

Item #2

Sugar taxes: discussion of the economic evidence

Incomplete draft summary of evidence of sugar taxes, for internal use only (contains some errors), 15 September 2014

Sugar taxes: discussion of economic evidence

Commented [BC1]: The areas highlighted in yellow need rewriting – but that can wait. Second order issue. Would expect to write intro right at the end anyway.[Wait till later]

1. Introduction

There have been growing calls for the introduction of a tax on sugar-sweetened beverages (SSBs) or on high sugar foods in general.

This paper is designed to help inform internal discussion and assess the potential costs, risks and effectiveness of sugar taxes, if they are considered in future. This paper assesses the economic evidence and international practice and discusses likely impact, determinants of success, and how a tax might apply in the New Zealand context.

We focus on impacts on reducing obesity or body mass index (BMI) levels, as taxes are usually proposed with this goal in mind. We note that there are other negative health outcomes with also stem from excessive sugar consumption, such as more dental caries; and these taxes have sometimes been used historically for revenue generation or industry protection purposes.¹

2. Background

Why is excessive sugar consumption a problem?

High obesity rates are one of the greatest health challenges facing New Zealand, with obesity expected to overtake tobacco consumption as the number one risk factor for health loss in New Zealand by 2016.²

In New Zealand in 2008/2009 median usual daily intake of total sugars from all sources was 120 g for males and 96 g for females. The most significant sugar was sucrose (males 55 g; females 42 g), followed by fructose (22 g; 18 g), glucose (21 g; 18 g), lactose (14 g; 12 g) and maltose (5 g; 3 g). The major contributors of total sugars in the diet were Fruit (18%), Non-alcoholic beverages (17%), Sugar and sweets (15%) and Milk (10%).³ [total % calories from sugar?] [can add chart with SSB consumption by age and gender if desired]

Commented [BC2]: Insert here a brief citation of evidence that sugar consumption in general, and soft drinks in particular, make a special contribution to obesity. Done

Current World Health Organisation Guidelines indicate that adults shouldn't consume more than 10% of their calories from free sugars (which is equivalent to 50g of sugar per day).⁴

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¹ World Sugar Research Organisation, "Sugar and Dental Caries", (2012) accessed via <http://www.wsro.org/AboutSugar/Sugardentalcaries.aspx>.

² Ministry of Health, *Health Loss in New Zealand: A report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study, 2006-2016*, Wellington: Ministry of Health. Accessed via <http://www.health.govt.nz/system/files/documents/publications/health-loss-in-new-zealand-final.pdf>

³ University of Otago and Ministry of Health. 2011. *A Focus on Nutrition: Key findings of the 2008/09 New Zealand Adult Nutrition Survey*. Wellington: Ministry of Health. p76

⁴ Free sugars is any sugar (including fructose) that is added to foods by manufacturers or consumers, plus that naturally present in honey, syrups, and fruit juices. It does not include sugar naturally present in milk or whole fruit and vegetables.

Draft guidelines put out for consultation this year propose reducing this to 5% of total calories or 25g of free sugars per day, as sugar consumption higher than 10% of daily calories is conducive to a higher rate of dental caries and sugar consumption of 5% is required for full absence of dental decay⁵. The World Health Organisation also point to randomised controlled trials that show that an increase in sugar intake is associated with an increase in body weight and a decrease in sugar intake is associated with a decrease in body weight for adults.⁶

Sugar consumption makes a significant contribution to obesity. High sugar drinks increase the risk of obesity and other health problems, such as type 2 diabetes. ~~for whatever is the correct wording given the evidence~~ Consumption of sugar-sweetened beverages is linked to an increased risk of obesity in children⁷. Cutting back on sugary drinks can also improve weight control in people who are initially overweight.⁸ People who consume sugary drinks regularly—1 to 2 cans a day or more—have a 26% greater risk of developing type 2 diabetes than people who rarely have such drinks.⁹

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Commented [MOH3]: All from: <http://www.hsph.harvard.edu/nutritionsource/sugary-drinks-fact-sheet/#references> Need to follow up on references individually

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~~[Now insert here a couple of sentences and perhaps a graph, showing rising sugar consumption in New Zealand].~~

Sugar consumption is not the only contributor to obesity, but it is considered to be an appropriate target for intervention because free sugars can add unnecessary calories to diets without providing other nutritional benefits.¹⁰

Why use a tax to target excessive sugar consumption?

There is growing advocacy ~~from we call them this or is commentators and researchers better?~~ for including some form of special tax in the basket of measures designed to reduce sugar consumption and obesity. Some advocate a tax on sugar sweetened beverages appears to be the most common proposal, as it would reduce SSB availability and

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⁵ <http://www.who.int/mediacentre/news/notes/2014/consultation-sugar-guideline/en/>

⁶ Te Morenga et al. (2012) Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. *BMJ* 345:e7492

⁷ Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet*. 2001;357:505-8.

⁸ Tate DF, Turner-McGrievy G, Lyons E, et al. Replacing caloric beverages with water or diet beverages for weight loss in adults: main results of the Choose Healthy Options Consciously Everyday (CHOICE) randomized clinical trial. *Am J Clin Nutr*. 2012;95:555-63.

⁹ Malik VS, Popkin BM, Bray GA, Despres JP, Willett WC, Hu FB. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. *Diabetes Care*. 2010;33:2477-83.

¹⁰ Free sugars are those added by manufacturers or consumers, excluding those naturally present in fruit, rice etc.

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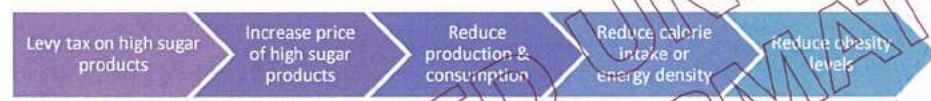
access, help create a healthier food environment and raise revenue that could be used for health research and promotion. XXXX^{11,12,13}

A tax on sugar is intended to contribute to reducing population-level obesity rates by raising the price of high sugar foods, thereby reducing individual consumption.

A sugar tax might also give producers an incentive to innovate and reformulate their products to reduce the sugar (and calorie) content. The tax, and the publicity around its introduction, may also signal to consumers the possible health effects of excess sugar consumption. This paper does not consider these two drivers.

An idealised chain of causation is summarised as follows. We use this as a lens to review evidence by economists in peer reviewed journals, and ask at each point what the likely impact might be.

Figure 2: Idealised chain of causation for potential impact of a sugar tax



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Others advocate a more comprehensive tax on all sugar-containing products.

Taxes on sugar are not usually proposed in isolation – they are usually mooted as part of a package along with restrictions on advertising and health promotion activities funded by the taxation revenue that would be generated.

The economic case for government intervention to correct obesity

The economic rationale for government intervention in consumption decisions rests on market failure and correcting inequalities. Even when these exist the – net benefits are

Commented [BC7]: we need to name figures. Do you want to indicate that this chain of causation is idealised, and that it doesn't address the incentive to innovate point or signalling? [REDACTED] Done. Have dealt with point by changing to reduce production and consumption, this is a judgment call though, and may make it too complex. As with addition of energy density, as this was coming through strongly in WHO material.

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Commented [BC8]: Does this section need to go earlier in the paper? I think so. Also needs to be rewritten so has more sophisticated framing. And at least one really accessible reference for each rationale, so those who are interested can follow up. [REDACTED] Done. Need to confirm whether happy with the references here, or whether other ones desired.

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¹¹ New Zealand Beverage Guidance Panel. Policy brief: Options to Reduce Sugar Sweetened Beverage (SSB) Consumption in New Zealand. 19th June 2014. The Panel includes Dr Gerhard Sundborn, Professor Boyd Swinburn, Warren Lindberg, Professor Jim Mann, Professor Cliona Ni Mhurchu, Dr Rob Beaglehole, Dain Guttenbeil, Dr Lisa Te Morenga, Professor Elaine Rush, Dr Robyn Toerzath, Hereni Marshall, Mafi Funaki-Tahifote, Jo Fitzpatrick, Margie Fepuleai, and Dr Colin Tukuitonga. They advocate for a 20% excise tax on SSBs with funding used for health promotion (among other options).

¹² FIZZ (Fighting Sugar in Softdrinks). It includes Dr Gerhard Sundborn (founder), Dr Rob Beaglehole (Dentist), Professor Rod Jackson (Epidemiologist), Professor Boyd Swinburn (Professor of Global Health), Dr Simon Thornley (Public Health Physician) and Associate Professor Tony Merriman (Geneticist). They advocate for action to reduce the intake of sugary drinks, and help a symposium on "Sugary Drink Free Pacific by 2030?" in Auckland in February 2014. FIZZ advocates for raising the price of sugary drinks through taxes (among other actions). <http://www.fizz.org.nz/>

¹³ NZMA. Policy Briefing: Tackling Obesity. May 2014. "But we suggest there are sufficient grounds to introduce a tax on sugar-sweetened beverages (SSB) given what is already known about the effects of SSB on nutrition and health and the results from modelling. Accordingly, the NZMA recommends that the government formally evaluate the use of fiscal mechanisms to reduce the consumption of unhealthy food, giving priority to a tax on SSB. We also recommend that any revenue raised through such a potential tax be ring-fenced and invested back into obesity research and prevention programmes." p20

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considered compared with the status quo, and cost-effective solutions sought. There are other rationales, including politics, patriarchy and power...

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Market failures mean that market prices do not reflect all the costs and benefits of consuming. In the case of obesity and high calorie foods – this would be manifest as §... when people consume high calorie products, the price they pay does not reflect the full impact of their consumption. For example, obesity caused by excessive sugar consumption (noting that some obesity is caused by excess calories not from sugar) has externalities such as decreased productivity or increased health costs, which are not reflected in the price of high sugar products currently, and therefore consumption is above the socially optimal level.¹⁴ Overconsumption can also be caused by overvaluing present consumption and undervaluing future health costs,¹⁵ or lack of information about the negative health impacts from over-consumption of high-sugar products, particularly by children.¹⁶

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These potential justifications for action, however, are balanced against a concern about regressivity and unintended consequences. A sugar tax is likely to be regressive in nature as any tax set would have a higher burden on low income households as it represents a larger portion of household income. However, while the financial effects of the tax will likely be regressive, the health gains may be progressive.¹⁷ For instance, New Zealand adults living in the most deprived areas are more than three times as likely to have been diagnosed with type 2 diabetes as adults living in the least deprived areas, and may therefore have more potential health gains from a tax.¹⁸ Potential unintended consequence could be consumer substitution towards higher calorie products or product reformulation that has worse health impacts, such as the use of high fructose corn syrup in place of sucrose.

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The existence of negative health effects is not sufficient in itself to justify government intervention. In order for intervention to be justified, we look for a market failure which leads to sub-optimal patterns of consumption. Then we ask if there is an intervention or group of interventions (such as a sugar tax) that can effectively counteract that market failure and change these consumption patterns; and what the evidence says about their potential costs, benefits and impacts, compared to the counterfactual of the status quo or no additional intervention. We also consider whether the status quo is unacceptable in terms of equity. We also need to be wary of potential government failures in the response, that may undermine any gains. In the case of sugar consumption, three types of market failures may be in play:

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- **Externalities.** Obesity caused by excessive sugar consumption [noting that some obesity is caused by excess calories not from sugar] has some costs which are borne by the obese (such as lower wages or labour market discrimination), but others which may be

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¹⁴ Joan Gil, Guillem Lopez-Cadasnovas, Toni Mora, "Taxation of unhealthy consumption of food and drinks: An updated literature review", *Hacienda Publica Espanola/Review of Public Economics* 207- (4/2013), 199-240, 121.

¹⁵ *Ibid.*

¹⁶ *Ibid.*

¹⁷ Zhen et al, "Predicting the effects of sugar-sweetened beverage taxes", 21.

¹⁸ Ministry of Health and Accident Compensation Corporation, 2013. *Injury-related Health Loss: A report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study 2006–2016*. Wellington: Ministry of Health.

borne by healthy-weight individuals such as higher insurance premiums, or extra taxes to cover increased health costs.¹⁹ These are negative externalities which would indicate that consumption is above the socially optimal level.

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• **Time-inconsistent preferences.** Consumers of high sugar foods are alleged to make irrational and impulsive consumption choices: present bias may lead them to overvalue present consumption and undervalue future health costs, a form of hyperbolic discounting.²⁰ This leads to overconsumption in the present.

• **Asymmetric information.** It has been argued that some consumers, particularly children, are partially or totally unaware of the negative health impacts resulting from the consumption of high sugar products.²¹ This leads them to underestimate their private consumption costs and therefore over-consume these products.

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All three of these market failures involve consumption being above its optimal level.

Government intervention might also be justified to correct health inequities. The prevalence of type 2 diabetes varies systematically between different groups, with adults in the most deprived areas more than three times as likely to have been diagnosed with diabetes as adults living in the least deprived areas (ref). Type 2 diabetes is also more prevalent among Pacific, Indian and Maori populations. Since type 2 diabetes is associated with excess sugar consumption, effective reduction in sugar consumption may mitigate inequality.

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The ability of a sugar tax to do this depends on how different groups would respond to a change in the price of high sugar products and modify their total calorie consumption as a response. The different financial and health effects are discussed under equity considerations in the evidence below.

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What would the tax apply to?

Commented [BC13]: This section on equity is not quite right. Suggest read something in the econ lit which discusses the econ approach to equity, and use that to frame the issue. Equity is something which Ministry staff have a sophisticated approach to, so we need to get the framing right. [REDACTED] Have altered.

Proposals range from narrowly focussed taxes on soft drinks to broader taxes applying to sugar contained in any products, including the following

Commented [BC14]: Would it be useful here to go a bit scientific, and talk about different types of sugar? Sucrose, lactose, fructose and how they are manifest in the different definitions of sugar? I know that this is where Ministry folk will leap to... [REDACTED] Done.

1. Soft drinks containing sugar (all carbonated beverages with added sugar)
2. All soft drinks (including non-sugary/artificially-sweetened/without added sugar)
3. Sugar-sweetened beverages (all beverages containing added sugar, including fruit juices, sports drinks, etc)
4. All sweetened beverages (all sweetened beverages, including artificially-sweetened)
5. All foods with added sugar
6. All foods with any sugar.

Commented [BC15]: Is this the right word? Do you mean those without added sugar? [REDACTED] MK: clarification made in text.

Commented [BC16]: What is the status of milk in these? [REDACTED] MK: It will include milk if milk has added sweetener. My understanding is that this is not the case b/c milk sugars are naturally-occurring.

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¹⁹ Joan Gil, Guillem Lopez-Cadasnovas, Toni Mora, "Taxation of unhealthy consumption of food and drinks: An updated literature review", *Hacienda Pública Española/Review of Public Economics* 207 (4/2013), 199-240, 121.

²⁰ Ibid.

²¹ Ibid.

The most commonly-proposed taxes are 1, 3 and 5, as these exclude artificially-sweetened alternatives, which may encourage consumers to choose untaxed artificially-sweetened alternatives over taxed sugar sweetened products.

In all of these options, the tax might be applied to the product or to the grams of sugar added to the product. Another possibility is to only apply the tax to products that contain more than a stated number of grams of sugar. This might give producers and consumers an incentive to switch to lower sugar (and calorie) alternatives, for example lower-sugar fruit juices, or sweetened soda water based drinks that fall below the threshold.

A final point is what types of sugar will be subject to the tax. Criticism of added sugar in foods is usually not limited to sucrose: it generally also includes high-fructose corn syrup and any other free sugars which are added.²² This paper will assume as much. The sugar taxes proposed here are not limited to sucrose but include added fructose, lactose, glucose and any other free sugars which are added to food.

Another possibility is that instead of taxing a specified group of products (a "product-based tax"), the tax might apply to each unit of added sugar, so that manufacturers pay a certain amount for each gram of sugar that is added to their foods (a "nutrient-based tax").

Variation is possible amongst these: for example, a tax threshold, so that the tax applies only to sugar-sweetened beverages that contain more than a stated number of grams of sugar. This might give producers and consumers an incentive to switch to lower sugar (and calorie) alternatives, for example lower-sugar fruit juices, or sweetened soda water based drinks.

How would the tax apply?

A sugar tax could be "volumetric" (taxed by volume of the food or beverage) or "valoric" (taxed by the price of the item). It could also be an "excise tax" (levied on the manufacture of the product) or a "sales tax" (levied on the consumer at the point of sale).

Within the various forms of proposed sugar taxes in the literature, excise taxes are almost always volumetric taxes, and sales taxes are almost always valoric taxes. For example, in New Zealand cigarettes face an excise tax of \$545.39 per 1,000 cigarettes (not exceeding 0.8kg tobacco content) or \$777.18 per kilo of tobacco content, which is levied on manufacturers or when imported²³. This is an example of a volumetric, excise tax. GST is an example of a valoric, sales tax – its levied on consumers at the point of sale, at a rate of 15% of the price of the good or service. Unless otherwise stated, that is it is assumed that what will excise taxes are volumetric, and sales taxes are valoric be assumed in this paper.

Excise taxes are almost always volumetric taxes, while sales taxes are almost always valoric taxes. Unless otherwise stated, that is what will be assumed in this paper.

²² Gary Taubes, "Is Sugar Toxic?", <http://www.nytimes.com/2011/04/17/magazine/mag-17Sugar-t.html?pagewanted=all&r=0>

²³ Excise and Excise-equivalent Duties Table (Tobacco Products Indexation and Separate 10% Increase) Amendment Order 2013

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Commented [BC17]: Suggest insert in here examples of each sort of tax in New Zealand – eg alcohol tax, GST... Done.

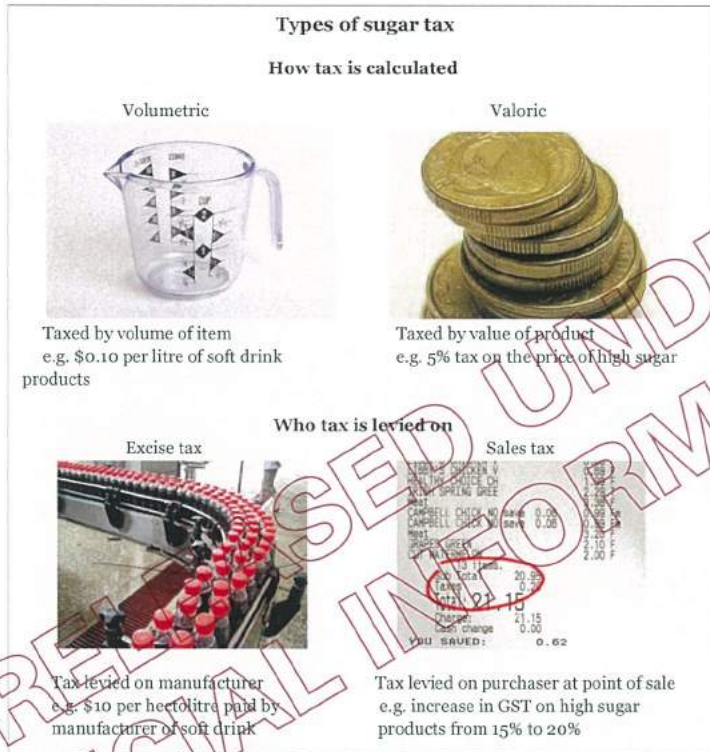
Commented [BC18]: Source? I didn't know this – are we 95% sure? MK: yeah, from what I read excise taxes always seem to be volumetric and sales always valoric. I never saw any example of a valoric excise or volumetric sales tax.

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Figure 1: Classification of tax types based on how tax is calculated and who tax is levied on



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Current international practice

First sentence: a number A number of countries have some form of sugar tax. Many of these were implemented in the last decade. and something about longevity of these taxes. To date European nations have tended to be most active in the use of sugar taxes for explicitly obesity-fighting purposes. Other jurisdictions, such as various US states, appear to have historically used them mainly for revenue-raising purposes, although they are being proposed now for obesity-fighting purposes. [Bronwyn to provide article about Pacific countries].

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The following table summarises the sugar taxes which are currently in place in a selection of various countries (ordered from most recently implemented). This list includes all jurisdictions we know of which have implemented obesity-targeting sugar taxes. The New Zealand dollar amounts in the above table have not been adjusted for purchasing power

Commented [BC19]: Has someone reviewed the figures in both tables, both the transcriptions and the calculations? Just normal practice... [redacted] [redacted] working on it.

Commented [BC20]: How was the selection selected? [redacted]
MK: Taken from a couple of meta-reviews of sugar taxes across the world, as well as other articles and websites

parity (PPP). The following table converts the nominal NZD values of foreign taxes into PPP-adjusted versions which account for the differing purchasing power in New Zealand²⁴.

Further detail is available in Appendix A.

Table 1: World sugar taxes: size, scope and NZD conversions

World sugar taxes: size, scope and NZD conversions						
Country	Date implemented	Tax scope	Tax type	Tax rate	NZD (nominal) (per litre per kg)	NZD (adjusted) (per litre per kg)
Mexico	2013	Junk food (high in salt, sugar and saturated fat) and soft drinks	Valoric + volumetric	8% (high sugar foods), 1 peso per litre (NZ\$0.087 per litre) on soft drinks	0.09	0.17
France	2012	SSBs + artificially-sweetened beverages	Volumetric	EUR0.072 (NZ\$0.11) per litre	0.11	0.13
Algeria	2012	Soft drinks	Valoric	0.5%	N/A	N/A
Hungary	2011	Soft drinks, energy drinks, sweets, salty snacks, other foods over a sugar/fat threshold	Valoric + volumetric	NZ\$0.02 per litre on soft drinks,	0.02	0.04
				NZ\$0.51 per kilogram for sweets,	0.51	1.11
				NZ\$1.30 per litre for energy drinks,	1.3	2.83
				NZ\$1.04 per kilogram for salty snacks, flat levy of NZ\$0.05 on all high sugar products	1.04	2.27
Finland	2011-12 (in current form)	Confectionery + soft drinks	Volumetric	EUR0.075 per litre (NZ\$0.12),	0.12	0.12
				EUR0.95 (NZ\$1.47) per kg of confectionery	1.47	1.49

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 Commented [BC22]: Why just valoric or volumetric? Why not sales + excise? Tell me what this column adds. (discuss with [redacted] if needed)
 MK sales vs. excise not included because we are assuming here that sales = valoric and excise = volumetric (see above). This column is important because it allows readers to see at a glance what the tax type is without having to glean this by reading the tax rate information.

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²⁴ Purchasing power parities (PPPs) are conversion rates that equalise the purchasing power of different currencies by eliminating the differences in price levels between countries.

²⁵ The above conversions to New Zealand dollars were done using exchange rates during the week of 7 July to 11 July 2014. (source for exchange rates?)

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Samoa	2008 (current form)	Soft drinks	Volumetric	0.40 tala (NZ\$0.20) per litre	<u>0.2</u>	<u>0.33</u>
Nauru	2007	SSBs, confectionery, imported sugar	Valoric	30%	<u>N/A</u>	<u>N/A</u>
Fiji	2006	Soft drinks	Volumetric	5% (imported soft drinks), FJD0.05 (NZ\$0.03) per litre on domestically-produced soft drinks	<u>0.03</u>	<u>0.06</u>
French Polynesia	2002	SSBs, confectionery, ice cream	Volumetric	60 francs per litre (NZ\$0.79)	<u>0.79</u>	<u>0.78</u>
Ireland	1975-1992	Soft drinks	Volumetric	IR0.37 per gallon (NZ\$0.04 per litre)	<u>0.04</u>	<u>0.04</u>
Denmark	1930s-2013	SSBs	Volumetric	DKK 1.64 (NZ\$0.34) per litre prior to abolition	<u>0.34</u>	<u>0.30</u>
Norway	1922	Sweetened beverages, sugar and chocolate products	Volumetric	NOK 2.85/L (NZ\$0.53) for soft drinks NZ\$1.33/kg for confectionery	<u>0.53</u> <u>1.33</u>	<u>0.46</u> <u>1.15</u>
United States	Various	Typically just soft drinks although some states are slightly broader	Both valoric and volumetric depending on state	Various, average is about 4.0-4.5%	<u>0.4</u> <u>0.8</u>	<u>0.55</u> <u>1.09</u>
Latvia	Not stated	Sweetened beverages	Volumetric	LVL0.052 per litre (NZ\$0.11 per litre)	<u>0.11</u>	<u>0.19</u>
Guatemala	Not stated	Sweetened beverages	Volumetric	Between GTQ0.10 and 0.18 per litre (NZ\$0.01 to NZ\$0.03)	<u>0.03</u>	<u>0.08</u>

Commented [MOH23]: Calculate PPPs for French Polynesia
MK: Done. Funny enough their purchasing power comes out to almost exactly the same as ours.

Commented [BC24]: What is diff between these and SSBs?
MK: This includes both sugar- and artificially-sweetened beverages. SSBs are only sugar-sweetened.

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The New Zealand dollar amounts in the above table have not been adjusted for purchasing power parity (PPP). The following table converts the nominal NZD values of foreign taxes into PPP-adjusted versions which account for the differing purchasing power in New Zealand.

²⁶ Sweetened beverages include both sugar and artificially-sweetened varieties.

Purchasing-power-adjusted-sugar-tax-magnitudes²⁷

Country and tax	NZD (nominal) (per litre/per kg)	NZD (adjusted) (per litre/per kg)	PPP deflator
Mexico (SSBs)	0.09	0.17	0.53
France (all non-alcoholic beverages with added sugar or sweetener)	0.11	0.13	0.87
Hungary (soft drinks)	0.02	0.04	0.46
Hungary (prepackaged-sweetened products)	0.51	1.11	0.46
Hungary (energy drinks)	1.3	2.83	0.46
Hungary (salty snacks)	1.04	2.27	0.46
Hungary (flat rate)	0.05	0.11	0.46
Finland (soft drinks)	0.12	0.12	0.99
Finland (confectionery)	1.47	1.33	0.99
Samoa (SSBs)	0.2	0.33	0.60
Fiji (locally-manufactured SSBs)	0.03	0.06	0.50
Ireland (soft drinks)	0.34	0.04	0.95
Denmark (soft drinks)	0.34	0.30	1.12
Norway (sugar and chocolate)	1.33	1.16	1.16
Norway (sweetened beverages)	0.53	0.46	1.16
USA (Berkeley, SSBs)	0.4	0.55	0.73
USA (San Francisco, SSBs)	0.8	1.09	0.73

²⁷ Calculations our own, using World Bank price data. (<http://data.worldbank.org/indicator/PA.NUS.PRVT.PP>). PPP deflators were calculated as follows: The World Bank website gives the amount of local currency needed in each country to buy the same amount of goods (an amount equal to US\$1 worth in the USA). In New Zealand this amount is NZ\$1.57. Foreign values were converted to NZD (rates as at 23/07/2014) to give the NZD amount needed to attain the same purchasing power in each country. This amount was divided by 1.57 to give that country's purchasing power as a fraction of New Zealand's.

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Latvia (beverages with added sugar or sweetener)	0.11	0.19	0.58
Guatemala (carbonated beverages)	0.03	0.08	0.38

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3. Analytical framework

Determine likely impact at each point along chain of causation

A tax on sugar is intended to contribute to reducing population-level obesity rates by raising the price of high sugar foods, thereby reducing individual consumption.

A sugar tax might also give producers an incentive to innovate and reformulate their products to reduce the sugar (and calorie) content. The tax, and the publicity around its introduction, may also signal to consumers the possible health effects of excess sugar consumption.

The chain of causation is summarised as follows. We use this as a lens to review evidence by economists in peer-reviewed journals, and ask at each point what the likely impact might be.



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The economic case for government intervention to correct obesity

The economic rationale for government intervention in consumption decisions rests on market failure and correcting inequalities. Even when these exist – not benefits, and cost-effective solutions. There are other rationales, including politics, patriarchy and power...

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Market failures mean that market prices do not reflect all the costs and benefits of consuming. In the case of obesity and high-calorie foods – this would be manifest as... when people consume high-calorie products, the price they pay does not reflect the full impact of their consumption.

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The existence of negative health effects is not sufficient in itself to justify government intervention. In order for intervention to be justified, we look for a market failure which leads to sub-optimal patterns of consumption. Then we ask if there is an intervention or group of interventions (such as a sugar tax) that can effectively counteract that market failure and change these consumption patterns; and what the evidence says about their potential costs, benefits and impacts, compared to the counterfactual of the status quo or no additional intervention. We also consider whether the status quo is unacceptable in terms of equity. We also need to be wary of potential government failures in the response, that may undermine any gains. In the case of sugar consumption, three types of market failures may be in play:

- **Externalities.** Obesity caused by excessive sugar consumption [noting that some obesity is caused by excess calories not from sugar] has some costs which are borne

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by the obese (such as lower wages or labour market discrimination), but others which may be borne by healthy weight individuals such as higher insurance premiums, or extra taxes to cover increased health costs.²⁶ These are negative externalities which would indicate that consumption is above the socially optimal level.

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- **Time-inconsistent preferences.** Consumers of high-sugar foods are alleged to make irrational and impulsive consumption choices: present bias may lead them to overvalue present consumption and undervalue future health costs, a form of hyperbolic discounting.²⁹ This leads to overconsumption in the present.
- **Asymmetric information.** It has been argued that some consumers, particularly children, are partially or totally unaware of the negative health impacts resulting from the consumption of high-sugar products.³⁰ This leads them to underestimate their private consumption costs and therefore over-consume these products.

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All three of these market failures involve consumption being above its optimal level.

Government intervention might also be justified to correct health inequities. The prevalence of type 2 diabetes varies systematically between different groups, with adults in the most deprived areas more than three times as likely to have been diagnosed with diabetes as adults living in the least deprived areas.³¹ Type 2 diabetes is also more prevalent among Pacific, Indian and Maori populations. Since type 2 diabetes is associated with excess sugar consumption, effective reduction in sugar consumption may mitigate inequality.

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The ability of a sugar tax to do this depends on how different groups would respond to a change in the price of high-sugar products and modify their total caloric consumption as a response. The different financial and health effects are discussed under equity considerations in the evidence below.

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These are some of the economic justifications for possible intervention to reduce excessive sugar consumption.

Estimate how consumption will change as price increases

The use of a tax to raise prices and reduce consumption is based on the law of demand—for a normal good the quantity demanded will decline as the price increases.

The exception to this might be if some high-sugar products are considered inferior goods, which some low-income consumers might demand more of as the price increases, where there are a few close substitutes and it takes up a considerable portion of their income. This isn't considered in this paper, but noted as a potential area for future consideration.

²⁶ Joan-Gil, Guillem Lopez-Cadasnovas, Toni Mora, "Taxation of unhealthy consumption of food and drinks: An updated literature review", *Hacienda Publica Espanola/Review of Public Economics* 207- (4/2013), 199-240, 121.

²⁹ Ibid.

³⁰ Ibid.

The question of how consumption changes as price increases is driven by several key economic concepts. **Price elasticity of demand (PED)** is a measure of how much quantity demanded changes as the result of a given price change. It is usually represented as a number which is the percentage change in quantity divided by the percentage change in price. For example, a PED of -0.8 means that 1% increase in price leads to a 0.8% decrease in quantity.

PED is determined largely by the availability of **substitutes**. When there are a wide range of possible substitutes, a price increase will simply cause consumers to switch to a substitute, so the quantity change (and PED) for the original product will be large. If substitutes are not readily available, consumers will have no choice but to continue buying the product, so the quantity change (and PED) will be quite small. Therefore for a sugar tax, a high PED is not necessarily a good thing because consumers may just switch to consuming other high-calorie substitutes. This will be explored in greater detail later on.

Complements are also important. If a price increase for one good leads to a consumption decrease for another good as well, that other good is complement. An example of this might be soft drinks and hamburgers: the two are often purchased together, so if the price of one increases, it may result in a consumption decrease for the other good as well. This is relevant for sugar tax because it means that a price increase on sugar may lead to consumption decreases for goods which are complements for sugary items.

Pass-through ratios are a measure of how much a tax increase is reflected in prices. A ratio of 1 means the price will increase by exactly the same amount as the tax. This is not necessarily the case: the ratio could be less than 1, meaning that price increases by less than the amount of the tax, or greater than 1, meaning that it increases by more than the amount of the tax. These are called "under-shifting" and "over-shifting" respectively. Pass-through ratios are determined by a number of factors including elasticities of demand and supply as well as the degree of competition in the market.

3.4. Evidence

Broadly speaking, the evidence on sugar taxes falls into two categories. **Modelling studies** use data on prices and consumption patterns to impute price elasticities and estimate the effect of a theoretical tax-induced price increase. **Empirical studies** examine the effect of a real-world tax or price increase on consumption. This paper will consider both kinds of evidence.

Do sugar taxes lead to increased prices?

Figure 3: Idealised chain of causation for potential impact of a sugar tax (focus on second arrow)

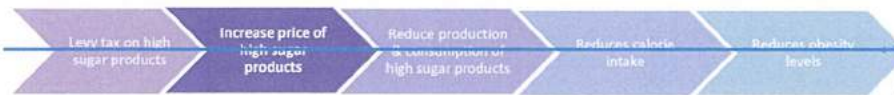


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In a market market the —increase in price as result of the tax will depend on supplier's assessment of the price elasticity of demand. —[insert a box explaining elasticity]. This will, in turn, reflect the availability of substitutes etc.

Elasticity and the role of substitutes and complements in consumer responses to a sugar tax

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Price elasticity of demand (PED) is a measure of how much quantity demanded changes as the result of a given price change. For example, a PED of -0.8 means that 1% increase in price leads to a 0.8% decrease in quantity.

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Responses are likely to be more elastic (greater than 1) where there are a wide range of possible **substitutes**, and more inelastic (less than 1) where there are fewer substitutes. What consumers substitute to is also key in determining the impact of a tax. For example, if consumers respond to an increased price of soft drinks by drinking more water its likely to be positive, but if they respond by drinking more orange juice or flavoured milks, its likely to have little effect on calorie intake and obesity levels, even though there may be other nutritional benefits. **Complements** also matter. A price This is relevant for sugar tax because it means that a price increase on sugar may lead to consumption decreases for goods which are

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This will, in turn, reflect the availability of substitutes etc. A key factor is industry concentration. Large firms with greater market power find it easier to pass price increases on to consumers, making overshifting more likely than in smaller firms with little market power.

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Prices could increase by an amount less than the amount of the tax ("under-shifting"), more than the amount of the tax ("over-shifting") or by the exact same amount as the tax ("full-shifting"). A key factor is industry concentration. Overshifting is more likely to occur in highly-concentrated industries,³¹ possibly because the market power conferred on firms by the lack of competition allows prices to be raised with fewer demand repercussions.³²

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Several studies have found that, in a highly-concentrated industry, excise taxes will over-shift and sales taxes will under-shift.³³ This effect has been found to occur with SSB taxes:

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³¹ Finkelstein, Eric A., Chen Zhen, Marcel Bilger, James Nonnemaker, Assad Farooqui, Jessica Todd, "Implications of a sugar-sweetened beverage (SSB) tax when substitutions to non-beverage items are considered", *Journal of Health Economics* 32 (2013) 219-239, 226.

³² Pass-through ratios are a measure of how much a tax increase is reflected in prices. A ratio of 1 means the price will increase by exactly the same amount as the tax. This is not necessarily the case: the ratio could be less than 1, meaning that price increases by less than the amount of the tax, or greater than 1, meaning that it increases by more than the amount of the tax. These are called "under-shifting" and "over-shifting" respectively. Pass-through ratios are determined by a number of factors including elasticities of demand and supply as well as the degree of competition in the market.

³³ Finkelstein et. al, "Implications of a sugar-sweetened beverage tax", 226, Eric A., Chen Zhen, Marcel Bilger, James Nonnemaker, Assad Farooqui, Jessica Todd, "Implications of a sugar-

as a percentage of the excise tax, prices have been found to rise by (depending on the study) 107-133%,³⁴ 129%,³⁵ and even as high as 264%.³⁶ SSB sales taxes were, as predicted, found to under-shift, with prices increasing only by 60-90% of the tax.³⁷

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Similarly, in France over-shifting occurred primarily among large retailers with proprietary brands,³⁸ indicating that over-shifting may be the result of greater market power.

Do increased prices reduce purchasing and consumption of the taxed products?

Figure 4: Idealised chain of causation for potential impact of a sugar tax (focus on arrows)



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The evidence largely supports the idea that a tax-induced price increase will cause a reduction in purchase and consumption of the taxed products. This is the case both for the SSB tax and the broader tax on added sugar. Below we focus on how large the reduction in purchase and consumption might be.

SSB tax

Estimates for the magnitude of the reduction vary. Most elasticities lie between -0.6 and -1.2 for soft drinks (i.e. a 1% increase in price is expected to lead to a 0.6% to 1.2% reduction in purchase of the taxed good) and generally the same or slightly larger for other SSBs. The following table summarises the price elasticities of demand estimated by various modelling studies. It shows that consumers reduce consumption in response to increased price. They are expected to be more responsive to changes in the price of sports drinks, and less responsive to changes in the price of regular soft drinks and juice drinks.

Table 2: Studies which investigate the link between an SSB tax and consumption

Studies which investigate the link between an SSB tax and consumption

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sweetened-beverage (SSB)-tax-when-substitutions-to-non-beverage-items-are-considered", *Journal of Health Economics* 32 (2013) 219-239, 226.

³⁴ Celine Bonnet and Vincent Requillart, "Strategic Pricing and Health Price Policies", accessed via http://neeo.univ.tlse1.fr/2944/1/strategic_pricing.pdf, 21.

³⁵ Finkelstein et. al, "Implications of a sugar-sweetened beverage tax", 226.

³⁶ U. Michael Bergman and Niels Hansen, "Excise Tax Pass-Through on Beverage Prices", accessed via http://www.econ.ku.dk/Kalender/seminarerepru/epru20032009/bergmanhansen_march2009.pdf

³⁷ Bonnett and Requillart, "Strategic Pricing and Health Price Policies".

³⁸ Berardri et. al, "The impact of a 'soda tax' on prices: Evidence from French micro data", accessed via <http://www.jma2014.fr/fichiers2013/37/soda-tax-bstv-jma.pdf>

Study	Country studied	Type of tax	Price elasticity of demand	Type of study
Gustavsen (2005) ³⁹	Norway	Modification of existing Norwegian VAT	-0.88 (regular soft drinks) ⁴⁰ Calculated from authors' statement that 10.8% price increase for soft drinks would lead to 9.5% consumption decrease	Modelling
Dharmasena and Capps (2011) ⁴¹	United States	20% valoric tax on SSBs	-2.25 (regular soft drinks) -0.7 (fruit drinks) -3.85 (isotonic drinks) ⁴² Calculated from authors' statement that 20% price increase would lead to 45% decrease in regular soft drinks, 14% for fruit drinks and 77% for isotonic drinks	Modelling
Zhen et. al (2013) ⁴³	United States	Half-cent per ounce volumetric tax on SSBs	-1.035 (regular soft drinks) -2.363 (energy/sports drinks) -1.192 (juice drinks)	Modelling Demand system (LINQUAD model)
Miao et. al (2013) ⁴⁴	United States	Not specified but tax calculated so that total calories reduce by 2.19%	-0.95 (carbonated soft drinks)	Modelling
Tiffin et. al (2013) ⁴⁵	United Kingdom	Various scenarios	Depends on scenario modelled, but:	Modelling

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³⁹ Geir Gustavsen, "Public Policies and the Demand for Carbonated Soft Drinks: A Censored Quantile Regression Approach", paper prepared for the 11th congress of the European Association of Agricultural Economists, Copenhagen, August 24-27, 2005, 10-12.

⁴⁰ Calculated from authors' statement that 10.8% price increase for soft drinks would lead to 9.5% consumption decrease

⁴¹ Senarath Dharmasena and Oral Capps Jr, "Intended and Unintended Consequences of A Proposed National Tax on Sugar-Sweetened Beverages to Combat the US Obesity Problem", *Health Economics* 21 (2012), 669-694, 684.

⁴² Calculated from authors' statement that 20% price increase would lead to 45% decrease in regular soft drinks, 14% for fruit drinks and 77% for isotonic drinks

⁴³ Chen Zhen, Eric A Finkelstein, James Nonnemaker, Shawn Karns, Jessica Todd, "Predicting the Effects of Sugar-Sweetened Beverage Taxes on Food and Beverage Demand in a Large Demand System", *American Journal of Agricultural Economics* 1-25; doi: 10.1093/ajae/aa049, 21-22.

⁴⁴ Zhen Miao, John Beghin and Helen Jensen, "Accounting for Product Substitution in the Analysis of Food Taxes Targeting Obesity", *Health Economics* 22: 1318-1343, 1338-40.

⁴⁵ Richard Tiffin, Ariane Kehlbacher, Matthew Salois, "The Effects of a Soft Drink Tax in the UK", *Health Economics* (2014), Wiley Online Library, DOI: 10.1002/hec.3046

		modelled based on the taxes in France and Hungary	Between -0.456 and -1.261 for regular soft drinks, -1.122 and -2.087 for sports drinks, and -0.479 and -1.0 for juice drinks with sweetener	
Sharma et. al (2014) ⁴⁶	Australia	20% valoric and 20 cent-per-litre volumetric	-0.63 (regular soft drinks) -1.05 (fruit drink)	Modelling
Finkelstein et. al (2013) ⁴⁷	United States	20% SSB tax	-1.32 (all SSBs)	Modelling
Harding and Lovenheim (2014) ⁴⁸	United States	Various valoric taxes/price increases	-2.197 to -2.260 (soda) -1.812 to -2.055 (cold beverages)	Modelling

There is also at least one empirical study which finds that taxes on soft drinks [in which country in the United States](#) are associated with lower total grams of soft drink consumption.⁴⁹

Tax on added sugar

The price elasticities of demand for a tax on added sugar are much less clear-cut. This is because a very wide range of foods and beverages would be affected, some of which are easily substitutable while others are not. There will therefore be wide variation in PEDs across the affected foods.

Nevertheless, it is possible to get an idea of the magnitude of the consumption response which would result from this tax.

[Table 3: Studies which investigate the effect of an added-sugar tax on consumption](#)

Studies which investigate the effect of an added-sugar tax on consumption				
Study	Country studied	Type of tax	Consumption response to price	Type of study
Jensen and Smed (2007) ⁵⁰	Denmark	Volumetric	A tax of 5.60 DKK (NZ\$1.19) per kilogram of sugar estimated to lead to a 15.8%	Modelling

⁴⁶ Anurag Sharma, Katharina Hauck, Bruce Hollingsworth and Luigi Sciliani, "The Effects of Taxing Sugar-Sweetened Beverages Across Different Income Groups", *Health Economics* (2014) Published online in Wiley Online Library. DOI: 10.1002/hec.3070, 4.3.

⁴⁷ Finkelstein, Eric A., Chen Zhen, Marcel Bilger, James Nonnemaker, Assad Farooqui, Jessica Todd, "Implications of a sugar-sweetened beverage (SSB) tax when substitutions to non-beverage items are considered", *Journal of Health Economics* 32 (2013) 219-239.

⁴⁸ Matthew Harding and Michael Lovenheim, "The Effect of Prices on Nutrition: Comparing the impact of Product and Nutrient-Specific Taxes", National Bureau of Economic Research working paper 19781, January 2014.

⁴⁹ Fletcher et. al, "The effects of soft drink taxes on child and adolescent consumption and weight outcomes", *Journal of Public Economics* 94 (2010) 967-974.

⁵⁰ Jorgen Jensen and Sinne Smed, "Cost-effective design of economic instruments in nutrition policy", *International Journal of Behavioural Nutrition and Physical Activity* 2007, 4:10, doi:10.1186/1479-5868-4-10

			percent reduction in sugar consumption.	
Nordstrom and Thurnstrom (2011) ⁵¹	Sweden	Volumetric	A tax of 0.182 SEK (NZ\$0.03) per gram of added sugar estimated to lead to an 11% decrease in added sugar consumption (when combined with a subsidy on fibre).	Modelling
Harding and Lovenheim (2014) ⁵²	United States	Valoric	20% tax on sugar would lead to a net 16% monthly decline in sugar consumption	Modelling
Miao et. al (2013) ⁵³	United States	Not clear: tax rate not stated but calibrated so that total calorie reduction is 2.19%, which they state is the estimated calorie reduction from a 1-cent per-ounce soft drink tax.	An added-sugar tax will reduce total sugar consumption by 11%. Tax rate is not specified but the authors state that it has been calibrated so that overall calorie reduction is 2%, which they state is the estimated calorie reduction from a 1-cent per-ounce soft drink tax.	Modelling

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While these studies give some idea of how sugar consumption would respond, it is less clear how the consumption of individual products would change as the result of an added-sugar tax. The study by Harding and Lovenheim estimated that the greatest decreases in calorie consumption would be for soft drinks, as well as other goods which may be substitutes or complements including baking goods, snacks and candy and warm beverages, with meat, condiments and packaged meals the least affected.⁵⁴ Miao et. al estimated that the largest decreases would be in soft drinks, coffee and tea, and sugars and sweets.

Impact on different groups

One key consideration is whether a tax would target the group of consumers who policymakers might be most interested in changing the behaviour of. The purpose is to reduce excessive sugar consumption, so heavy consumers of sugar are the group which would likely be targeted. A tax would likely be ineffective at reducing excessive sugar consumption at the population level if only low or moderate consumers of sugar responded to the price increase.

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MK: There is but it doesn't meet our criteria for economic evidence. It can be found in earlier versions of the document before non-economic evidence was removed.

⁵¹ Jonas Nordstrom and Linda Thurnstrom, "Economic policies for healthier food intake: the impact on different household categories"

⁵² Harding and Lovenheim, "The effect of prices on nutrition".

⁵³ Miao et. al, "Accounting for product substitution in the analysis of food taxes targeting obesity"

⁵⁴ Harding and Lovenheim, "The effect of prices on nutrition", table 7.

The evidence seems to indicate is consistent with the hypothesis that heavy consumers of sugar will reduce consumption by more than lighter consumers of sugar. This was found to occur by Gustavsen, Tiffin et. al and Finkelstein et. al. Consumption responses also vary by income and family status. Zhen et al. and Sharma et. al both estimated that low-income consumers would decrease consumption of SSBs by more than high-income consumers, while Nordstrom and Thunstrom's sugar tax model saw much larger reductions in added sugar consumption for households with children than those without them.⁵⁵ This seems to indicate that taxes are particularly effective at targeting sugar consumption by children.

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Does reducing consumption of the taxed products lead to a reduction in total calorie intake?

Figure 5: Idealised chain of causation for potential impact of a sugar tax (focus on arrow 4)



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While evidence suggests that taxes will reduce purchases, this may not translate into reduced calorie intake if the reduction is too small, or if consumers substitute towards other, non-taxed, high-calorie or high fat items.

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Yes: changed to reflect this.

SSB tax

Table 4: Studies which investigate the effect of an SSB tax on total calorie intake

Studies which investigate the effect of an SSB tax on total calorie intake				
Study	Country studied	Type of tax	Consumption response to price	Type of study
Harding and Lovenheim (2014)	United States	Valoric	Consumption reduction brought on by 20% SSB tax would reduce net total calories purchased by 8.4%. This is because the broader scope of an SSB tax compared to a soft-drink tax limits the possibility of substituting to other high sugar beverages.	Modelling
Fletcher et. al (2014)	United States	Various – collects data from a variety of US state taxes	Analyses the relationship between existing US soft drink taxes and calorie intake. Finds that large increases in soft drink taxes are unlikely to reduce calorie intake. This empirical study doesn't provide an explanation for	Empirical

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⁵⁵ Nordstrom and Thunstrom, "Economic policies for healthier food intake", 135.

			this, but speculates that it is due to substitution effects.	
Sharma et. al (2014)	Australia	20% valoric SSB tax	Projected that consumption decrease brought on by 20% SSB tax would reduce net individual caloric intake by 10,678kJ per year on average. This is about one third of 1% of average NZ yearly energy intake. Only modest substitution towards other beverages.	Modelling
Finkelstein et. al (2013)	United States	20% valoric price increase	Found that the consumption reduction brought on by a 20% SSB price increase would reduce net total calorie intake by 4.7%. No evidence found of substitution towards high sugar food items.	Modelling
Zhen et. al (2013)	United States	Half-cent per ounce volumetric tax	Consumption reduction from half-cent-per-ounce (NZ\$0.14 per litre) SSB tax would reduce net total calories by 33kJ per person, per day on average. This is about a third of 1% of average NZ daily energy intake. This effect would be higher if it were not for substitution towards other high-calorie items (decrease in SSBs calories is 63kJ per day).	Modelling
Dharmasena and Capps (2012)	United States	20% valoric tax	Consumption reduction brought on by a 20% SSB price increase would reduce net per capita calorie intake by 1881kJ per month. This is about two-thirds of 1% of average NZ monthly energy intake. Effect is partially offset by substitution towards coffee, fruit juice and low-fat milk.	Modelling
Fletcher et. al (2010)	United States	Various – collects data from a variety of US state taxes	Found no statistically significant relationship between US state soft drink taxes and total caloric intake. This is because decline in soft drink calories is totally offset by substitution towards whole milk and juice calories.	Empirical

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The two studies which find no significant effect on calorie intake (both by Fletcher et. al) differ from the other studies in some key ways. The Fletcher studies only consider existing US state soft drink taxes, which are probably less effective than an SSB tax at reducing calorie intake because other high-calorie beverages (such as fruit and sports drinks) are left untaxed.

The Fletcher studies also incorporate only existing US state sales taxes; Secondly, authors such as Finkelstein believe that US state sales taxes these will not have a significant effect

anyway because the taxes are too small and sales taxes may not affect purchasing behaviour because in the USA they are not reflected in the shelf price. The differing conclusions may be the result of the differing methodologies rather than a reflection of the true efficacy of an SSB tax.

Nevertheless, whether a tax-induced SSB consumption decrease will lead to a decrease in total calories and by how much is still not clear based on this evidence.

Tax on added sugar

There is not a large amount of good economic evidence on the effect that an added-sugar tax would have on total calorie intake.

Table 5: Studies which investigate the effect of an added-sugar tax on total calorie intake

Studies which investigate the effect of an added-sugar tax on total calorie intake				
Study	Country studied	Type of tax	Consumption response to price	Type of study
Harding and Lovenheim (2014) ⁵⁶	United States	Valoric	20% tax on sugar would lead to a net 19% decrease in total calories. This is believed to be because the very broad tax limits the ability to substitute away.	Modelling
Miao et. al (2013) ⁵⁷	United States	Not clear, tax rate not stated but calibrated so that total calorie reduction is 2.19%, which they state is the estimated calorie reduction from a 1-cent-per-ounce soft drink tax.	find that there will be substitution from high-sugar to low-sugar variants of the same kinds of products. The authors do not give exact figures for total calorie reduction. However, this seems to indicate that substitution effect will be positive, not negative which may mean that total calories reduce.	Modelling
Nordstrom and Thurnstrom (2011) ⁵⁸	Sweden	Volumetric	A tax of 0.182 SEK (NZ\$0.03) per gram of added sugar estimated to lead to	Modelling

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⁵⁶ Harding and Lovenheim, "The effect of prices on nutrition".
⁵⁷ Miao et. al, "Accounting for product substitution in the analysis of food taxes targeting obesity"
⁵⁸ Jonas Nordstrom and Linda Thurnstrom, "Economic policies for healthier food intake: the impact on different household categories"

			a net 5% increase in fat consumption and a net 10% average increase in total kilojoules. However the increase in kJ may just be because this package includes a subsidy for fibre. If the fibre subsidy were removed this may not be the case.	
Jensen and Smed (2007) ⁵⁹	Denmark	Volumetric	Sugar tax would induce some substitution towards other fatty foods, although the substitution does not appear to be large enough to mitigate the effect of the tax. Exact figures for net total calories reduced are not stated.	Modelling

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There is not a large amount of good economic evidence on the effect that an added sugar tax would have on total calorie intake. Overall, the above studies appear to broadly support the proposition that a tax would reduce total calorie intake, provide some basis for cautious optimism, especially the work by Miao et. al (2013) and Harding and Lovenheim (2014).

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MK: wording changed to avoid this.

Impact on different groups

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MK: Done.

There is evidence that reduced calorie intake is concentrated in low income groups and high sugar consumers.

Both Sharma et. al (2014) and Zhen et. al (2013) found that the caloric reduction would be much greater for low income consumers than for high income consumers. Zhen found that the calorie reduction would be more than twice as large for low-income consumers (13.2kcal or 55kJ per day) than for high-income consumers (5.6kcal or 23kJ per day). Sharma finds that reductions in consumption and bodyweight are highest for low-income consumers (mean reduction of 0.4 kg for low-income versus just 0.228 kg for high-income) through

⁵⁹ Jorgen Jensen and Sinne Smed, "Cost-effective design of economic instruments in nutrition policy", International Journal of Behavioural Nutrition and Physical Activity 2007, 4:10, doi:10.1.1186/1479-5868-4-10

which it may be inferred that low-income groups experience the greatest reduction in overall calorie consumption, more than twice the size in the latter study.

Sharma et. al (2014) also found that the reduction would be much greater for heavy consumers than for low and moderate consumers. For an average consumer of beverages, the tax was projected to reduce calories by 10,678kJ per year, but for heavy consumers (those at the 95th percentile of consumption), the reduction would be 54,494kJ per year.

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4.5. Application

Scope of the tax

This paper has considered two tax options: a product-based SSB tax and a nutrient-based added sugar tax. There is some evidence that broader, nutrient-based taxes are both more effective as well as more efficient.^{60 61} This is believed to be because the broad nature of the tax limits the ability to switch to untaxed high-calorie items, and also tends to limit distortive effects and deadweight loss.

The SSB tax would also provide poorer incentives: a consumer would have less incentive to switch from a high-sugar SSB to a low-sugar SSB because as long as they are both SSBs, the tax will apply equally to both (assuming that it is a straight SSB tax that includes all sugar sweetened beverages, not those over a certain threshold; and noting that the total price might still be different for the different products). An added-sugar tax might create this incentive, because a high-sugar item would experience a greater price increase than a low-sugar one.

On the other hand, a narrower product-based SSB tax may be simpler to implement and administer. Identifying SSBs and then taxing them at a single rate is relatively simple; it may be more difficult to identify all foods with added sugar and then compute tax liability based on the varying amounts of sugar in each item. Both taxes would likely require government monitoring to ensure compliance, which could be complex and costly, particularly for the broader tax. Broad taxes may also be less feasible politically due to the wider scope of government intrusion that they represent.

Excise vs. sales tax

Another issue is whether an excise (volumetric) tax or a sales (valoric) tax would be preferable, if government intervention is warranted. A volumetric tax may be preferable because it might be more effective at discouraging bulk-buying. Bulk purchases are cheaper per unit than non-bulk purchases, so under a valoric tax smaller non-bulk purchases will experience a greater increase in per-unit price. This would incentivise people towards bulk purchases. Under a volumetric tax, the per-unit price will increase by a uniform amount so

⁶⁰ Harding and Lovenheim, "The effect of prices on nutrition".

⁶¹ Miao et. al, "Taxing sweets: Sweetener input tax or final consumption tax?" *Contemporary Economic Policy* vol. 30 no. 3 July 2012, 344-361.

that this incentive will not exist as a result of the tax (although it may still exist as a result of the cheaper total price).

Excise taxes are also likely to over-shift, while sales taxes will under-shift (see above). Over-shifting may be preferable because this means a price increase of the same size can be achieved with a smaller tax, thus mitigating some of the tax-induced inefficiency. This would be one ground for preferring an excise tax over a sales tax.

Another disadvantage of a sales tax is the effect it might have on the tax system. New Zealand already taxes high sugar items, along with other goods and services, at a single GST rate of 15%. Using a sales tax would require the GST to be raised for the taxed products. The introduction of exceptions like this would undermine the integrity of New Zealand's GST system. With an excise tax, the GST could be left at 15% because the tax would be levied on manufacturers before GST is imposed.

Size of the tax

Finally, there is the question of how large ~~the tax should be~~ a tax should be, if implemented. For ~~an~~ the SSB tax, the modelling literature and public health commentators seem to be converging on the idea that a 20% price increase should be large enough to reduce consumption and calorie intake sufficiently. This could be achieved through either an excise or sales model. Ideally, if an SSB tax was used it should be set at the point where the marginal benefit of the tax equals the marginal cost, but there may be information gaps that prevent this analysis from occurring. Another consideration would be whether to use an iterative approach, and gradually increase the tax and assess how consumers are responding to it, and modify the approach accordingly. This might also be a way to increase consumer buy-in to a tax, if progressed.

It is less clear what the size might be for the added-sugar tax. Assuming a 355ml can of Coca-Cola has 39 grams of sugar, then NZ\$0.00125 per gram of sugar would work out to a tax of NZ\$0.137 per litre, similar in size to volumetric taxes overseas, for that particular beverage. The added sugar tax modelled by Nordstrom and Thurnstrom (2011) was much larger than this: SEK 0.182 (NZ\$0.03) per gram of added sugar.⁶²

While a number of authors have claimed that a tax will only affect behaviour if it is large enough, this is only the case if there are non-linear demand responses. Fletcher et. al have pointed out that 'proponents of large taxes implicitly rely on a "threshold effect", where a tax must be above a certain size before it begins to significantly affect consumption.'⁶³ It is not clear whether such effects exist. Only one study explicitly investigates the existence of non-linear demand, and found no evidence that it existed for soft drink taxes.⁶⁴ It certainly seems plausible that non-linear demand could exist: for example, a large tax might attract much more media attention than a small tax, which would make consumers much more cognisant of the large tax and reduce their demand by proportionally more. However, it

Commented [MOH57]: I'm not convinced by this. Its also about determining what calorie reduction or consumption reduction or obesity reduction we want, and working backwards to determine the level of the tax to meet that, and using an iterative process to get to that. A linear response matters too - e.g. a 20% change in price, leading to a 20% reduction, or 10% change in price through tax, leading to a 10% reduction.

⁶² Exchange rate calculated on 21/08/2014. NZD amount is not PPP-adjusted.

⁶³ Fletcher et. al, "The proof is in the pudding: Response to Chaloupka, Powell and Chiqui", *Journal of Policy Analysis and Management*, vol. 30, no. 3, 664-665 (2011).

⁶⁴ Fletcher et. al, "Non-linear effects of soda taxes on consumption and weight outcomes", *Health Economics* (2014), published online in Wiley Online Library. DOI: 10.1002/hec.3045

would be important for further research to be conducted in this area should a tax be proposed in New Zealand.

Table 6: Tax type – options for policy makers if a sugar tax is progressed

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Tax type – options for policy makers if a sugar tax is progressed	
	Options
Tax scope and application	<p>SSB tax. Tax would include SSBs only. Narrower scope may allow more substitution to other unhealthy beverages or foods. Scope relatively easy to define because it is clear what SSBs are. Administrative costs could be lower compared to added sugar tax.</p> <p>Added sugar tax. Tax would include all foods and beverages with added sugar. May be more effective and efficient. May be politically less feasible due to wider govt. intrusion. Administrative costs could be higher compared to SSB tax.</p>
Tax type	<p>Excise tax. An excise (volumetric) tax is levied on the manufacturer. Targets volume and can discourage bulk buying. Likely to overshift. Excise model proven to be successful with tobacco.</p> <p>Sales tax. Valoric and levied on consumer. Does not target volume and possibly ineffective at discouraging bulk buying. Likely to undershift. May be less administratively complex. May undermine integrity of GST system.</p>
Tax size	<p>Most jurisdictions with SSB taxes appear to have chosen tax rates between NZ\$0.10 and NZ\$0.20 per litre of the beverage (adjusted for PPP). It may be preferable to start on the lower end of this range to avoid unnecessary inefficiency brought on by high tax rates.</p> <p>It is less clear what the magnitude might be for an added-sugar tax. Assuming a 355ml can of Coca-Cola has 39 grams of sugar, then NZ\$0.00125 per gram of sugar would work out to a tax of NZ\$0.137 per litre, in the middle of the above range, for that particular beverage.</p>

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Equity considerations

A frequent criticism of sugar taxes is that they are likely to be regressive. Not only do low-SES households spend a higher proportion of their income on foods (including high sugar foods), they may also spend more on high sugar foods in absolute terms. United States data shows that socioeconomic status (SES) is related to consumption of unhealthy foods, with low-SES households consuming more of these items.⁶⁵ This means that low-SES households are likely to pay a higher proportion of their income in tax.

⁶⁵ Adam Drewnowski and SE Specter, "Poverty and obesity: the role of energy density and diet costs", *Am J Clin Nutr* January 2004 vol. 79 no. 1 6-16. Accessed via <http://ajcn.nutrition.org/content/79/1/6.long>

This regressive effect has been found in studies by Madden,⁶⁶ Finkelstein,⁶⁷ Sharma,⁶⁸ and others. The studies are divided on which type of tax is likely to be more regressive: the study by Sharma et. al finds that a valoric (sales) tax would be more regressive than a volumetric (excise) tax, while the Finkelstein study finds the opposite.

Although the financial effects of the tax will likely be regressive, the health gains may be progressive.⁶⁹ Calorie reductions have been found to be higher for low-income households, leading to greater weight loss for these groups.⁷⁰ Policymakers may wish to view the regressivity question as a trade-off: is it worthwhile to subject low-SES households to a regressive financial effect in the short term so that progressive health benefits will accrue in the long term?

Consumption also differs according to ethnic group. Maori females are 1.5 times more likely than their non-Maori counterparts to consume 3 or more soft drinks per week, although there was no difference between Maori and non-Maori males.⁷¹ Similarly, Pacific people are significantly more likely to be high consumers of soft drinks than non-Pacific people.⁷² Also important are the age and gender gradients: younger people consume more total sugar, as well as getting a higher proportion of that sugar from beverages.⁷³ Males consume more total sugar than females across all age groups, and get more of that sugar from beverages and sweets.⁷⁴ The equity impact is therefore not limited to lower and higher-income groups: consideration should also be given to ethnic, age and gender effects.

Effects on obesity and health

The purpose of a sugar tax is likely to be to reduce calorie intake from sugar consumption. This is intended to ameliorate the negative health impacts resulting from excessive sugar intake such as obesity and obesity-related illnesses.

There is evidence that even a small decrease in calorie consumption can have significant effects on population weight. Hill et. al (2003) estimated that a population wide decrease of only 50 calories per day could halt weight gain for 90% of the population,⁷⁵ although the

⁶⁶ David Madden, "The Poverty Effects of a Fat Tax in Ireland", *Health Economics* 2013, published online in Wiley Online Library, doi:10.1002/hec.3006, 4-5.

⁶⁷ Finkelstein et. al, "Implications of a sugar-sweetened beverage tax", 226.

⁶⁸ Sharma et. al, "The effects of taxing sugar-sweetened beverages across different income groups", 4-7.

⁶⁹ Zhen et. al, "Predicting the effects of sugar-sweetened beverage taxes", 21.

⁷⁰ Sharma et. al, "The effects of taxing sugar-sweetened beverages across different income groups", Table X.

⁷¹ Ministry of Health, "A Focus on Maori Nutrition: Findings from the 2008/09 New Zealand Adult Nutrition Survey", accessed via <http://www.health.govt.nz/publication/focus-maori-nutrition>

⁷² Ministry of Health, "A Focus on Pacific Nutrition: Findings from the 2008/09 New Zealand Adult Nutrition Survey", accessed via <http://www.health.govt.nz/publication/focus-pacific-nutrition>

⁷³ Ministry of Health, "A Focus on Nutrition: Key Findings of the 2008/09 New Zealand Adult Nutrition Survey", 76-80. Accessed via <http://www.health.govt.nz/system/files/documents/publications/a-focus-on-nutrition-v2.pdf>.

⁷⁴ Ministry of Health, "A Focus on Nutrition: Key Findings of the 2008/09 New Zealand Adult Nutrition Survey", 76-80. Accessed via <http://www.health.govt.nz/system/files/documents/publications/a-focus-on-nutrition-v2.pdf>.

⁷⁵ Hill et. al, "Obesity and the environment: where do we go from here?", *Science* vol. 299 (2003), 853-855.

evidence presented above indicates that calorie decreases from a sugar tax would probably be smaller than that, depending on the level that it is set at.

A number of studies employ a rule of thumb that 3500 calories is equal to 1 pound of body weight (32,220 kJ = 1kg).⁷⁶ This implies a tax-induced average per-capita weight reduction of 0.7 kg per year, 0.7 to 1.2 kg per year, or 0.293 kg per year depending on the modelling study.⁷⁷ Other studies have found that a tax would have little effect on weight,⁷⁸ although this is likely because the substitution effects prevent calorie reduction, rather than calorie reduction not leading to weight loss. On the other hand, many authors have noted that the 3500-calorie rule is likely far too simplistic and does not adequately capture the subtleties of the relationship between energy intake and weight.⁷⁹ This may lead to overestimates of how much weight loss will result from a tax.

Reducing population weight will likely bring down rates of obesity and obesity-related diseases. Rose (2008, orig 1992) estimated that if the average weight in a population could be reduced by 1.25%, the number of people who are obese in the same population would be reduced by one quarter, due to changes in social norms around the acceptability of being overweight and obese.⁸⁰ The New Zealand health costs from diabetes, hypertension, osteoarthritis and other diseases attributable to obesity, indicate that a reduction in obesity would lead to a reduction in these illnesses and also in costs to the health system.⁸¹

Application to the New Zealand context

Almost all of the research discussed in this paper comes from overseas. A key issue is therefore how New Zealand differs and how this could impact upon the success or otherwise of a tax here.

One difference is that New Zealand may have higher PED for high sugar items than the USA, where the bulk of the aforementioned studies were conducted. One study estimated a mean New Zealand PED for soft drinks of -1.27 and -1.34 for energy drinks.⁸² This is higher than in the USA or other comparable OECD countries where PED estimates were generally between -0.5 and -1.2. This was believed to be because New Zealand is less wealthy on a per-capita basis, so consumers respond more strongly to changes in the price of non-essential food items.⁸³ Higher PED indicates that a tax may have a larger impact on consumption in New Zealand.

⁷⁶ This rule of thumb is used in Hill et. al (2003), Dharmasena and Capps (2012), and others.

⁷⁷ Weight figures come from Finkelstein (2013), Dharmasena and Capps (2012) and Sharma (2014) respectively. Note that Finkelstein uses a more recent methodology instead of the 3500 calorie rule.

⁷⁸ C.f. Gelbach et. al, "Cheap Donuts and Expensive Broccoli: The Effect of Relative Prices on Obesity", accessed via

http://www.law.yale.edu/documents/pdf/Intellectual_Life/JKlick_Cheap_Donuts.pdf. See also Fletcher et. al (2014).

⁷⁹ Martijn Katan and David Ludwig, "Extra Calories Cause Weight Gain But How Much?", accessed via <http://www.foodpolitics.com/wp-content/uploads/JAMA.pdf>

⁸⁰ Rose, G. *Rose's Strategy of Preventive Medicine*. 2008. Oxford University Press, New York.

⁸¹ Lal et. al, *Aust NZ J Public Health*. 2012; 36:550-6

⁸² Cliona Ni Mhurchu et. al, "Food Prices and Consumer Demand: Differences across Income Levels and Ethnic Groups", *PLoS ONE* 8(10):e75934. doi: 10.1371/journal.pone.0075934

⁸³ *Ibid*.

It is also possible that CPED – the pattern of substitution resulting from the tax – could be different in New Zealand. There is evidence showing a significant complementary relationship between SSBs and pastry products (such as pies) in New Zealand, so an SSB tax may also bring down consumption of these products.⁸⁴ Conversely, SSBs and pork/poultry products are substitutes, meaning that an SSB price increase would raise consumption of these (potentially higher calorie) meats.⁸⁵ There appears to be only one study which investigates food PED and CPED in New Zealand, so it would be useful to obtain additional research on this issue. Practical examples could also be considered, for instance, whether individuals would still choose to purchase a pie, but consume it with a diet soft drink instead.

One notable advantage enjoyed by New Zealand is that cross-border tax avoidance is much more difficult here. In Denmark, for example, some shoppers simply drove to nearby Germany or Sweden to purchase high sugar items without Danish taxes applied. For obvious reasons this is not possible in New Zealand, and while consumers could theoretically have untaxed food and beverages shipped in from overseas this is likely to be prohibitively expensive.

Finally, the structure of New Zealand grocery markets means that taxes may be more likely to over-shift. Over-shifting requires a highly concentrated market in order to grant the requisite market power. New Zealand's grocery market is dominated by just two firms: Progressive Enterprises Limited and Foodstuffs Limited. This may indicate a higher degree of market concentration in New Zealand which could increase the probability and extent of over-shifting.

The issue of how a tax may interact with existing New Zealand food policies is discussed in Appendix C.

[We need to consider what location a sugar tax would be used in. Only supermarkets or expanded to include cafes, restaurants, fast food and takeaways, food markets etc. Likely to have much larger impact if also includes latter]

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Potential side effects

One potential positive side effect of a tax is that manufacturers could reformulate their products to reduce sugar content and limit their exposure to the tax. This seems much more likely with the added-sugar tax than the SSB tax.

With the SSB tax, depending on how it is defined, the only way to avoid the tax might be to remove all sugar from the item so that it is no longer a sugar-sweetened beverage. This could be relatively difficult. Under the added-sugar tax, even a small reduction in sugar content would still reduce the tax paid, because the tax is calculated by unit of added sugar. Making a small decrease in sugar content is likely to be much more straightforward.

On the other hand, reformulation can also have negative effects. In Mexico, the introduction of the sugar tax led a major soft drink manufacturer to switch to using high-fructose corn

⁸⁴ Ibid.

⁸⁵ Ibid.

syrup instead of sugar, which has a potentially worse health impact.⁸⁶ This illustrates the possibility that manufacturers could replace sugar with even more unhealthy substitutes in order to limit tax exposure and carefully consider the scope of the tax.

It is also possible that a tax may induce some black-market manufacture of SSBs or high sugar foods, although the tax would probably have to be very high indeed to justify the investment of time and money required to do so. This would depend on the specific details of how the tax is targeted.

One potential problem which is unique to the added-sugar tax is that it may reduce consumption of other beneficial nutrients. An SSB tax has been so widely mooted partly because SSBs are considered to be nutrient-poor,⁸⁷ so reducing their consumption could not harm overall nutrition. However, an added-sugar tax would reduce consumption of all foods with added sugar, some of which could have important nutrients in them. This could lead to negative health effects in spite of the decrease in sugar consumption. This side effect has not received much attention in the literature and it would be useful for further investigation to be undertaken into it.

Measurement difficulties

Measuring the success of a sugar tax may be difficult. The aim of the tax is to reduce caloric intake stemming from excessive sugar consumption. Several metrics could be used as proxies for this.

- **Industry sales figures (SSBs, high sugar foods):** Will indicate how much overall consumption decreases as a result of the tax. These do not segment by low, medium or high volume sugar consumers, so it would be difficult to tell from these if the tax was having its intended effect of reducing sugar intake among those who consume it the most.
- **Ministry of Health adult nutrition surveys:** These provide a detailed breakdown of sugar consumption (among many other things) by age, ethnicity, SES, and other variables. This would be an excellent way to understand whether the tax is having its intended effect of reducing excessive consumption. However, they are conducted quite infrequently (last one was in 2008/09), which means (1) it would take a long time before data becomes available to show the effect of the tax, and (2) it is more difficult to see if consumption changes are a result of the tax, or of other factors which have occurred in the time since the tax was implemented.
- **Obesity rates:** Lowering sugar consumption through the tax might be intended to reduce calorie intake. A flow-on effect of this is that obesity rates would hopefully decline. Looking at the change in obesity prevalence in New Zealand may therefore indicate the effect of the tax. Again, though, it will be difficult to determine how much

⁸⁶ Laura Cornelsen et. al, "Why fat taxes won't make us thin", *Journal of Public Health* 36(2), 2014, accessed via <http://pubhealth.oxfordjournals.org/content/early/2014/05/21/pubmed.fdu032.long>

⁸⁷ Ni Mhurchu et. al, "Twenty percent tax on fizzy drinks could save lives and generate millions in revenue for health programmes in New Zealand", *New Zealand Medical Journal* 14 February 2014, Vol 127 No 1389, 92-95.

of the change is due to the tax and how much is due to other variables, for example an increase in the use of active transport methods.

Choosing an appropriate method for measuring the success of the tax is therefore an important consideration for policymakers. One option might be to set up a dedicated survey (with observations timed to be before and after implementation) to measure this, although it would be more cost effective to build on existing mechanisms where possible.

Another problem is the significant time lag between consumption changes and weight loss. Even if a decrease in caloric intake is identified, it may take a long time before this translates into a measurable decline in obesity or BMI across the population.

Unintended consequences could also be measured for, for example increase in sodium levels if consumers substitute away from high sugar products to high salt savoury products.

5. Conclusion

This paper has considered the impact and implications of both an SSB tax and a tax on added sugar. There is some evidence that these could be effective at reducing total calorie consumption, but it is not yet clear-cut. Most of the uncertainty surrounds the substitution effects that would result from the tax: some studies have estimated that consumers might switch to buying untaxed high-calorie items, meaning that there will be little change in total calorie intake. On the other hand, many other studies estimate that substitution effects are small and there would still be significant reductions in calorie intake.

There are a number of issues which warrant consideration should a tax be considered. These include:

- What its size and scope should be
- Whether to use an excise or sales tax
- The equity impact
- How a tax might operate in the New Zealand context,
- What the side effects might be
- How the impact could be measured
- How to involve producers and consumers in the development of the process to increase their buy-in and potential behaviour change

Several areas exist where further research would be useful before a tax was considered for implementation. These include the potential presence of non-linear demand effects, New Zealand-specific PED and CPED, and possible effects of an added-sugar tax on total nutrient intake.

Table 7:

What we know	What we don't know
Taxes likely to lead to consumption decreases for the taxed goods.	How total calorie intake will change as a result of the tax: substitution effects are still not clear. If consumers simply substitute to other high-calorie items, there will probably be little change in total calories.

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Calorie decrease will probably lead to some weight decrease.	How substitution patterns differ in NZ compared to overseas. If there is substantial difference, then overseas studies may be of little use.
Excise tax may be better than a sales tax because it discourages bulk buying, is more likely to overshift, and does not impinge on GST integrity.	Whether the added-sugar tax would unintentionally reduce consumption of other beneficial nutrients. This could mean that overall health effects might be negative in spite of calorie reductions.
Taxes seem to be effective at targeting heavy consumers of sugar and low-income consumers.	Whether there are non-linear demand effects. This has relevance for the size of the tax.
Nutrient-based added-sugar tax probably more efficient and effective than product-based SSB tax. On the other hand it may have downsides such as greater administrative complexity.	How the impact of the tax could be measured. Possible that a dedicated survey could be set up to measure this.
Tax probably financially regressive, although health benefits may be progressive.	The exact nature of the relationship between calories and weight. It seems that the popular 3500-calorie rule is probably far too simplistic and inappropriate to use for estimating weight loss resulting from a sugar tax.

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6. References

- Berardri et. al, "The impact of a 'soda tax' on prices: Evidence from French micro data", accessed via <http://www.jma2014.fr/fichiers2013/37/soda-tax-bstv-jma.pdf>
- Bergman, U. Michael and Niels Hansen, "Excise Tax Pass-Through on Beverage Prices", accessed via http://www.econ.ku.dk/Kalender/seminarerepru/epru20032009/bergmanhansen_march2009.pdf
- Bonnet, Celine and Vincent Requillart, "Strategic Pricing and Health Price Policies", accessed via http://neeo.univ.tlse1.fr/2944/1/strategic_pricing.pdf, 21.
- Cornelsen, Laura et. al. "Why fat taxes won't make us thin", *Journal of Public Health* 36(2), 2014, accessed via <http://pubhealth.oxfordjournals.org/content/early/2014/05/21/pubmed.fdu032.long>
- Dharmasena, Senarath and Oral Capps Jr, "Intended and Unintended Consequences of A Proposed National Tax on Sugar-Sweetened Beverages to Combat the US Obesity Problem", *Health Economics* 21 (2012), 669-694, 684.
- Drewnowski, Adam and SE Specter, "Poverty and obesity: the role of energy density and diet costs", *Am J Clin Nutr* Junary 2004 vol. 79 no. 1, 6-16. Accessed via <http://ajcn.nutrition.org/content/79/1/6.long>
- Finkelstein, Eric A., Chen Zhen, Marcel Bilger, James Nonnemaker, Assad Farooqui, Jessica Todd, "Implications of a sugar-sweetened beverage (SSB) tax when substitutions to non-beverage items are considered", *Journal of Health Economics* 32 (2013) 219-239, 226.
- Finkelstein, Eric A., Chen Zhen, Marcel Bilger, James Nonnemaker, Assad Farooqui, Jessica Todd, "Implications of a sugar-sweetened beverage (SSB) tax when substitutions to non-beverage items are considered", *Journal of Health Economics* 32 (2013) 219-239.
- Fletcher et. al, "Non-linear effects of soda taxes on consumption and weight outcomes", *Health Economics* (2014), published online in Wiley Online Library. DOI: 10.1002/hec.3045
- Fletcher et. al, "The effects of soft drink taxes on child and adolescent consumption and weight outcomes", *Journal of Public Economics* 94 (2010) 967-974.
- Fletcher et. al, "The proof is in the pudding: Response to Chaloupka, Powell and Chriqui", *Journal of Policy Analysis and Management*, vol. 30, no. 3, 664-665 (2011).
- Galbach et. al, "Cheap Donuts and Expensive Broccoli: The Effect of Relative Prices on Obesity", accessed via http://www.law.yale.edu/documents/pdf/Intellectual_Life/JKlick_Cheap_Donuts.pdf. See also Fletcher et. al (2014).
- Gil, Joan, Guillem Lopez-Cadasnovas, Toni Mora, "Taxation of unhealthy consumption of food and drinks: An updated literature review", *Hacienda Publica Espanola/Review of Public Economics* 207-(4/2013), 199-240, 121.
- Gruber, Jonathan. *Public Finance and Public Policy*, 4th ed., (New York: Worth Publishing, 2013), 565.

Gustavsen, Geir. "Public Policies and the Demand for Carbonated Soft Drinks: A Censored Quantile Regression Approach", paper prepared for the 11th congress of the European Association of Agricultural Economists, Copenhagen, August 24-27, 2005, 10-12.

Ministry of Health, *Health Loss in New Zealand: A report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study, 2006-2016*. Wellington: Ministry of Health. Accessed via <http://www.health.govt.nz/system/files/documents/publications/health-loss-in-new-zealand-final.pdf>

Hill et. al, "Obesity and the environment: where do we go from here?", *Science* vol. 299 (2003) 853-855.

Jensen, Jorgen and Sinne Smed, "Cost-effective design of economic instruments in nutrition policy", *International Journal of Behavioural Nutrition and Physical Activity* 2007, 4:10. doi:10.1186/1479-5868-4-10

Katan, Martijn and David Ludwig, "Extra Calories Cause Weight Gain But How Much?", accessed via <http://www.foodpolitics.com/wp-content/uploads/JAMA.pdf>

Lal et. al, *Aust NZ J Public Health*. 2012; 36:550-6

Madden, David. "The Poverty Effects of a Fat Tax in Ireland", *Health Economics* 2013, published online in Wiley Online Library, doi:10.1002/hec.3006, 4-5.

Matthew Harding and Michael Lovenheim, "The Effect of Prices on Nutrition: Comparing the impact of Product and Nutrient-Specific Taxes", National Bureau of Economic Research working paper 19781, January 2014.

Miao et. al, "Taxing sweets: Sweetener input tax or final consumption tax?" *Contemporary Economic Policy* vol. 30 no. 3 July 2012, 344-361.

Miao, Zhen, John Beghin and Helen Jensen, "Accounting for Product Substitution in the Analysis of Food Taxes Targeting Obesity", *Health Economics* 22: 1318-1343, 1338-40.

Ministry of Health, "A Focus on Maori Nutrition: Findings from the 2008/09 New Zealand Adult Nutrition Survey", accessed via <http://www.health.govt.nz/publication/focus-maori-nutrition>

Ministry of Health, "A Focus on Nutrition: Key Findings of the 2008/09 New Zealand Adult Nutrition Survey", 76-80. Accessed via <http://www.health.govt.nz/system/files/documents/publications/a-focus-on-nutrition-v2.pdf>.

Ministry of Health, "A Focus on Nutrition: Key Findings of the 2008/09 New Zealand Adult Nutrition Survey", 76-80. Accessed via <http://www.health.govt.nz/system/files/documents/publications/a-focus-on-nutrition-v2.pdf>.

Ministry of Health, "A Focus on Pacific Nutrition: Findings from the 2008/09 New Zealand Adult Nutrition Survey", accessed via <http://www.health.govt.nz/publication/focus-pacific-nutrition>

Mora, T. et al. (2014). "The influence of obesity and overweight on medical costs: a panel data perspective." *Eur J Health Econ*. Published online 21 January 2014.

Ni Mhurchu, Cliona et. al, "Twenty percent tax on fizzy drinks could save lives and generate millions in revenue for health programmes in New Zealand", *New Zealand Medical Journal* 14 February 2014, Vol 127 No 1389, 92-95.

Ni Mhurchu, Cliona et. al. "Food Prices and Consumer Demand: Differences across Income Levels and Ethnic Groups", *PLoS ONE* 8(10):e75934. doi: 10.1371/journal.pone.0075934

Nordstrom, Jonas and Linda Thurnstrom, "Economic policies for healthier food intake: the impact on different household categories", *European Journal of Health Economics* (2011) 12:127-140

Rose, G. *Rose's Strategy of Preventive Medicine*. 2008. Oxford University Press, New York.

Sharma, Anurag, Katharina Hauck, Bruce Hollingsworth and Luigi Sciliani, "The Effects of Taxing Sugar-Sweetened Beverages Across Different Income Groups", *Health Economics* (2014) Published online in Wiley Online Library. DOI: 10.1002/hec.3070, 4.3.

Thow et. al, "Effect of fiscal policy on diet, obesity and chronic disease: a systematic review", *Bull World Health Organ* 2010;88:609-614, 611.

Tiffin, Richard, Ariane Kehlbacher, Matthew Salois, "The Effects of a Soft Drink Tax in the UK", *Health Economics* (2014), Wiley Online Library, DOI: 10.1002/hec.3046

World Sugar Research Organisation, "Sugar and Dental Caries", accessed via <http://www.wsro.org/AboutSugar/Sugardentalcaries.aspx>

Zhen, Chen, Eric A Finkelstein, James Nonnenmaker, Shawn Kays, Jessica Todd, "Predicting the Effects of Sugar-Sweetened Beverage Taxes on Food and Beverage Demand in a Large Demand System", *American Journal of Agricultural Economics* 1-25. doi: 10.1093/ajae/aat049, 21-22.

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Appendix A: Additional information about international practice

Hungary

Hungary passed a tax on foods and beverages high in sugar (as well as other dietary undesirables such as fat and caffeine) in 2011. This tax combines both volume and price-based measures. The value of the tax depends on the type of product. For example, the added tariff on soft drinks was NZ\$0.02 per litre. It was NZ\$0.51 per kilogram for prepackaged sweetened products and NZ\$1.30 per litre for energy drinks. They also levied NZ\$1.04 per kilogram for salty snacks.⁸⁸

Additionally, there is flat levy which is applied to all products which contain amounts of sugar or fat over a certain threshold: this is imposed at a rate of NZ\$0.05 per item.⁸⁹

France

France's tax was passed in 2012 and is focused specifically on SSBs. The tax applies to all non-alcoholic beverages with added sugar or sweetener such as soft drinks, fruit drinks and flavoured waters. The tax is officially set at 7.16 euros (NZ\$11.07) per hectolitre, which works out to approximately 0.072 euros (NZ\$0.11) per litre.⁹⁰ This is paid by the manufacturer (an excise tax).⁹¹

Finland

Finland has had a tax on soft drinks for several years, but in 2011 this was raised significantly and joined by new taxes on confectionery products. The excise tax on soft drinks was raised to 0.075 euros (NZ\$0.12) per litre (previously 0.045 euros), while the confectionery tax was introduced at a rate of 0.75 euros (NZ\$1.16) per kilogram,⁹² and raised to 0.95 euros (NZ\$1.47) in 2012.⁹³

Mexico

⁸⁸ Tiago Villanueva, "European nations launch tax attack on unhealthy foods", *CMAJ* vol. 183 no.17, accessed via <http://www.cmaj.ca/content/183/17/E1229.short>

⁸⁹ Catherine Cheney, "Battling the Couch Potatoes: Hungary Introduces 'Fat Tax'", *Der Spiegel* online, accessed via <http://www.spiegel.de/international/europe/battling-the-couch-potatoes-hungary-introduces-fat-tax-a-783862.html>

⁹⁰ OECD Obesity Update 2012, accessed via <http://www.oecd.org/health/49716427.pdf>, 4.

⁹¹ *Ibid.*

⁹² *Ibid.*

⁹³ Joan Gil, Guillem Lopez-Cadasnovas, Toni Mora, "Taxation of unhealthy consumption of food and drinks: An updated literature review", *Hacienda Publica Espanola/Review of Public Economics* 207-(4/2013), 199-140, 125.

Mexico instituted a comprehensive 'fat tax' in 2013, which applies to both food and beverages containing excessive levels of sugar, fat and salt. Foods which are high in sugar, salt or saturated fat are subject to an 8% levy, and SSBs attract further attention in the form of a 1-peso (NZ\$0.087) charge per litre of the beverage.⁹⁴

Mexico's tax differs slightly from those in France and Hungary in that it is partially valoric – high sugar foods are taxed on a price basis (8%) rather than by the amount of sugar they contain. However, the SSB component remains volumetric with the 1 peso-per-litre charge.

Pacific Islands (Fiji, Samoa, Nauru, French Polynesia)

Fiji imposes both valoric and volumetric taxes on soft drinks. In addition to an excise tax of 5% on all imported soft drinks, there is also a FJD\$0.05 (NZ\$0.03) per litre excise tax on all locally-manufactured soft drinks. However, these taxes were intended as a revenue-raising exercise rather than for any obesity-reduction purpose.⁹⁵

Samoa imposes an excise tax of 0.40 tala (NZ\$0.20) per litre of imported or domestically-produced soft drinks. Although originally envisioned as a revenue-raiser, this tax has been modified and refocused (it was increased from T0.30 to T0.40 in 2008, for example) in recent years with the aim of improving health outcomes.⁹⁶

Nauru imposes a levy of 30% on imported sugar, SSBs and confectionery with the explicit intention of preventing 'excessive consumption of sugar' and improving nutrition.⁹⁷

French Polynesia introduced a range of sugar taxes in 2002. These include excise taxes on SSBs, import taxes on SSBs and confectionery, and a separate tax on ice cream. The SSB tax is levied at a rate of 60 francs per litre (NZ\$0.79).⁹⁸

United States

State-level SSB taxes are levied by 33 US states (as at 2009) at an average rate of 4.25% (in supermarkets) and 4.51% (in vending machines), but the variation in the rates and types of these taxes has seen the SSB taxes in the US described as an inconsistent 'patchwork'.⁹⁹ The current SSB taxes in the US are generally considered to be too low to significantly affect consumer behaviour or obesity rates, and were intended primarily to generate revenue rather than as a public health measure.¹⁰⁰

However, the USA may be on the verge of introducing its first explicitly obesity-targeting SSB taxes: the cities of San Francisco and Berkeley will vote on the implementation of

⁹⁴ Sarah Boseley, "Mexico to tackle obesity with taxes on junk food and sugary drinks", *The Guardian*, accessed via <http://www.theguardian.com/world/2013/nov/01/mexico-obesity-taxes-junk-food-sugary-drinks-exercise>

⁹⁵ Anne Marie Thow et. al., "Taxing Soft Drinks in the Pacific: Implementation Lessons for Improving Health", *Health Promotion International* 26(1), 55-64, 57-58.

⁹⁶ Ibid, 58.

⁹⁷ Ibid, 59.

⁹⁸ Chriqui et. al, "A typology of beverage taxation", 416.

⁹⁹ Judy Jou and Win Techakehakij, "International application of sugar-sweetened beverage (SSB) taxation in obesity reduction: Factors that may influence policy effectiveness in country-specific contexts", *Health Policy* 107 (2012) 83-90, 86.

¹⁰⁰ Ibid.

obesity-targeting SSB taxes later this year. The proposed taxes are a "penny per ounce" in Berkeley and "two cents per ounce" in San Francisco.¹⁰¹ This translates to NZ\$0.40 per litre in Berkeley and NZ\$0.80 per litre in San Francisco (assuming 1 gram = 1 millilitre and exchange rates at 10/07/2014).

These taxes seem extremely high compared to those in Hungary, France and the Pacific, but it should be borne in mind that these cities are among the wealthiest in the USA and have per-capita GDPs well above the US average (which is already very high). This highlights the need to ensure that tax rates are adjusted for purchasing power in the countries they are implemented in.

Norway

Norway taxes sugar and chocolate products at a rate of EUR0.86 per kilogram. This equates to NZ\$1.33.¹⁰² This tax is long-standing and was introduced in 1922. Norway also taxes sweetened beverages at a rate of NZ\$0.53 per litre.¹⁰³

Ireland

Ireland placed a special excise tax on soft drinks between 1975-1992. Initially set at IR0.10 per gallon, it was raised to IR0.37 per gallon (about NZ0.04 per litre at 1995 exchange rates, the earliest available) in 1980 before later being abolished.¹⁰⁴ Abolition was due to a number of factors including EU pressure to harmonise tax rates by removing special excise taxes, as well as decreasing revenues generated by the tax.¹⁰⁵

Denmark

Denmark had had a long-standing SSB tax which had existed since the 1930s, but this was abolished in 2013. Immediately prior to abolition, the tax was levied at a rate of DKK 1.64 (NZ\$0.34) per litre of SSB.¹⁰⁶ The tax appears to have been abolished primarily because of supposed negative effects on employment and economic growth, though some have noted the ease of potential evasion (consumers simply drove to nearby Germany or Sweden in order to avoid the tax).

Other jurisdictions (Algeria, Latvia, Guatemala)

Algeria places a small (0.5%) charge on the sales volume of soft drink manufacturers.¹⁰⁷

¹⁰¹ Candice Choi, "Soda tax's last stand? Bay Area preps for showdown", *Sacramento Bee*, accessed via <http://www.sacbee.com/2014/07/08/6540638/soda-taxes-last-stand-bay-area.html>

¹⁰² Gil et. al. "Taxation of unhealthy consumption of food and drinks", 125.

¹⁰³ Chriqui et. al, "A typology of beverage taxation", 417.

¹⁰⁴ Ibid.

¹⁰⁵ Bahl R, Bird R, Walker MB. "The uneasy case against discriminatory excise taxation: soft drink taxes in Ireland." *Public Finance Rev* 2003; 31: 510-33 doi: 10.1177/1091142103253753.

¹⁰⁶ Caroline Scott-Thomas, "Denmark to scrap decades-old soft drink tax", accessed via <http://www.foodnavigator.com/Legislation/Denmark-to-scrap-decades-old-soft-drink-tax>

¹⁰⁷ Chriqui et. al, "A typology of beverage taxation: Multiple approaches for obesity prevention and obesity prevention-related revenue generation", *Journal of Public Health Policy* (2013) 34, 403-423.

Latvia has an excise tax on beverages (including water) with added sugar or sweeteners. This is levied at a rate of LVL5.20 per 100 litres (NZ\$0.11 per litre).¹⁰⁸

Guatemala places a tax on the distribution and preparation of carbonated (including diet) beverages, sports drinks, fruit juices and bottled water. This is charged at rates which vary from GTQ0.18 per litre (NZ\$0.03) for carbonated beverages, GTQ0.012 per litre (\$NZ0.02) for sports drinks, and GTQ0.10 per litre (NZ\$0.01) per litre for fruit juices.¹⁰⁹

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¹⁰⁸ Ibid.

¹⁰⁹ Ibid.

Appendix B: Detailed discussion of modelling and empirical studies

Modelling studies

An increasing number of econometric studies have been conducted into the relationship between sugar (especially SSB) taxes, consumption levels, and obesity. The majority of these appear to find that taxes will reduce sugar consumption and obesity rates at least to some extent, although some studies have found that there is no (or a negligible) relationship.

An early study (2005) by Gustavsen investigated the relationship between SSB prices and consumption in Norway, differentiating between low, moderate and high consumers of SSBs. It found that a price increase (in the form of doubling Norway's existing production and value-added taxes on these products) would lead to significant reductions in consumption, with the reduction far greater (74 litres per year vs. 2 litres per year) for those identified as heavy consumers of SSBs.¹¹⁰

A 2011 study published in the journal *Health Economics* attempted to estimate the effects on consumption and body weight of a proposed 20% tax on SSBs. Utilising a demand system (QUAIDS) model, the authors found that there would be significant decreases in SSB consumption, including a 49% decrease in consumption of regular soft drinks and a 26% decrease in consumption of added-sugar fruit drinks.¹¹¹ The authors pay particular attention to the demand interrelationships between non-alcoholic beverages, finding that such a tax would significantly increase consumption of coffee and natural fruit juice as consumers substitute away from the taxed beverages. They estimate that, all told, the tax would reduce caloric intake by 449.6 calories (1881.7 kJ) per person, per month, leading to an average reduction in body weight of 1.54 lbs (0.7 kg) per year.¹¹²

A more recent (2014) study utilises a similar Almost Ideal Demand System (AIDS) model to analyse the effect of two different proposed SSB taxes: a 20% sales (valoric) tax and a volumetric \$0.20/L tax, modelling the impact on consumption, body weight and tax burden for low, medium and high income consumers. The valoric tax was estimated to reduce consumption of the taxed beverages (regular soft drinks, cordial and fruit drinks) by 11.5%, 33.2% and 25.5% respectively.¹¹³ This would lead to an average reduction of caloric intake of 10,678 kJ per year, which translates into an average yearly weight reduction of

¹¹⁰ Geir Gustavsen, "Public Policies and the Demand for Carbonated Soft Drinks: A Censored Quantile Regression Approach", paper prepared for the 11th congress of the European Association of Agricultural Economists, Copenhagen, August 24-27, 2005, 10-12.

¹¹¹ Senarath Dharmasena and Oral Capps Jr, "Intended and Unintended Consequences of A Proposed National Tax on Sugar-Sweetened Beverages to Combat the US Obesity Problem", *Health Economics* 21 (2012), 669-694, 684.

¹¹² Ibid, 689.

¹¹³ Anurag Sharma, Katharina Hauck, Bruce Hollingsworth and Luigi Sciliani, "The Effects of Taxing Sugar-Sweetened Beverages Across Different Income Groups", *Health Economics* (2014) Published online in Wiley Online Library. DOI: 10.1002/hec.3070, 4.3.

0.293kg.¹¹⁴ The effects on consumption and body weight appear to be progressive, with the low-income cohort projected to have the largest decreases in consumption and body weight.¹¹⁵

The volumetric tax was projected to lead to lower decreases in consumption of soft drinks and fruit drink, but higher decreases in consumption of cordial (due to the fact that cordial is often purchased in large-volume multipacks). The high caloric content of cordial means that the volumetric tax was expected to lead to greater weight reductions, although the researchers note this will not always be the case in principle.¹¹⁶

A 2013 study by Finklestein et. al. incorporated the possibility of substitution to non-beverage items brought on by an SSB tax. This is an important expansion upon the previous two studies which only considered substitution between beverages. This study found that a 20% valoric tax on SSBs would reduce daily caloric intake per person by approximately 4.7%, leading to a cumulative weight loss of 2.9lbs (1.3kg) over 10 years. Moreover, substitution effects appeared to be limited; some substitution to fruit juices was found, but there was no evidence of substitution to high sugar foods.¹¹⁷

Another 2013 study (Zhen et. al.) again utilised a demand-system model to estimate the effect of SSB taxes. Similarly to the 2013 Finklestein et. al. study, it considered effects across a range of foods and beverages rather than limiting itself simply to beverages. The authors found that a half-cent-per-ounce (US\$0.176 per litre) price increase in SSBs would lead to a daily caloric reduction of 7.9 calories (33kJ) per person. This decrease was found to be highly progressive, with low-income consumers experiencing more than double the caloric decrease of the high-income cohort.¹¹⁸ This was estimated to lead to reductions of 0.7 kg per person and 0.31 kg per person per year for the low and high-income groups respectively. However, although the health gains are progressive, the financial effect of the tax is regressive; the low income cohort would not only pay a higher proportion of its income in tax, but also a higher absolute value of tax per household.¹¹⁹

Other studies have found the effects of SSB taxes to be negligible or inadequate. A 2011 paper by Jayson Lusk and Christiane Schroeter attempted to estimate the value of consumers' willingness-to-pay (WTP) for weight loss required in order for a fat tax (such as an SSB or sugar tax) to be welfare-enhancing for the consumer. The researchers estimate that in order to increase utility, the consumer must be willing to pay \$1493 per pound (approx. \$3285 per kg) of weight lost in order to offset the welfare-decreasing effects (measured by the equivalent variation, EV, of the price increase) of the tax.¹²⁰ The researchers note that while this "seems like a large amount", further research is needed to determine what consumers' WTP actually is. Moreover, this study does not account for

¹¹⁴ Ibid, 4.3-4.4.

¹¹⁵ Ibid, 4.5.

¹¹⁶ Ibid, 4.7.

¹¹⁷ Finklestein et. al., "Implications of a sugar-sweetened beverage tax", 225.

¹¹⁸ Chen Zhen, Eric A Finklestein, James Nonnemaker, Shawn Karns, Jessica Todd, "Predicting the Effects of Sugar-Sweetened Beverage Taxes on Food and Beverage Demand in a Large Demand System", *American Journal of Agricultural Economics* 1-25; doi: 10.1093/ajae/aat049, 21-22.

¹¹⁹ Ibid, 21.

¹²⁰ Jayson Lusk and Christiane Schroeter, "When do fat taxes increase consumer welfare?", *Health Economics* 21: 1367-1374 (2012), 1370.

welfare effects outside of the individual consumer (e.g. through the correction of externalities) and assumes perfect rationality of consumers (so time-inconsistency is not an issue).¹²¹ These issues seem to limit the validity of its conclusions, as those two exclusions are precisely the two strongest economic justifications for a sugar tax.

A recent (2014) study investigated the effects of SSB taxes while accounting for non-linear demand responses, finding that the effect of the tax on BMI would be 'small in magnitude and not statistically significant'.¹²² A different study in the same year examined the effects of a soft-drink tax on low, medium and high consumers of these products and found that although the effect is 'not as clear cut as might be expected', the net impact on caloric intake is likely to be small.¹²³ However, the authors note that several variables can influence the effectiveness of a tax, including the types of beverages to which it applies (if it includes diet beverages, the effect on caloric intake is lessened) and the exact nature of complement/substitute relationships between items.¹²⁴

The above studies consider the impact of soft drink and SSB taxes upon consumption and obesity. But what about the broader category of sugar taxes? A meta-analysis by Powell and Chaloupka in 2009 reviewed a number of earlier studies on the relationship between fat taxes (including, but not limited to, sugar taxes) and obesity. They found that the existing evidence indicated that small taxes or subsidies are unlikely to have an effect on BMI or obesity prevalence, though it was noted that "nontrivial" (i.e. larger) taxes may have a measurable effect.¹²⁵ One caveat of this review was that it was conducted in 2009 and does not account for any of the studies in this area conducted since then, many of which (see above) find a significant link between sugar taxes and consumption/obesity.

A 2007 Danish study utilised a demand-system (AIDS) model to estimate the effect of a range of proposed taxes and subsidies, including a sugar tax. It found that although a sugar tax was likely to lead to large decreases in sugar consumption, it would induce increases in consumption of other foods, including fatty ones such as butter and other dairy products.¹²⁶ This would mitigate the effect of the tax on caloric intake and raises questions about its effectiveness at reducing BMI and obesity prevalence.

A more recent (2013) study by Miao et. al. analysed the effect of both sugar taxes and fat taxes. The results indicated that a tax on added sugar would lead to significant reductions in sugar intake (as high as an 11% decrease). It also noted that a sugar tax seemed to be a more efficient fiscal instrument than a fat tax due to the lower welfare loss as measured by EV (equivalent variation).¹²⁷

¹²¹ Ibid, 1372-73.

¹²² Jayson M Fletcher, David Frisvold, Nathan Tefft, "Non-linear effects of soda taxes on consumption and weight outcomes", *Health Economics* (2014), Wiley Online Library, DOI: 10.1002/hec.3045, 2.3.

¹²⁴ Ibid.

¹²⁵ Lisa Powell and Frank Chaloupka, "Food Prices and Obesity: Evidence and Policy Implications for Taxes and Subsidies", *The Milbank Quarterly*, Vol. 87, No. 1, 2009, 229-257, 249.

¹²⁶ Jorgen Jensen and Sinne Smed, "Cost-effective design of economic instruments in nutrition policy", *International Journal of Behavioural Nutrition and Physical Activity* 2007, 4:10, doi:10.1186/1479, 5.

¹²⁷ Zhen Miao, John Beghin and Helen Jensen, "Accounting for Product Substitution in the Analysis of Food Taxes Targeting Obesity", *Health Economics* 22: 1318-1343, 1338-40.

Another very recent study (2014), published by the National Bureau of Economic Research in the USA, utilises a demand system model to simulate tax impacts. This study is particularly notable for its very large data set (over 123 million food purchase transactions) and novel method of partitioning products into nutritional clusters. A 20% soft drink tax was found to lead to a 4.84% reduction in total purchased calories, while a 20% SSB tax led to a reduction of 8.4%. A 20% tax on sugar led to an even larger caloric decrease of 18.54%. The researchers consider that the broader taxes are more effective because their wide scope limits the possibility of substitution to other unhealthy foods.¹²⁸

Few studies focus explicitly on the supposed regressivity of sugar taxes, although one 2013 paper investigates the effect of fat taxes (including, but not limited to, sugar and SSB taxes) on various poverty measures and attempts to reach a conclusion on the question of regressivity. It found that these taxes are generally regressive due to the fact that low-income consumers spend a larger proportion of their income on food and beverages, but notes that this regressivity could be 'almost completely mitigated' if appropriate subsidies to low-income households were implemented.¹²⁹ The feasibility of such subsidies may be called into question, however, due to the difficulty in defining which households are 'low-income' and the heterogeneity of sugar consumption patterns amongst them.

Empirical evidence

Empirical evidence on the effect of sugar and SSB taxes is harder to come by. This is partly because obesity-targeting taxes are such a recent innovation that it may be too soon to draw conclusions about their effectiveness in the countries where they are employed (such as France, Hungary and Mexico). However, as noted above, sugar and SSB taxes have existed in some form for a long time in countries such as Norway, Ireland, Denmark and the USA, which may provide some empirical evidence of the relationship between these taxes and consumption levels in these countries.

Because Ireland had implemented and then removed SSB taxes, it provided a natural empirical testing ground for Bahl et. al to investigate the relationship between taxation and SSB consumption. They find that the two are negatively related; a 20% reduction in the tax caused consumption to increase by 6.8%.¹³⁰

However, other studies focusing on US states have found the opposite. One paper examined the relationship between state soft drink taxes and population BMI over 16 years and found no effect.¹³¹ Another study compared the state of Maine (5.5% soft drink and

¹²⁸ Matthew Harding and Michael Lovenheim, "The Effect of Prices on Nutrition: Comparing the impact of Product and Nutrient-Specific Taxes", National Bureau of Economic Research working paper 19781, January 2014.

¹²⁹ David Madden, "The Poverty Effects of a Fat Tax in Ireland", *Health Economics* 2013, published online in Wiley Online Library, doi:10.1002/hec.3006, 4-5.

¹³⁰ Bahl R, Bird R, Walker MB. The uneasy case against discriminatory excise taxation: soft drink taxes in Ireland. *Public Finance Rev* 2003; 31: 510-33 doi: 10.1177/1091142103253753.

¹³¹ Anne Marie Thow, Stephen Jan, Stephen Leeder and Boyd Swinburn, "The effect of fiscal policy on diet, obesity and chronic disease: a systematic review", *Bulletin of the World Health Organisation* 2010, doi: 10.2471/BLT.09.070987

snack tax) with New Hampshire (no tax) and found no relationship between the tax and obesity prevalence.¹³²

Yet another US study looked specifically at the impact upon children's BMI: it found that existing soft drink taxes were unlikely to impact upon the BMI of children as a whole, though they appear to be much more effective among low-income and overweight groups.¹³³ One paper by Lin and Smith (2010) notes that SSB sales taxes in the USA may be of limited use as evidence either for or against a sugar excise tax, because US sales taxes are not included in the shelf price and therefore consumers may be unaware and less responsive to those taxes.¹³⁴ Excise taxes, on the other hand, would be included in the shelf price.

A 2009 paper published by the National Bureau of Economic Research looked at the relationship between food prices and BMI, finding that the short-term effects of food prices on body weight were 'very modest', although there would be significant effects in the long term (c. 30 years). The researchers suggest that this means fat taxes will not be a quickly effective solution to curbing obesity.¹³⁵ One limitation of this study is that it considers the price per calorie across a wide variety of foods rather than focusing just on SSBs or high-sugar foods.

Finally, a 2007 study using US data examined the relationship between the ratio of healthy food prices to non-healthy food prices and obesity, finding that there was a statistically significant causal relationship – as healthy food became relatively more expensive, BMI increased.¹³⁶ Conversely, as healthy food becomes relatively less expensive (such as through a sugar tax), one would expect BMI to decrease. However, the effect was very small and the authors suggest that taxes are therefore not an effective means of altering population BMI.

¹³² Ibid.

¹³³ Roland Sturm, Lisa M. Powell, Jamie F. Chriqui and Frank J. Chaloupka, "Soda Taxes, Soft Drink Consumption, And Children's Body Mass Index", *Health Affairs*, no. (2010): doi: 10.1377/hlthaff.2009.0061

¹³⁴ Bing-Hwan Lin and Travis Smith, "The Effects of a Sugar-Sweetened Beverage Tax: Consumption, Calorie Intake, Obesity and Tax Burden by Income", paper selected for presentation at the Agricultural and Applied Economics Association 2010, July 25-27, 4.

¹³⁵ Dana Goldman, Darius Lakdawalla, Yuhui Zheng, "Food Prices and the Dynamics of Body Weight", National Bureau of Economic Research, Working Paper 15096, accessed via <http://www.nber.org/papers/w15096.pdf>, 16.

¹³⁶ Jonah Gelbach, Jonathan Klick, Thomas Stratmann, "Cheap Donuts and Expensive Broccoli: The Effect of Relative Prices on Obesity", *Social Science Research Network*. Available: <http://papers.ssrn.com/sol3/papers.cfm> (2007).

Appendix C: How would a sugar tax interact with existing policies?

An important issue is the interface between a sugar tax and other sugar-curbing policies which already exist. There are a number of policies already in place which are aimed at curbing intake of sugar and other unhealthy foods:

- Project Energize is a programme in primary and intermediate schools in the Waikato in which trained nutrition specialists work with schools to encourage healthier eating and exercise.
- Healthy Families NZ involves health promotion staff working with schools, workplaces and other institutions to provide education and guidance on how to lead healthier lives.
- Green Prescriptions are written advice from doctors advising patients to get more physical exercise. The patient is referred to support person who motivates and encourages them to be more active.
- All food and drinks sold in New Zealand are required to have nutritional labels on the package so that consumers can make an informed decision about the nutritional value of the item.
- The Ministry of Health provides guidelines which advise limiting excessive intake of sugar.
- Guidelines issued by the Advertising Standards Authority require advertisers to avoid encouraging children to consume excess amounts of high-sugar foods and to show appropriate serving sizes.

These policies tend to be educative and/or voluntary. They do not limit or prohibit consumption of unhealthy foods, preferring merely to encourage consumption of healthy ones and inform people about nutritional choices and content.

On the face of it, it would seem that a sugar tax would complement these messages well. A tax acts an incentive to shift consumption from unhealthy to healthier items, sending a financial message to accompany the informational message of the existing policies.

However, a tax might also be seen as contradicting existing policies. Existing policies, being merely educative, assume that consumers are conscientious enough to take responsibility for their own diet choices if they are given the correct information and encouragement. A tax might be seen as forcing consumers to eat in a certain way, which undermines the taking-responsibility-for-yourself message of current policies. Individuals may resent the implication

that they need to be 'prodded' by a tax in order to eat properly, and confused by the contrasting messages that the policies send.

References: Appendices

Bahl R, Bird R, Walker MB. "The uneasy case against discriminatory excise taxation: soft drink taxes in Ireland." *Public Finance Rev* 2003; 31: 510-33 doi: 10.1177/1091142103253753.

Boseley, Sarah. "Mexico to tackle obesity with taxes on junk food and sugary drinks" *The Guardian*, accessed via <http://www.theguardian.com/world/2013/nov/01/mexico-obesity-taxes-junk-food-sugary-drinks-exercise>

Cheney, Catherine. "Battling the Couch Potatoes: Hungary Introduces 'Fat Tax'", *Der Spiegel* online, accessed via <http://www.spiegel.de/international/europe/battling-the-couch-potatoes-hungary-introduces-fat-tax-a-783862.html>

Choi, Candice. "Soda tax's last stand? Bay Area preps for showdown", *Sacramento Bee*, accessed via <http://www.sacbee.com/2014/07/08/6540638/soda-taxes-last-stand-bay-area.html>

Chriqui et. al, "A typology of beverage taxation: Multiple approaches for obesity prevention and obesity prevention-related revenue generation", *Journal of Public Health Policy* (2013) 34, 403-423.

Dharmasena, Senarath and Oral Capps Jr, "Intended and Unintended Consequences of A Proposed National Tax on Sugar-Sweetened Beverages to Combat the US Obesity Problem", *Health Economics* 21 (2012), 669-694, 684.

Fletcher, Jason M, David Frisvold, Nathan Tefft, "Non-linear effects of soda taxes on consumption and weight outcomes", *Health Economics* (2014), Wiley Online Library, DOI: 10.1002/hec.3045, 2/3.

Gelbach, Jonah, Jonathan Klick, Thomas Stratmann, "Cheap Donuts and Expensive Broccoli: The Effect of Relative Prices on Obesity", *Social Science Research Network*. Available: <http://papers.ssrn.com/sol3/papers.cfm> (2007).

Goldman, Dana, Darius Lakdawalla, Yuhui Zheng, "Food Prices and the Dynamics of Body Weight", National Bureau of Economic Research, Working Paper 15096, accessed via <http://www.nber.org/papers/w15096.pdf>, 16.

Gustavsen, Geir. "Public Policies and the Demand for Carbonated Soft Drinks: A Censored Quantile Regression Approach", paper prepared for the 11th congress of the European Association of Agricultural Economists, Copenhagen, August 24-27, 2005, 10-12.

Harding, Matthew and Michael Lovenheim, "The Effect of Prices on Nutrition: Comparing the impact of Product and Nutrient-Specific Taxes", National Bureau of Economic Research working paper 19781, January 2014.

Jensen, Jorgen and Sinne Smed, "Cost-effective design of economic instruments in nutrition policy", *International Journal of Behavioural Nutrition and Physical Activity* 2007, 4:10, doi:10.1186/1479.

Jou, Judy and Win Techakehakij, "International application of sugar-sweetened beverage (SSB) taxation in obesity reduction: Factors that may influence policy effectiveness in country-specific contexts", *Health Policy* 107 (2012) 83-90, 86.

Lin, Bing-Hwan and Travis Smith, "The Effects of a Sugar-Sweetened Beverage Tax: Consumption, Calorie Intake, Obesity and Tax Burden by Income", paper selected for presentation at the Agricultural and Applied Economics Association 2010, July 25-27.

Lusk, Jayson and Christiane Schroeter, "When do fat taxes increase consumer welfare?", *Health Economics* 21: 1367-1374 (2012), 1370.

Madden, David. "The Poverty Effects of a Fat Tax in Ireland", *Health Economics* 2013, published online in Wiley Online Library, doi:10.1002/hec.3006.

Miao, Zhen, John Beghin and Helen Jensen, "Accounting for Product Substitution in the Analysis of Food Taxes Targeting Obesity", *Health Economics* 22: 1318-1343, 1338-40.

OECD Obesity Update 2012, accessed via <http://www.oecd.org/health/49716427.pdf>, 4.

Powell, Lisa and Frank Chaloupka, "Food Prices and Obesity: Evidence and Policy Implications for Taxes and Subsidies", *The Milbank Quarterly*, Vol. 87, No. 1, 2009, 229-257, 249.

Scott-Thomas, Caroline. "Denmark to scrap decades-old soft drink tax", accessed via <http://www.foodnavigator.com/Legislation/Denmark-to-scrap-decades-old-soft-drink-tax>

Sharma, Anurag, Katharina Hauck, Bruce Hollingsworth and Luigi Sciliani, "The Effects of Taxing Sugar-Sweetened Beverages Across Different Income Groups", *Health Economics* (2014) Published online in Wiley Online Library. DOI: 10.1002/hec.3070, 4.3.

Sturm, Roland, Lisa M. Powell, Jamie F. Chiriqui and Frank J. Chaloupka, "Soda Taxes, Soft Drink Consumption, And Children's Body Mass Index", *Health Affairs*, no. (2010): doi: 10.1377/hlthaff.2009.0061

Thow, Anne Marie et. al., "Taxing Soft Drinks in the Pacific: Implementation Lessons for Improving Health", *Health Promotion International* 26(1), 55-64, 57-58.

Thow, Anne Marie, Stephen Jan, Stephen Leeder and Boyd Swinburn, "The effect of fiscal policy on diet, obesity and chronic disease: a systematic review", *Bulletin of the World Health Organisation* 2010, doi: 10.2471/BLT.09.070987

Tiffin, Richard, Ariane Kehlbacher, Matthew Salois, "The Effects of a Soft Drink Tax in the UK", *Health Economics* (2014), Wiley Online Library, DOI: 10.1002/hec.3046.

Villanueva, Tiago. "European nations launch tax attack on unhealthy foods", *CMAJ* vol. 183 no.17, accessed via <http://www.cmaj.ca/content/183/17/E1229.short>

Zhen, Chen, Eric A Finklestein, James Nonnemaker, Shawn Karns, Jessica Todd, "Predicting the Effects of Sugar-Sweetened Beverage Taxes on Food and Beverage Demand in a Large Demand System", *American Journal of Agricultural Economics* 1-25; doi: 10.1093/ajae/aa049, 21-22.

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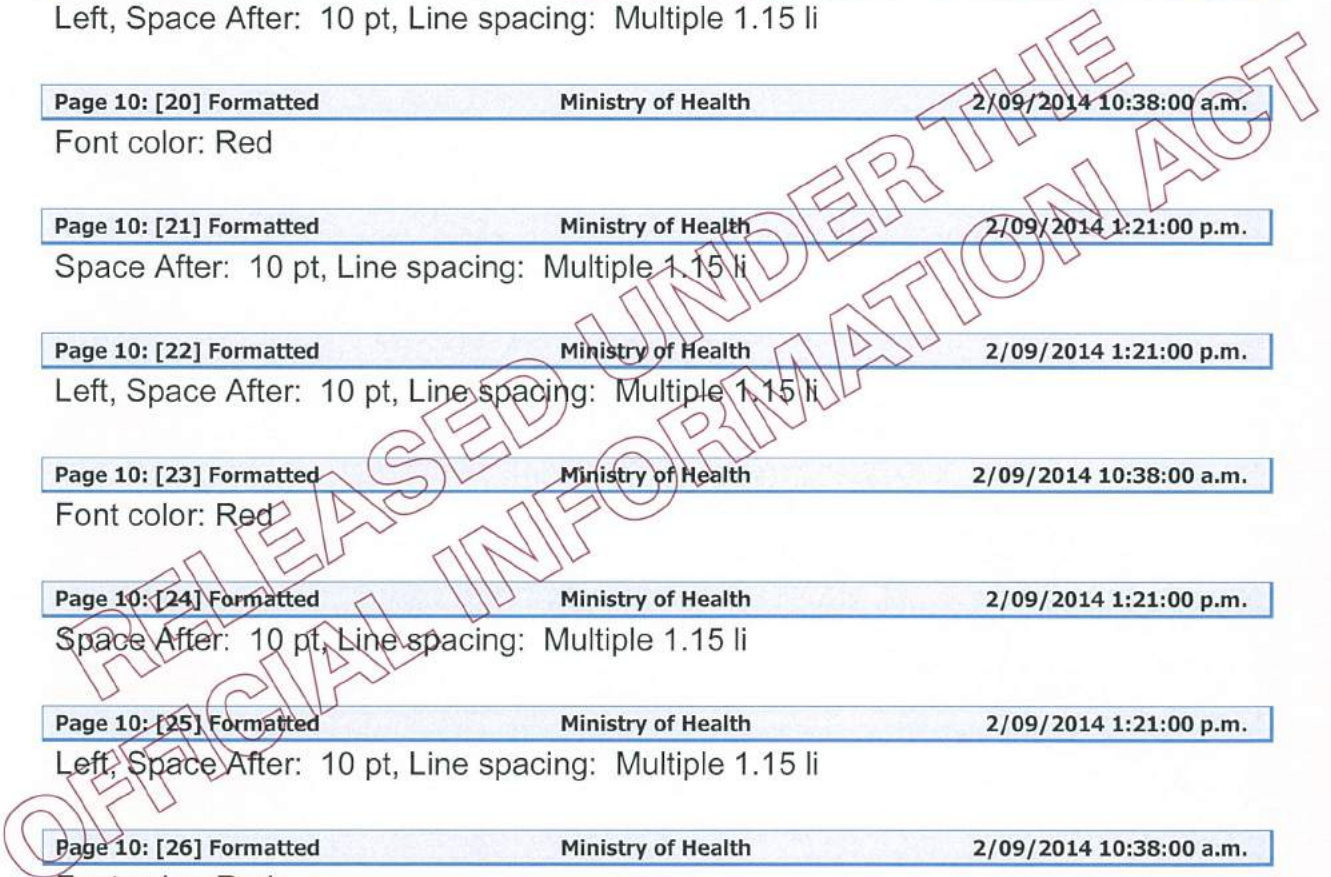
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