Mexico [34, 35], a tax of a similar rate on confectionery in Norway had an uncertain effect on consumer behaviour [49]. However, these taxes are modest compared to some recently implemented taxes. For example, a 50% levy on carbonated beverages was recently introduced in Saudi Arabia, and has been reported to have resulted in a 35% decline in carbonated beverage sales [50]. In considering appropriate tax rates, it is critical to estimate and monitor the extent to which taxes affect retail prices [12•]. There is mixed evidence from implementation in the US, Mexico and the UK regarding the extent to which manufacturers ‘pass-through’ taxes to consumers, with some examples of consumer prices rising by the full amount of the tax, and other examples of manufacturers absorbing a substantial component of the tax themselves [20, 51, 52]. Lessons from the tobacco context suggest it is also important that taxes are reviewed annually and adjusted to (at least) account for inflation in order to maintain and enhance the effects on consumer behaviours [44, 45]. As a case in point, annual increases in Australian tobacco taxes are thought to have contributed to declining smoking rates over a sustained period [53].

## Interaction of food and beverage taxes with related policy interventions

It is widely agreed that improvements in population diets and related disease requires multiple concurrent strategies [6, 54]. In relation to fiscal strategies, there is emerging evidence that

combining taxes on unhealthy foods and beverages with subsidies on healthy foods and beverages may have a greater impact on population diets through greater incentive for healthier substitution choices [39, 45]. Moreover, it has been estimated that combined taxes and subsidies may reduce the financial burden associated with food and beverage taxes, especially among low-income households, thereby producing beneficial welfare outcomes [37, 55•]. Furthermore, combined taxes and subsidies may help alter perceptions regarding the relative affordability of healthy and unhealthy food, with evidence indicating that the perceived lower level of affordability of healthy diets is a barrier to healthy changes [56]. Despite this, no country to date has earmarked tax revenue to subsidise healthier foods. However, there are notable examples of revenue being used to support further public health efforts (e.g. children’s sports programs in the UK) or social policy (e.g. early childhood education in Philadelphia) [9].

There is also emerging evidence for an additive effect on consumer behaviour when taxes are combined with non-fiscal policies. A recent simulated choice experiment, found a cumulative effect on improved nutrient intake in response to a combined tax on sugary drinks or high-sugar foods and front-of-pack nutrition labelling [38]. In another simulated choice experiment, exposure to educational messaging prior to a 20% SSB price increase had an additive effect on the reduction in SSB demand [57].

A key area for future research is an investigation of the inter-relationship between taxes on unhealthy foods and beverages and the broader marketing practices of food companies. Price promotions are a particularly important area to explore, given that there is a body of evidence indicating that unhealthy foods and beverages are frequently price promoted, and the extent and magnitude of price promotions on unhealthy products are greater than healthier products [58]. In addition, studies of the magnitude of price promotions on unhealthy foods and beverages report discounts ranging from 11 to 37% [58], thus potentially undermining many current taxes. Furthermore, experience from the tobacco context suggests that manufacturers are likely to employ various pricing strategies, such as reducing wholesale pricing and promoting price discounts, in order to counter tax-related price increases [59, 60]. Interestingly, the one study known to assess food industry tactics in response to a SSB tax were not consistent with the tobacco literature, and reported a decreasing prevalence of price discounts, especially among taxed beverages, following introduction of the tax [61]. Future research should further explore food industry responses to food and beverage taxes, including through pricing strategies and other marketing approaches, as well as the potential impact of government policy options that simultaneously address the price of unhealthy foods and beverages and broader marketing of unhealthy foods and beverages.

Given the strong links between unhealthy diets, environmental sustainability and climate change [5, 62], some policy

options (such as taxes on greenhouse gas emissions) designed primarily to address environmental factors are likely to impact food prices. Similarly, health-related taxes on unhealthy foods and beverages, such as red meat, are likely to have important co-benefits on greenhouse gas emissions [63]. Indeed, analyses for Australia have shown that incorporating the price of food-related greenhouse gas emissions into the price of food could be beneficial for population health, while supporting emission-reduction commitments [64]. Future research should further explore the impact of food taxes on both health and environmental sustainability outcomes, and aim to inform policy options that maximise population and planetary health.

## Conclusion

Taxes on unhealthy foods and beverages show promise as an effective strategy to reduce unhealthy food and beverage consumption. Evidence from real-world implementation of food and beverage taxes has demonstrated that they are associated with decreased purchase and consumption of targeted foods and beverages and/or nutrients. There is also evidence that reductions in taxed food and beverage purchases can be greater among low-income households. However, evaluations of various food taxation schemes have identified some increases in the purchase of non-taxed unhealthy foods and/or nutrients due to substitution behaviours. This highlights the importance of ensuring taxation design is optimised to minimise unhealthy substitution effects, as well as the need to evaluate the impact of food and beverage taxes on overall diets, not just targeted products.

Future research should evaluate the longer-term impact of food and beverage taxes and incremental tax increases on consumer behaviour; explore the interaction between food and beverage taxes and other preventative health, environmental sustainability and fiscal policies; and investigate the impact of food and beverage taxes on perceived affordability of different foods and beverages. More broadly, increased implementation of taxes on unhealthy foods and beverages is likely to be enhanced by a comprehensive research program that investigates a range of determinants of effective taxation policy and outcomes. This includes rigorous evidence of the impact of taxes on unhealthy foods and beverages on supply-side changes to the healthiness and environmental sustainability of the food supply; consumer attitudes and knowledge towards food; macroeconomic outcomes, including government revenue; consumer welfare; and population and planetary health outcomes.

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