



TRADE POLICY TECHNICAL NOTES

TRADE AND FOOD SECURITY

No. 19 ■ NOVEMBER 2017

Ex-post evidence on the effectiveness of policies targeted at promoting healthier diets*



Mario Mazzocchi, University of Bologna

ABSTRACT

This note provides a structured review of adoption trends of national policies aimed at promoting healthier diets and collates evidence on their effectiveness. We limit our focus to evidence exploiting data collected after the policy implementation, and using appropriate counterfactual methods to identify the policy effect.

INTRODUCTION

Over the last 10 years, the number of national-level policies targeting the triple burden of malnutrition has increased very quickly, especially outside Europe and the United States. This report aims to provide an updated picture of the evidence base on the effectiveness for different types of policies implemented by governments to promote healthier diets. Our review is limited to evidence that (a) refers to policies at the national (state) level with an explicit nutrition focus, and (b) is based on ex-post evaluations. Whenever available, we prioritise studies where the ex-post evidence is benchmarked against rigorous counterfactual scenarios on relevant policy outcomes. This is a non-trivial challenge, given the lively scientific debate on the evaluation of nutrition policies. There is consensus that outcome variables should not be limited to intakes, but ideally capture the ultimate effects on weight and health. However, the evaluation of these impacts is hindered by the scarcity of longitudinal (cohort) data, that would allow to capture medium and long-term effects. Instead, most of the current evidence is grounded on proxy and short-term outcome variables. Thus, our review of the ex-post evidence makes an explicit reference to the available outcome variables and to the adoption of appropriate counterfactual methods, i.e. what would be the level of the outcome variable in absence of the policy. This can lead to very different evaluations relative to simple pre-post comparisons, because nutrition and health outcomes respond over time to many other factors than the policies of interest. Our

search for national policies is based on the Nourishing Framework database of the World Cancer Research Fund International.¹ Where possible, the collected information was integrated with the WHO Global database on the Implementation of Nutrition Action (GINA), and any additional information from recently published policy reviews or relevant policy reports from official sources.

TABLE 1. CLASSIFICATION OF POLICIES

SUPPORTING MORE INFORMED CHOICE
Advertising restrictions (including voluntary codes)
Public information campaigns & social marketing
Nutrition education
Labelling regulations
CHANGING THE (MARKET) ENVIRONMENT
Fiscal measures (taxes, subsidies, income-based vouchers)
Regulation of school environments
Food reformulation (including voluntary public-private schemes)
Measures targeting accessibility to healthy foods and availability of unhealthy foods

Source: Adapted from Capacci *et al.*, (2012)

¹ <http://www.wcrf.org/int/policy/nourishing-framework>

POLICY ADOPTION TRENDS

The policies adopted since the year 2000 that explicitly target the promotion of healthier diets are shown in Table 2 (information policies) and Table 3 (market policies). As already noted in Capacci *et al.*, (2012), information measures are by far the most popular measure among governments, as they are relatively less intrusive than explicit regulations constraining the behaviour of economic agents. They are also more visible, hence attracting public support for policy-makers. Nevertheless, relative to previous surveys, more restrictive actions like advertising bans, mandatory labelling requirements and health claims regulations have become more common. Labelling strategies based on simplified signposting, such as guideline daily amounts (GDA), traffic lights or certified logos are mostly confined to voluntary practices. Although some regulatory steps (e.g. in the European Union) have been taken to allow for their implementation at the national level, they are prone to controversy

among various stakeholders, especially for the uncertainty in the nutrient profiling models on which they base their simplified classification. This is the case of the voluntary traffic light schemes enabled in the UK and adopted by some retailers, that led to an information proceedings by the European Commission.²

Education measures such as the introduction of nutrition education in school curricula are also becoming more common, but their spread rate is not as fast as for other information measures. Furthermore, while school policies and restrictions on school availability of selected foods and drinks are becoming more and more frequent, these are not necessarily accompanied by education measures, which has been often pointed out as a limiting factor for their effectiveness.

² [MEPs raise concerns \(again\) in relation to traffic light labels](#), David Burrows, Food Navigator, 7-Sep-2016

TABLE 2. ADOPTION OF INFORMATION POLICIES

POLICY	COUNTRIES
ADVERTISING BANS	
Statutory	Brazil (2015), Canada (Quebec, 1978), Chile (2016), Finland (1978), France (2007), Iran (2004), Ireland (2013), Mexico (2014), Norway (1997), South Korea (2009), Sweden (1991), Taiwan (2016), United Kingdom (2007)
Voluntary codes and self regulations (non exhaustive)	Canada (2008), Netherlands (2015), Spain (2005), European Union (2009)
PUBLIC INFORMATION CAMPAIGNS & SOCIAL MARKETING	
Promotion of fruit & vegetable intakes	Argentina, Canada, Chile, Denmark, France, Germany, Mexico, New Zealand, South Africa, Spain, Tonga, United Kingdom, United States, Western Australia
Salt reduction campaigns	Estonia, Malaysia (2012), New Zealand, Thailand (Low Salt Network, 2014), United Kingdom (2004)
Sugar reduction campaigns	Hungary (Happy, 2010), Malaysia (Reduce Sugar, 1998), Singapore (Life's Sweeter with Less Sugar, 2014-2014), Thailand (Sweet Enough Network, 2003), Tonga (A Mouthful of Sugar, 2012)
Broad healthy eating campaigns	Australia (LiveLighter 2012, MeasureUP 2008), Canada (Nutrition facts 2010; Eatwell, 2011), Chile (Choose to Live Healthily, 2011), France (Manger Bouger, 2001), Macedonia (2014), Mexico (2014), Netherlands (2009), Norway (2012), Pacific Island (2011), Peru (2013), Singapore (1992), United Kingdom (Change4Life, Start4Life, 2009), Venezuela (2014)
NUTRITION EDUCATION	
Nutrition education in school curricula	Australia (2015), Brazil (2009), Finland, Germany (2007), Japan (2005), Malaysia, Mexico, South Africa, United Kingdom (2014), Vietnam
Non-school setting	Australia, Malaysia, Singapore, United States
LABELLING REGULATIONS	
Mandatory nutrient labelling	Virtually all countries
Specific trans-fat labelling requirements	Argentina, Brazil, Canada, Chile, Hong Kong, Paraguay, South Korea, Taiwan, United States, Uruguay
Simplified signposting	Australia and New Zealand (Health Star Rating, voluntary 2014), Chile (2015, front-of-package "high in" label), Sweden (1989, Keyhole), Sweden, Denmark and Norway (Nordic Logo, 2009), Iceland (Nordic Logo, 2013), Lithuania (Nordic Logo, 2014), Ecuador (compulsory traffic light, 2014), European Economic Area (voluntary front-of-pack guidelines, GDA, traffic lights allowed), Finland (1993 "high in", 2000 heart symbol), Belgium, Czech Republic, Netherlands and Poland (voluntary "Choices" logo, 2006), Nigeria (voluntary Heart Check logo, 2005), Singapore (1998 voluntary Healthier Choice symbol), Slovenia (1993, voluntary Little Heart logo), South Korea (2011, colour code), Thailand (2007 compulsory GDAs and warning, 2016 voluntary healthier choice logo), United Kingdom (2013, voluntary front-of-pack labelling scheme under the responsibility deal), Fiji and Solomon islands (compulsory on-shelf labelling for fat meat products, 2009)
Restaurant menu labelling	Australia (2010, compulsory for large chains), Bahrain (2010, voluntary), Canada (Ontario 2017, compulsory for large chains), Malaysia (voluntary, 2008), South Korea (2010, compulsory for large chains), United Kingdom (2011, out-of-home calorie labelling, voluntary under UK responsibility deal), USA (compulsory for large chains and vending machine providers, 2017)
Health claims regulations	Australia and New Zealand (2016), Costa Rica & El Salvador & Guatemala & Honduras & Nicaragua (2012), European Union countries (2006), Indonesia (2011), Malaysia (2010), South Africa (2012), South Korea (2000), United States (1994)

Sources: Nourishing Framework Database (<http://www.wcrf.org/int/policy/nourishing-framework>) and ad-hoc searches

TABLE 3. ADOPTION OF MARKET POLICIES

POLICY	COUNTRIES
FISCAL MEASURES	
Taxes on drinks and foods	See Table 4
Price subsidies and income-based vouchers	United Kingdom (Healthy Start for pregnant women and mothers with young children, 2006), United States (SNAP-WIC revised to meet nutritional goals in 2009, Healthy Incentives Pilot in Hampden County 2012)
REGULATION OF SCHOOL ENVIRONMENTS	
School meal standards	Most countries set nutrition-based standards for school meals
School fruit schemes	Australia (2005), Canada (province-level, 2005), European Union (2010), Norway (2007), United Kingdom (2004), United States (2008)
Restrictions on school supplies	Australia (capital territory only, no sugary drinks from 2015), Bahrain, Chile (2012), Costa Rica (2012), France (2010) Hungary (2012, school ban on all foods subject to the tax), Kuwait, Latvia (soft drinks, 2006), Lithuania (soft drinks, 2011), Mauritius (2009, ban of unhealthy food and drinks), Mexico (2014, only elementary schools), Poland (2014), Romania (2008), South Korea (fast food and soda banned within 200 meters of schools, 2010), United Arab Emirates (2011), United Kingdom (2014) USA (state-level bans, varying years), Uruguay (soda and snacks, 2015)
Vending machine bans	Australia (capital territory only, 2014), Bermuda (2006), France (2005), Slovenia (2010), United States (13 states have a middle school ban, 9 states a high school ban)
FOOD REFORMULATION	
Mandatory nutrition standards for producers	Argentina (salt, 2015; trans-fat 2014), Austria (trans-fat, 2009), Belgium (salt in bread, 1985), Bulgaria (salt, 2012), Denmark (transfat ban, 2003), Ghana (limit on fats in meat, 1990s), Greece (salt in bread, 1971), Hungary (salt in bread, 2012, trans-fat 2013), Iceland (trans-fat ban, 2010), Iran (salt, trans-fat 2005), Latvia (trans-fat, 2016), Norway (trans-fat, 2014), Paraguay (salt in bread and flours, 2013), Portugal (salt in bread, 2009), Samoa (turkey tails, 2011), Singapore (trans-fat, 2012), South Africa (trans-fat, 2011, salt, gradual from 2013), Switzerland (trans-fat, 2008), United States (partially hydrogenated oils, 2015, trans-fats in some cities)
Agreements on reduction of unhealthy nutrients	Almost all countries have some sort of voluntary initiatives industry-government collaboration to promote the supply of healthier food, the UK agreement (Responsibility Deal, 2011) and US agreements (National Salt Reduction, 2009) were subject to some evaluation. Malaysia (fast foods, 2014) and Thailand (hotels, sugar packets, 2015) had agreements to reduce portion sizes.
ACCESSIBILITY MEASURES	
Promote sales of healthy foods in unserved areas	United States (Healthy Food Financing Initiative, 2014, 23 states implementing measures), Singapore (2011, Healthier Dining Programme, compliers can display a logo), United Kingdom (Change4Life Convenience Stores, 2011), USA (WIC revision in 2009, city level initiatives)
Restrict sales of unhealthy foods	Bahrain (2010, limitation of drinking sizes in fast food chains, voluntary), Canada (2009, trans-fat limits for food services), Mexico (Mexico city restaurants, Less Salt, More Health, 2013), United Kingdom (2011 responsibility deal, caterers, voluntary salt reductions, 2011), United States (city level bans on trans-fats in food served by restaurants, 2006)

Sources: Nourishing Framework Database (<http://www.wcrf.org/int/policy/nourishing-framework>) and ad-hoc searches

Table 3 provides an overview of the policies adopted since the 2000s. The introduction of mandatory nutrition standards and the imposition of restrictions on foods supplied at school have become more widespread, but nutrition-driven taxes are the measure which has gained most popularity over the past few years, probably because of the economic crisis and the pressure on public budget, but maybe also due to the increasing evidence on their relative effectiveness. Out of 18 countries listed in the Nourishing framework data-base as adopters of soda or fat taxes, 13 are newcomers, i.e. they have introduced their tax after 2010. Most of these taxes are relatively small, below 10 percent of the retail prices (see Table 4), but governments of small countries especially in Central and South America have recently imposed higher tax levels, and it will be informative to evaluate their impact. Among other measures, mandatory standards are mostly confined to trans-fats and salt, and sometimes to specific foods. In most countries, however, there are voluntary schemes where food producers set goals to reduce the content of sodium or unhealthy fats. Similarly, explicit regulations targeting the availability of healthy foods in underserved areas or improving the nutritional standards of outlets

or caterers are limited, but voluntary (especially local) schemes are increasingly common.

EVIDENCE FROM EX-POST EVALUATION STUDIES

We identified 80 evaluation studies meeting our selection criteria. Table 5 summarizes the evidence gathered from the evaluations.³

Evidence on advertising restrictions

Despite many countries adopting some form of restrictions on promotions targeted to children of foods rich in unhealthy nutrients, these regulations are generally partial, either because they do not target *all* media to which children are exposed (especially the internet), or because the constraints are limited to selected time slots and broadcasting channels. Only few countries (in the Scandinavian region) apply comprehensive bans. In countries without statutory restrictions, some form of self-regulation or voluntary schemes involving food companies and broadcaster usually exist. We found

³ Individual information on the selected studies is provided as an Appendix to this note

TABLE 4. ADOPTION OF NUTRITION-BASED TAXES

COUNTRY	WHAT IS TAXED	YEAR	TAX LEVEL
Barbados	Sugary drinks	2015	10%
Belgium	Soft drinks	2016	€ 0.068/litre
Chile	Drinks with sugar above 62.5 g/litre	2011	18%
Denmark (removed 2013)	Foods with sat fats exceeding 23 g/Kg	2012	\$2.70/Kg of saturated fat
Dominican Republic	Food and drinks high in sugar	2015	10%
Finland	Soft drinks (continuing) and confectionery (removed 2017)	1940	€ 0.95/Kg confectionery, € 0.22/ltr drinks with sugar >0.5%, € 0.11/ltr other drinks
France	Soft drinks with added sugar/sweeteners	2012	€ 0.072/litre
French Polynesia	Soft drinks and confectionery	2002	\$ 0.44/litre (domestic), \$ 0.66/litre (imported)
Hungary	Soft drinks and foods high in salt, sugar	2011	Varying rates, e.g. \$ 0.24/litre soft drinks
Kiribati	Soft drinks with added sugar	2014	40%
Mauritius	Soft drinks with sugar	2013	\$ 0.01 per gram of sugar
Mexico	Soft drinks with added sugar and foods > 275 Kcal/100g	2014	\$ 0.07/litre (drinks), 8% (caloric foods)
Norway	Soft drinks and confectionery	1981	\$ 0.40/litre (drinks), \$ 2.44/litre (syrups), \$ 2.43/Kg confectionery, \$ 0.94/Kg. sugar
Samoa	Soft drinks and turkey tails	1984	\$ 0.17/litre (soft drinks), 100% import duty (turkey tails)
St Helena	Soft drinks with more than 15g/litre of sugar	2014	\$1.14/litre
Sain Vincent Grenadines	Brown sugar	2016	15%
Tonga	Soft drinks, animal fat products, turkey tails	2013	\$ 0.50/litre (drinks), \$ 0.90/Kg. (animal fats), \$ 0.70/Kg. (tails)
United States (State-level)	Soft drinks (34 states, soda/sweet taxes)	1933	All taxes are below the 10% level
United States (city level)	Soft drinks (7 cities, soda tax)	2014	\$ 0.34/litre (except Boulder \$ 0.68, Philadelphia \$ 0.50)

Sources: Nourishing Framework Database (<http://www.wcrf.org/int/policy/nourishing-framework>)

TABLE 5. SUMMARY OF EVIDENCE FROM EX-POST EVALUATION STUDIES

POLICY	ADOPTION LEVELS/TRENDS	AVAILABILITY	EX-POST EVIDENCE ON NATIONAL POLICIES		
			STUDIES IDENTIFIED	DIRECTION	STRENGTH
Advertising restrictions	Low (higher for voluntary codes)	Limited	12	Comprehensive regulation effective, other ineffective	Suggestive, short-term
Information campaigns	High and rising	High	10	Effective	Strong
Nutrition education	Medium (rising)	Very scarce	0	NA	NA
Labelling regulations	High and rising	Medium	13	Effective in inducing reformulation, less on intakes	Suggestive
Changing the market environment					
Fiscal measures	High and rising	High	16	Effective in changing prices and consumption	Suggestive/strong
School environment	High and rising	High	18	Effective in changing school behaviours, but not overall diet	Suggestive/strong
Mandatory nutrition standards	Medium (rising)	Scarce	3	Good compliance, effective in reducing unhealthy nutrients	Suggestive
Voluntary standards	High and rising	High	5	Effective	Suggestive
Accessibility policies	Low (mainly local)	Scarce	3	Mixed	Suggestive

Sources: Nourishing Framework Database (<http://www.wcrf.org/int/policy/nourishing-framework>)

12 evaluations based on ex post data, mostly looking at exposure and advertising content. The evidence is consistent and points out at the scarce (if any) impact of partial bans and voluntary schemes, even when the outcome is exposure and not the actual impact on children diets and weight. The issue is not necessarily about compliance when advertising practices are explicitly regulated, but rather on the insufficient scope of regulations. Instead, evaluations of voluntary schemes indicate very low compliance to the codes by the private sector. More comprehensive bans – especially those acting on multiple media – are shown to be effective in reducing exposure or improving the nutritional quality of advertised food. One study (Goris *et al.*, 2010) considers various types of national-level advertising policies and projects weight outcomes based on a simulation model dealing with uncertainty. The study is suggestive that effective and comprehensive bans may reduce childhood obesity relative to countries with partial bans.

Evidence on public information campaigns

The vast majority of countries have some form of public guidelines to healthy eating, but ad hoc evaluations of their effectiveness in terms of influencing eating behaviours are hardly possible. Similarly, the adoption of public information campaigns is nowadays common across the world, but the number of studies that assess their impact against appropriate counterfactual scenarios and using relevant outcome measures is not so large. The evidence, however, is quite strong, and points in various directions. First, these actions do achieve the objective of raising awareness, at least in the short term, but few studies monitor whether positive attitudes are sustained over time. Second, most evaluations on actual consumption response highlight positive and significant impacts, albeit usually not very large, especially when they not part of a multi-component policy effort (Mozaffarian *et al.*, 2012). When behaviours are self-reported and measured through questionnaires, results should be rather regarded as a confirmation of increased awareness and positive attitudes, as self-reports are known to be biased towards positive behaviours because of social desirability. Third, an interesting element emerges from studies, as those by Young and Swinburn (2002) or Sharma *et al.* (2015) that monitor the actual composition of supplied foods in response to government information campaign. These evaluations show that social marketing initiatives may trigger a significant reformulation strategy adopted by the industry.

Evidence on labelling policies

The effects on consumer behaviour of different approaches to labelling has been widely investigated in the marketing literature, but there few studies look at the ex-post evidence on national-level regulations. The findings in the studies we have selected are heterogeneous and the evidence mixed, depending on the policy goal and the outcome variable. For example, there seems to be a general consensus that broad policy initiatives like the US Nutrition Labeling and Education Act (NLEA) have a limited and short-lived impact, if not updated or followed by more specific and stringent rules. More specific measures regulating the labelling of trans-fats in Canada, South Korea and the United States seemed to be effective in reducing intakes and inducing industrial reformulation, although some uncertainty remains about the substitution with saturated fats. The adoption of “simplified signposting” actions, i.e. particular front-of-pack labelling strategies such as traffic lights or GDAs has been so far limited, and mostly confined to voluntary

actions. However, there is some suggestive evidence that they generate – or are accompanied to – reformulation efforts. Similarly, menu calorie labelling in restaurants has not yet been adopted by any government as a mandatory policy, with the exception of some local governments (New York) in the United States. Several evaluation of these local efforts exist, and they mostly show that, despite raising awareness, their ultimate impact on energy intake is limited, if any. Surprisingly, the few counterfactual studies looking at the impact on weight outcome suggest that these measures are associated with a reduction in BMIs, although the causal identification is problematic due to the variety of policies adopted at the same time in states and cities where menu labelling is already a practice.

Evidence on fiscal measures

The number of research studies looking at the impact of soda taxes and fat taxes is growing exponentially, but not many of these evaluation efforts observe changes in purchasing or consumption behaviour following an actual tax and most rely on demand simulations. Because of the economic relevance of taxation in the policy debate, and the difficulty of predicting product substitutions, overall dietary outcomes and weight or health outcomes simply based on estimated elasticities, these simulation studies may be incorrect. An accurate analysis of the ex-post evidence where available is crucial. Table A5 in the Appendix lists 15 evaluation studies and one systematic review aimed at quantifying the impact of fiscal measures based on ex post data. Given the variability in the tax levels, and the fact that most of these taxes are low relative to purchase prices in supermarkets, the body of evidence is not conclusive, but is (strongly) suggestive of effectiveness in terms of reducing consumption, and not only as a mean to raise tax revenues for the public budget.

The experience of countries like Denmark, France, Hungary, Mexico indicate that these taxes are indeed transmitted to the retail price, and do generate a significant reduction in purchases, although probably not large enough to induce meaningful weight or health outcomes at the population level. The fiscal measures adopted by Denmark, Hungary and Mexico – three countries that are quite different in terms of culture and market dynamics – were targeted at a variety of foods and not only soft drinks. For all three countries, the available ex-post evidence directs to significant reductions in purchased quantities. These evaluations are based on rigorous counterfactual scenarios and the effect size ranges between a reduction around 1 percent for taxed foods in Denmark according to Bødker *et al.*, (2015) and a 5 percent reduction for foods and soft drinks in Mexico, with Hungary somewhere in the middle between these two estimates. Interestingly, none of these studies finds a full substitution between taxed and non-taxed goods, suggesting a reduction in the overall food/drink intake. Instead, evidence from the United States indicates that small taxes as those implemented in 34 US states, have a negligible effect on consumption, and none on weight outcomes. Our search strategy ignores city-level soda taxes as those introduced in 7 US cities since 2014 (see Table 5), but their level (at least \$ 0.34/litre) is much larger than fiscal measures adopted at the state level. There are two evaluations of the Berkeley soda tax (Faibe *et al.*, 2015; Silver *et al.*, 2017) and they both indicate a meaningful price and consumption response, ranging between a 21 percent reduction in consumption found by Faibe *et al.*, and a 10 percent reduction found by Silver *et al.*, over the first year of the

tax. These large impacts certainly deserve a closer look, for various reasons. First, Silver *et al.*, find a significant 7 percent increase in purchases from stores in adjacent cities not imposing the tax, pointing out at an obvious limitation of fiscal measures implemented at local level. Second, the relatively large effects of the tax do not necessarily depend on the price increase only, as the Berkeley tax was implemented after an electoral poll, hence accompanied with an intrinsic awareness and information campaign. This is likely to have enhanced the tax outcomes, at least in the short term. The signalling effect of taxes on unhealthy goods, as experienced with tobacco and alcohol, does deserve further analysis by economists in order to capture the full impact of taxation, and privileges observational studies over elasticity-based simulations.

The other front of fiscal measures, subsidies, is not experiencing the diffusion rate of taxation. The reason mirrors the explanation for the surge in nutrition taxes during the economic crisis, as taxes generate budget revenues, but subsidies are extremely expensive. Within the Supplemental Nutrition Assistance Program (SNAP) program, the USDA piloted a 30 percent subsidy on fruit & vegetables, finding the potential for a very significant impact (about half a portion per day per individual), but also estimating a cost of up to \$4.5 billion per year to implement the program at the federal level. Finally, another success story in terms of healthy food availability, weight and health outcome, is the 2009 revision of the Women, Infant and Children (WIC) scheme within the United States SNAP. The revision of the scheme provided economic incentives to recipients to purchase healthier options within the food assistance program, and the new scheme has been found to be effective in increasing availability at the retail level and improving dietary outcomes.

Evidence on the regulation of school environments

Measures targeting children in schools are by far those receiving the highest public support, thus is not surprising that many of them exists, often implemented at the sub-national level or even at the individual school level. This has generated a vast literature on their evaluation, including ex-post evaluation. Our focus is on national-level policies, and most of the ex-post evidence points towards effectiveness, with some major caveats. First, lack of compliance is not a minor threat to national-level policies, especially when their scope is not comprehensive. For example, vending machine bans are unlikely to achieve their goal if restricted foods are available in other school-based (or near school) outlets, which is often found to be the case. Interestingly, there are example of national regulations affecting food supply in the vicinity of schools, for example South Korea bans the sale of fast foods and sodas within 200 metres of schools. Second, targeting school behaviours does not seem to guarantee the achievement meaningful changes in the overall diet, as compensation effects and out-of-school habits hinder the reach of school-based policies. More comprehensive actions, including accompanying education measures, are clearly required to extend the scope of these measures. Third, and not unrelated to the previous point, the effects of these policies risks to be short-lived and there is little evidence on their effectiveness on long-term behaviour. Again, modifying one environment is insufficient to induce sustainable changes.

Evidence on mandatory and voluntary nutrition standards

Few ex-post evaluations considering a counterfactual dimension – or at least monitoring compliance with the regulation – exist for

mandatory nutrition standards implemented through national regulations. The Danish trans-fat ban has been recognized as very effective by two studies, as Stender *et al.*, (2006) show a very high level of compliance and a major reduction in the trans-fat content of fast food items relative to fast food chains other countries. A recent study by Restrepo and Rieger (2016) has explored the impact of the ban on mortality, using a difference-in-difference approach relative to a synthetic control group made by matched data from other countries, and provides robust evidence of a significant reduction in mortality from CVD associated with the ban. South Africa has recently implemented nation-wide limits for sodium content in foods, and the first evaluations show a relatively high level of compliance already in the first year of implementation.

Voluntary schemes and private-public partnership are more common, and we found five ex-post evaluations, four addressing salt reduction, one trans-fat reduction. All studies indicate a significant impact of the scheme, and especially the Food Standard Agency salt reduction strategy is often cited as a policy success story.

Evidence on actions to alter the accessibility to healthy and unhealthy foods

By their nature, these measures targeting sales and retail points rather than food production are mostly implemented at local level, but three evaluations from the United States provide some insights. As for the broader trans-fat reduction policies, the New York ban of trans-fat from products sold in restaurants has been effective in reducing intakes and mortality from cardiovascular disease. Instead, incentives to support the availability of healthy foods in deprived areas are not found to be effective, as market dynamics seem to be more powerful in driving the supply and retailing sectors than (minor) policy initiatives.

SUMMARY AND CONCLUDING REMARKS

Given the recent adoption trends, the coming years will hopefully provide a much stronger evidence basis grounded on ex-post findings. The evidence basis we have reviewed is heterogeneous in terms of the outcome variables being targeted, but some general conclusions can be drawn on three levels: (a) compliance with regulations; (b) impact on behaviours; (c) impact on obesity and health. Unfortunately, mainly due to data limitations, the current evidence is mainly confined to the assessment of the short-term impact on (a) and (b), even with policies that are supposed to manifest their full potential in the longer term, as, for example, school-based policies. Based on the evidence we have reviewed, our main conclusions are the following:

In term of **compliance**, policies targeted at the private sector are generally effective when they are mandatory, and the regulation is very specific. With few exceptions, voluntary advertising codes and voluntary labelling schemes fail to achieve levels of compliance which translate into detectable behavioural impacts on the population. The conclusion is slightly different for reformulation efforts adopted under a public-private agreement, as there seem to be significant impacts on the product composition where they have been adopted and evaluated. However, the existing evaluations refer to countries like Australia, Scandinavian countries, the UK or the US where the public debate and the public policy efforts on nutrition and obesity are relatively advanced. This places a stronger incentive on firms to comply with the voluntary agreements, both

because of public image returns and because failure of these agreements would ultimately lead to mandatory regulations.

In term of impact on **behaviours** (mainly measured as purchases and less frequently as diet quality), our review indicates that:

- Advertising regulations have little impact on behaviours (if any), at least in the short-term. This is probably due to the narrow scope of most regulations, usually limited to specific media, or even to specific channels and time of the day. More comprehensive efforts are required, but in the information age it seems more feasible and effective to promote better information than control private advertising efforts;
- Information campaigns do generate positive effects on behaviours, especially if they are framed within broader policy packages. More specifically, the “signalling effect” of other policies (e.g. introducing small taxes or labelling requirements) should not be underestimated, and together with explicit social marketing efforts these multi-component policies are the most likely route to success;
- There is a direct effect of labelling policies on consumer choice, but this is usually small. However, those evaluations that looked at reformulation efforts following a nutrition-based labelling regulation, did confirm that these measures generate positive reformulation efforts;
- School-based measures work, but their impact is limited to the school environment, and the compensation effects outside school often offset the benefits of the school policies. As for information campaigns, it is necessary that these policies are administered within broader packages that enhance their impact, for example by increasing targeting the schoolchildren families, and by increasing their awareness through education measures. Measuring the long-term impact of education measures is hardly feasible, which does not mean that education is a key element in multi-component packages;
- Fiscal measures do generate changes in consumption, especially when they are large, and when they are well signalled. The recent experience of poll-based city-level taxes adopted in the US suggests that they can have an important impact, because the price effect is accompanied by higher awareness and knowledge associated with the poll and the related media coverage. Unsurprisingly there are not many examples of price subsidies, as these place a nontrivial burden on public budget, but pilot policies and simulation studies suggest that they could be very effective in promoting the consumption of healthy foods

Finally, the evidence on the ultimate impact of national policies on **body-mass index and/or health** is still limited. There is a growing research body linking behavioural outcome to weight and health outcomes based on epidemiological models on risk factors. Unsurprisingly, only those measures that generate large and sustained behavioural change translated into significant health improvement at the population level, and taken individually most measures fail to generate sufficiently large outcomes. There is still a major methodological gap to evaluate the combined and cumulative effect of multiple policies targeting the same population and food groups, but this seems to be the most realistic and successful policy setting nowadays.

Finally, under a methodological perspective, our review placed a great emphasis on the use of observational ex-post data to evaluate policies. Although these ex-post evaluations are certainly the most desirable route to build an evidence basis, they come with the big challenge of adopting robust approaches for identifying the policy impact and isolating it from the variety of confounding factors which act at the same time. The toolkit is certainly there, but it usually clashes with the lack of adequate data. The policy effort to improve surveillance and monitoring to improve the evidence basis is as important as the nutrition policies themselves.

REFERENCES

- Bødker, M., Pisinger, C., Toft, U. and Jørgensen, T., 2015. The Danish fat tax—effects on consumption patterns and risk of ischaemic heart disease. *Preventive Medicine*, 77: 200-203.
- Capacci, S., Mazzocchi, M., Shankar, B., Macias, J.B., Verbeke, W., Pérez-Cueto, F.J., Koziol-Kozakowska, A., Piórecka, B., Niedzwiedzka, B., D’addesa, D. and Saba, A., 2012. Policies to promote healthy eating in Europe: a structured review of policies and their effectiveness. *Nutrition reviews*, 70: 188-200.
- Falbe, J., Rojas, N., Grummon, A.H. and Madsen, K.A., 2015. Higher retail prices of sugar-sweetened beverages 3 months after implementation of an excise tax in Berkeley, California. *American Journal of Public Health*, 105: 2194-2201.
- Goris, J.M., Petersen, S., Stamatakis, E. and Veerman, J.L., 2010. Television food advertising and the prevalence of childhood overweight and obesity: a multicountry comparison. *Public health nutrition*, 13: 1003-1012.
- Mozaffarian D., Afshin A., Benowitz N., Bittner V., Daniels S., Franch H., Jacobs D., Kraus W., Kris-Etherton P., Krummel D., Popkin B., Whitsel L. and Zakai N., 2012. Population approaches to improve diet, physical activity, and smoking habits: a scientific statement from the American Heart Association. *Circulation*, 126: 1520-1521.
- Restrepo, B.J. and Rieger, M., 2016. Denmark’s policy on artificial trans fat and cardiovascular disease. *American Journal of Preventive Medicine*, 50: 69-76.
- Sharma, A., di Falco, S. and Fraser, I., 2015. Consumption of Salt Rich Products in the UK: Impact of The Reduced Salt Campaign. MPRA Paper No. 62359.
- Silver, L.D., Ng, S.W., Ryan-Ibarra, S., Taillie, L.S., Induni, M., Miles, D.R., Poti, J.M. and Popkin, B.M., 2017. Changes in prices, sales, consumer spending, and beverage consumption one year after a tax on sugar-sweetened beverages in Berkeley, California, US: A before-and-after study. *PLoS Medicine*, 14, e1002283.
- Stender, S., Dyerberg, J. and Astrup, A., 2006. Consumer protection through a legislative ban on industrially produced trans fatty acids in foods in Denmark. *Scandinavian Journal of Food and Nutrition*, 50: 155-160.
- Young, L. and Swinburn, B., 2002. Impact of the Pick the Tick food information programme on the salt content of food in New Zealand. *Health Promotion International*, 17, pp.13-19.

Appendix

EX-POST EVIDENCE ON THE EFFECTIVENESS OF NATIONAL NUTRITION POLICIES: SELECTED STUDIES, OUTCOME MEASURES, AND METHODOLOGIES

List of tables

Table A1. Evidence on the effectiveness of advertising regulations and codes.....	12
Table A2. Evidence on the effectiveness of public information campaigns and social marketing	13
Table A3. Evidence on the effectiveness of labelling measures.....	14
Table A4. Evidence on the effectiveness of school-based measures.....	15
Table A5. Evidence on the effectiveness of taxes and subsidies	16
Table A6. Evidence on the effectiveness of mandatory nutrition standards.....	17
Table A7. Evidence on the effectiveness of voluntary nutrition standards.....	17
Table A8. Evidence on the effectiveness of accessibility measures	18
References to cited studies.....	18

TABLE A1. EVIDENCE ON THE EFFECTIVENESS OF ADVERTISING REGULATIONS AND CODES

COUNTRY	REFERENCE	OUTCOME	METHOD	EVIDENCE
ADVERTISING BAN AND REGULATIONS (STATUTORY)				
Canada (Quebec)	Dhar & Baylis (2011)	Fast-food expenditure	Difference-in-Difference	Significant reduction in purchase frequency
	Potvin Kent <i>et al.</i> , (2012)	Nutritional content of advertised food	Mean comparison with no-ban region (post-ban data only)	Small improvement in healthiness of advertised food
Ireland	Tatlow-Golden <i>et al.</i> , (2015)	Nutritional content of advertised food	Descriptive statistics (sample of the target population, post-ban)	Exposure to unhealthy food adverts remains significant
Norway	Bugge (2016)	% of unhealthy food advertised	Descriptive statistics (multiple media considered, TV, internet, magazines)	Relatively low exposure, especially to the most unhealthy foods
Republic of Korea	Kim <i>et al.</i> , (2013)	Unhealthy food advertising budget, number of adverts, gross rating points by broadcaster	Pre-post comparison	Good compliance by broadcasters in the first year
Sweden	Goris <i>et al.</i> , (2010)	Fraction of childhood obesity attributable to advertising	Simulation based on advertising exposure estimates, relative to other countries with no ban	Lower obesity rates relative to countries with no ban
United Kingdom	Adams <i>et al.</i> , (2012)	Number of adverts, exposure, nutritional content of advertised food	Pre-post comparison	High compliance, but exposure to unhealthy food adverts unchanged
	Boyland <i>et al.</i> , (2011)	Content of adverts	Analysis of adverts in the year following the regulation	High exposure to unhealthy food adverts
	Silva <i>et al.</i> , (2015)	Advertising expenditure, expenditure of household with children	Counterfactual analysis	Significant reduction in advertising expenditure, small reduction in unhealthy food expenditure
VOLUNTARY ADVERTISING CODES				
Canada (Ontario)	Potvin Kent and Wanless (2014)	Number of adverts	Pre-post comparison	Voluntary restrictions non-effective, adverts in children channels increased
Spain	Romero-Fernández <i>et al.</i> , (2010)	% of adverts complying with the code	Comparison between adhering and non-adhering companies	Voluntary code not effective, high non-compliance and no difference with companies not adhering
Germany (EU)	Effertz and Wilcke (2012)	% of products with unhealthy ingredients	Comparison pre-post	Voluntary code not effective, % of adverts with unhealthy food increased
Netherlands	Goris <i>et al.</i> , (2010)	Fraction of childhood obesity attributable to advertising	Simulation based on advertising exposure estimates, relative to other countries with no ban	Lower obesity rates relative to countries with no ban

TABLE A2. EVIDENCE ON THE EFFECTIVENESS OF PUBLIC INFORMATION CAMPAIGNS AND SOCIAL MARKETING

COUNTRY	GOAL	REFERENCE	OUTCOME	METHOD	EVIDENCE
Australia	Healthier eating (broad)	Morley <i>et al.</i> , (2016)	Awareness	Difference-in-Difference	Significant impact on awareness
	Reducing obesity	King <i>et al.</i> , (2014)	Awareness, self-reported behaviours	Pre-post comparison (with covariates)	Significant impact on awareness and knowledge, not on reported behaviours
	Promoting F&V	Pollard <i>et al.</i> , (2008)	Awareness, self-reported behaviours	Pre-post comparison (with covariates)	Significant impact on awareness and behaviours
New Zealand	Reducing salt	Young and Swinburn (2002)	Sodium content in industrial product	Pre-post comparison	Evidence on reformulated products with less salt
United Kingdom	Promoting F&V	Capacci and Mazzocchi (2011)	F&V purchases	Counterfactual model	Significant impact on F&V purchases
	Promoting F&V	Griffith <i>et al.</i> , (2014)	F&V purchases	Difference-in-Difference	Significant impact on F&V purchases
	Reducing salt	Sharma <i>et al.</i> , (2015)	Sodium content in food sold by supermarket	Structural break in time series data	Significant reduction of sodium in purchased food
	Reducing salt	Ni Mhurchu <i>et al.</i> , (2011)	Sodium content in food purchased by households	Post-policy descriptives, comparison with Australia	Suggestive of effectiveness, but levels above the limit
	Reducing salt	Shankar <i>et al.</i> , (2011)	Urinary sodium level	Counterfactual model	Significant reduction in sodium
	Reducing salt	Sutherland	Use of added salt	Counterfactual model	Significant reduction in added salt

TABLE A3. EVIDENCE ON THE EFFECTIVENESS OF LABELLING MEASURES

COUNTRY	POLICY GOAL	REFERENCE	OUTCOME	METHOD	EVIDENCE
Canada	Trans-fat labels	Ricciuto <i>et al.</i> , (2009)	Average fat composition, proportion of 'transfat-free' margarines and average prices of margarines	Pre-post non-parametric mean comparison	Some impact on high-price margarines, but overall little impact when voluntary
	Trans-fat labels	Friesen and Innis (2006)	TFA contained in women breast milk	Pre-post comparison	Significant decrease in exposure of children
South Korea	Trans-fat labels	Lee <i>et al.</i> , (2010)	Trans-fat and lipid content of processed foods	Pre-post comparison on the same food products	Significant decrease in lipids and trans-fat content
United Kingdom	Voluntary monochrome GDA	Boztug <i>et al.</i> , (2015)	Retail sales in supermarkets with GDA labels	Difference-in-difference and interrupted time series	Slight reduction in the share of unhealthy products purchased
United States	Menu calorie labeling	Deb and Vargas (2016)	BMI	Counterfactual analysis, mixture models	Significant impact on overweight women, and all men's BMI categories
	Menu calorie labeling	Dumanovsky <i>et al.</i> , (2011)	Energy content per purchase	Pre-post comparison on the same outlets	Very small impact, larger for largest chains
	Menu calorie labeling	Elbel <i>et al.</i> , (2009)	Awareness and energy intake	Comparison with control group, only post-policy	Increase in awareness, no impact on energy intake
	Menu calorie labeling	Finkelstein <i>et al.</i> , (2011)	Energy intake	Difference-in-difference (two counties)	No impact on energy intake
	Menu calorie labeling	Restrepo (2016)	BMI and probability of obesity	Difference-in-difference	Significant impact
	NLEA regulation	Patterson <i>et al.</i> , (2017)	Attitudes and consumption behaviours	Counterfactual model	Only short-term impact on attitudes, very small impact on behaviours
	NLEA regulation	Variyam (2008)	Nutrient intakes	Difference-in-difference (relative to out-of-home behaviour)	Modest effect on intakes
	Trans-fat labels	Doell <i>et al.</i> , (2012)	Trans-fat intakes	Pre-post comparison	Reduction in trans-fat intakes
	Trans-fat labels	Van Camp <i>et al.</i> , (2012)	Saturated fat content per serving and proportion of total fats (chips and cookies)	Pre-post comparison	Reduction in trans-fat levels, but increase in saturated fats especially for cookies

TABLE A4. EVIDENCE ON THE EFFECTIVENESS OF SCHOOL-BASED MEASURES

COUNTRY	POLICY GOAL	REFERENCE	OUTCOME	METHOD	EVIDENCE
SCHOOL MEAL STANDARDS					
France	School meal guidelines (1999)	Bertin <i>et al.</i> , (2012)	Compliance of school meals with guidelines	Ex-post analysis relative to guidelines	Insufficient compliance (less than 30% of schools had high compliance)
	School meal guidelines (1999)	Dubuisson <i>et al.</i> , (2015)	Diet quality of children taking school lunches	Comparison with children not taking school lunch	Children taking school lunches had a better diet, children eating at school but not with school lunches had a diet higher in unhealthy foods
United Kingdom	Revision of school meal standards in 2009	Spence <i>et al.</i> , (2014)	Nutritional quality of diet of 11-12 y.o. children (including out of school)	Pre-post model with covariates	No significant impact on nutritional quality
	Revision of school meal standards in 2009	Spence <i>et al.</i> , (2013)	Nutritional quality of school lunches in primary schools	Pre-post model comparing children eating school meals to children bringing packed lunch	The revision of standards had a significant impact on school nutritional quality, and total diet
United States	New USDA Nutrition Standards in the National School Lunch and Breakfast Program 2012	Cohen <i>et al.</i> , (2014)	Food selection, consumption and waste	Model-based pre-post comparison on a large sample of primary and middle school children	Fruit selection increased by 23% and vegetable selection remained unchanged. Fruit consumption remained unchanged, vegetable consumption increased by 16%. Waste remained substantial
	School meal standards across US States	Taber <i>et al.</i> , (2013)	In-school purchases, BMI, overall consumption, obesity	Model-based	Significant impact of more stringent standards than USDA's on obesity and BMI for children eligible for free meal
SCHOOL FRUIT SCHEMES					
Italy	EU school fruit scheme	Brunello <i>et al.</i> , (2014)	Unhealthy snack sales	Difference-in-difference on stores near targeted school	Reduction in snack sales in regular stores, but not in discount stores
Norway	National school fruit scheme in primary school	Øvrum and Bere (2014)	Fruit intake of children and parents	Ex post comparison between participating children and non-participating children (randomized), model with covariates	Positive impact both on children (0.36 portions = +25%) and parents (0.19 portions, +12.5%), no impact on vegetable intakes
United Kingdom	National school fruit scheme (age 4-6)	Fogerty <i>et al.</i> , (2007)	Self-reported fruit intake of children aged 4-6	Difference-in-difference	Significant increase in consumption, but only on the first year (about 0,6 portions per day)
	National school fruit scheme (age 4-6)	Wells and Nelson (2005)	Self-reported fruit intake of children aged 4-6 and aged 7-8	Mean comparison on children who (had) participated relative to control	Impact found on age bracket 4-6 (50 grams per day), no significant difference on those aged 7-8, impact not sustained
United States	USDA Fresh Fruit & Vegetable Program	Qian <i>et al.</i> , (2016)	BMI of Arkansas children participating to the scheme	Difference-in-difference combined with propensity score matching	Significant impact on BMI
	USDA Fresh Fruit & Vegetable Program	Olsho <i>et al.</i> , (2015); Bartlett <i>et al.</i> , (2013)	Student FV consumption and total energy intake in and out of school	Regression discontinuity design	Positive impact (50 grams per day of F&V and 47 calories), both at school (42 grams) and outside school (8 grams)
SCHOOL SUPPLY RESTRICTIONS/INTERVENTIONS					
France	Vending-machine ban	Capacci <i>et al.</i> , (2017)	Calorie and nutrient intake at school, morning snack at school, and total diet	Regression discontinuity design combined with difference-in-difference	The ban reduced sugar intake and prevalence of morning snack at school and sugar intake at school, other nutrient unaffected. No significant impact on the total diet
United States	District-level vending machine restrictions	Fletcher <i>et al.</i> , (2010)	School purchases of soft drinks and overall purchases	Post-ban mean comparison with schools with no restrictions	Significant reduction in purchases at school, no difference on total consumption
	State-level school restrictions on soft drinks	Taber <i>et al.</i> , (2012)	SSB access and purchases at school, overall SSB purchases (all self-reported)	Linear model on cohort data with state-level policy variables	Ban on all SSBs led to significant reduction in access and weekly purchases, ban on sodas did not result in significant impact. Overall consumption was unaffected
	Connecticut ban	Huang and Kiesel (2012)	Purchases of soft drinks out-of-school	Difference-in-difference (household with/without children, states with no ban)	No evidence of increased purchases out of school following the ban
International	Various interventions	Driessen <i>et al.</i> , (2014)	Various	Systematic review of ex post studies	Impact on school environment, few studies with appropriate control groups

TABLE A5. EVIDENCE ON THE EFFECTIVENESS OF TAXES AND SUBSIDIES

COUNTRY	POLICY GOAL	REFERENCE	OUTCOME	METHOD	EVIDENCE
TAXES					
Denmark	Saturated fat tax	Smed <i>et al.</i> , (2016)	Intake of saturated fats and various foods, predicted mortality outcomes	Counterfactual panel model on home purchase data	Significant reduction (-4%) in saturated fat intake, increase in vegetable consumption, -0.4% in mortality from NCD (123 lives per year)
	Saturated fat tax	Bødker <i>et al.</i> , (2015)	Nutrient intakes, risk of heart disease	Pre-post comparison on retail scan data	Estimated sales reduction of 0.9% for taxed foods, small reduction in fats and risk of HD
France	Soft drinks	Berardi <i>et al.</i> , (2016)	Transmission of the tax to retail prices	Difference-in-difference relative to non-taxed foods	Full transmission of the tax
Hungary	Fat and soft drink tax	Biro (2015)	Consumption of processed foods relative to unprocessed	Panel data with fixed effects and comparison with unprocessed foods	Significant decrease (-3.4%) in processed foods and increase (+1.1%) in unprocessed food consumption
	Fat and soft drink tax	WHO Europe (2015)	Consumption of taxed products, tax revenues	Pre-post comparison	Significant decrease in consumption, especially in overweight and low-income groups. Tax revenues as planned (€ 200m in two years)
Mexico	Fat and soft drink tax	Colchero <i>et al.</i> , (2017)	Purchases of taxed beverages	Counterfactual panel model on sales data	Significant reduction in taxed beverages (-5.5% in 2014, -7.6% in 2015), increase in non-taxed beverages (+2.1%)
	Fat and soft drink tax	Batis <i>et al.</i> (2016)	Purchases of taxed foods	Counterfactual panel model on home purchase data	Significant reduction in taxed foods (-5.1% in 2014), no significant increase in non-taxed foods, impact higher on low-income groups
United States	State level soda taxes	Powell <i>et al.</i> , (2009)	Adolescent BMI	State-level pseudo-panel data on sales, taxes and BMI, counterfactual model	No significant impact on BMI (small from vending machine soda taxes)
	State level soda taxes	Fletcher <i>et al.</i> , (2010a)	Average BMI (all age groups)	State-level counterfactual panel model, with fixed effects and tax levels	A 10% tax rate increase is estimated to decrease BMI by 0.03 points
	State level soda taxes	Fletcher <i>et al.</i> , (2010b)	Adolescent calorie intake, consumption of soda and substitutes and BMI	State-level counterfactual model, with fixed effects and tax levels	Reduction in calorie intake estimated between 5 and 7 calories and 20 grams of soda consumption per tax percentage point, no impact on overweight or obesity
	State level soda taxes	Sturm <i>et al.</i> , (2010)	Total drinks per week, drinks per week at school and BMI of schoolchildren	State-level model	No average impact on consumption of a differential soda tax, small impact on BMI (-0.01). Increasing the differential by 1% results in -0.06 drinks per week at school (significant) and -0.08 points of BMI. Larger effects for those at risk of overweight and low-income groups
SUBSIDIES					
United States	30% subsidy on F&V price (Massachusetts)	Bartlett <i>et al.</i> , (2014); Olsho <i>et al.</i> , (2016), Klerman <i>et al.</i> , (2014)	Consumption of fruit & vegetables, use of SNAP benefits for F&V, costs for nationwide implementation	Randomized pilot study with control group	Significant impact on consumption (+0.5 portions per day), use of SNAP benefits, costs ranging between \$1 billion and \$4.5 billions per year
	Revision of WIC program	Lu <i>et al.</i> , (2016)	Shelf-space for healthy foods, visibility of WIC labels	Pre-post test on the same stores	Significant impact both on shelf-space and visibility
	Revision of WIC program	Schultz <i>et al.</i> , (2015, review)	Dietary intake and availability of healthier food	Systematic review on ex post studies	Significant positive impact on diet quality and availability of healthier food

TABLE A6. EVIDENCE ON THE EFFECTIVENESS OF MANDATORY NUTRITION STANDARDS

COUNTRY	POLICY GOAL	REFERENCE	OUTCOME	METHOD	EVIDENCE
Denmark	Trans-fat ban (2003)	Restrepo and Rieger (2016a)	Mortality from CVD	Difference-in-difference with synthetic control group	Reduction in mortality from CVD around 4%
	Trans-fat ban (2003)	Stender <i>et al.</i> , (2006)	Trans-fatty acid content of fast-food items in major chains across 30 countries	Post-ban mean comparison	Trans-fatty acid content of fast-food meals fell below 1g after the regulation and was the lowest among the 30 countries; considering a menu high in trans-fat, the reduction was from 30g before the ban
South Africa	Mandatory sodium limits (2016)	Peters <i>et al.</i> , (2017)	% of products meeting the mandatory limits	Pre-post monitoring	67% of products complying, 49% of products not complying were less than 25% above the limits

TABLE A7. EVIDENCE ON THE EFFECTIVENESS OF VOLUNTARY NUTRITION STANDARDS

COUNTRY	POLICY GOAL	REFERENCE	OUTCOME	METHOD	EVIDENCE
Australia	Food and Health Dialogue Targets (2009)	Trevena <i>et al.</i> , (2014)	Mean and median salt content of 1843 foods from supermarket shelves as reported in the label, proportion of foods meeting the target	Model-based monitoring of trends	Significant reduction in mean sodium level of bread (40mg per 100g, -9%), breakfast cereals (80mg/100g, -25%), cured meats (-100mg/100g, -8%), no significant difference between publicly committed companies and other companies
Netherlands	Dutch Task Force for the Improvement of the Fatty Acid Composition (2003)	Temme <i>et al.</i> , (2011)	Food composition and food consumption for a sub-set of foods targeted by the task-force	Pre-post comparison on the same products	Composition: reduction of median TFA content (0.3g per 100g), especially pastry, cakes and biscuits. No change in other fats. Intake: reduction in TFA (-0.2% of total energy), no impact on other fats
United Kingdom	FSA salt reduction strategy (2006, bread)	Brinsden <i>et al.</i> , (2013)	Salt content in breads available in supermarkets	Cross-sectional comparisons over time	Progressive reduction in salt level (-20% between 2001 and 2011 on average, -17% on the same products)
	FSA salt reduction strategy (2006)	Eyles <i>et al.</i> , (2013)	Sodium content of products purchased by household	Mean comparison pre-post on the same products, based on consumer household panel data 2006 and 2011	Overall significant mean reduction of -26 mg/100g (-7%) in available food, -21 mg/100g (-6%) on purchased food. Considering the same products, the reduction was -23 mg/100g (-7%)
United States	National Salt Reduction Initiative	Curtis <i>et al.</i> , (2016)	Sodium density in top-selling products in 61 food categories	Pre-post comparison on the same products	26% of products met the 2012 targets in 2014 (3% met the 2014 target), 43% of products showed a reduction in salt content. On average, sodium content declined by 6.8%

TABLE A8. EVIDENCE ON THE EFFECTIVENESS OF ACCESSIBILITY MEASURES

COUNTRY	POLICY GOAL	REFERENCE	OUTCOME	METHOD	EVIDENCE
United States	New York green carts (mobile shops selling F&V)	Li <i>et al.</i> , (2014)	GIS location of green carts	Model-based odds of locating in deprived area	Green Carts were rarely in food deserts and usually had multiple healthy stores nearby
	New York trans fat ban from restaurants	Angell <i>et al.</i> , (2012)	Fat intakes of restaurant customers	Model-based pre-post comparison with covariates	Trans-fats decreased by 2.4 grams per 1000 KCal, saturated fats increased by 0.55 grams per 1000 KCal
	New York trans fat ban from restaurants	Restrepo and Rieger (2016b)	Mortality from CVD	Difference-in-difference	Reduction in mortality from CVD around 4%

REFERENCES

Advertising regulations

- Adams, J., Tyrrell, R., Adamson, A.J. and White, M., 2012. Effect of restrictions on television food advertising to children on exposure to advertisements for 'less healthy' foods: repeat cross-sectional study. *PLoS one*, 7(2), p. e31578.
- Boyland, E.J., Harrold, J.A., Kirkham, T.C. and Halford, J.C., 2011. The extent of food advertising to children on UK television in 2008. *International Journal of Pediatric Obesity*, 6(5-6), pp. 455-461.
- Bugge, A.B., 2016. Food advertising towards children and young people in Norway. *Appetite*, 98, pp. 12-18.
- Dhar, T. and Baylis, K., 2011. Fast-food consumption and the ban on advertising targeting children: the Quebec experience. *Journal of Marketing Research*, 48(5), pp. 799-813.
- Effertz, T. and Wilcke, A.C., 2012. Do television food commercials target children in Germany?. *Public health nutrition*, 15(08), pp. 1466-1473.
- Goris, J.M., Petersen, S., Stamatakis, E. and Veerman, J.L., 2010. Television food advertising and the prevalence of childhood overweight and obesity: a multicountry comparison. *Public health nutrition*, 13(07), pp. 1003-1012.
- Kim, S., Lee, Y., Yoon, J., Chung, S.J., Lee, S.K. and Kim, H., 2013. Restriction of television food advertising in South Korea: impact on advertising of food companies. *Health Promotion International*, 28(1), pp. 17-25.
- Potvin Kent, M. and Wanless, A., 2014. The influence of the children's food and beverage advertising initiative: Change in children's exposure to food advertising on television in Canada between 2006–2009. *International journal of obesity*, 38(4), pp. 558-562.
- Potvin Kent, M., Dubois, L. and Wanless, A., 2012. A nutritional comparison of foods and beverages marketed to children in two advertising policy environments. *Obesity*, 20(9), pp. 1829-1837.
- Romero-Fernández, M.M., Royo-Bordonada, M.Á. and Rodríguez-Artalejo, F., 2010. Compliance with self-regulation of television food and beverage advertising aimed at children in Spain. *Public health nutrition*, 13(07), pp. 1013-1021.
- Silva, A., Higgins, L.M. and Hussein, M., 2015. An Evaluation of the Effect of Child-Directed Television Food Advertising Regulation in the United Kingdom. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, 63(4), pp. 583-600.
- Tatlow-Golden, M., Murrin, C., Bergin, R., Kerr, M., O'Brien, S. and Livingstone, B., 2015. Creating good feelings about unhealthy food: children's televised 'advertised diet' on the island of Ireland, in a climate of regulation. *The Irish Journal of Psychology*, 36(1-4), pp. 83-100.

Public information campaigns

- Capacci, S. and Mazzocchi, M., 2011. Five-a-day, a price to pay: an evaluation of the UK program impact accounting for market forces. *Journal of health economics*, 30(1), pp. 87-98.
- Griffith, R., Scholder, S.V.H.K. and Smith, S., 2014. *Getting a Healthy Start?: Nudge Versus Economic Incentives*. CMPO Working Paper Series No. 14/328.
- King, E.L., Grunseit, A.C., O'Hara, B.J. and Bauman, A.E., 2013. Evaluating the effectiveness of an Australian obesity mass-media campaign: how did the 'Measure-Up' campaign measure up in New South Wales?. *Health education research*, 28(6), pp. 1029-1039.
- Morley, B., Niven, P., Dixon, H., Swanson, M., Szybiak, M., Shilton, T., Pratt, I.S., Slevin, T., Hill, D. and Wakefield, M., 2016. Population-based evaluation of the 'Live Lighter' healthy weight and lifestyle mass media campaign. *Health education research*, p. cyw009.
- Ni Mhurchu, C., Capelin, C., Dunford, E.K., Webster, J.L., Neal, B.C. and Jebb, S.A., 2011. Sodium content of processed foods in the United Kingdom: analysis of 44,000 foods purchased by 21,000 households. *The American journal of clinical nutrition*, 93(3), pp. 594-600.
- Pollard, C.M., Miller, M.R., Daly, A.M., Crouchley, K.E., O'Donoghue, K.J., Lang, A.J. and Binns, C.W., 2008. Increasing fruit and vegetable consumption: success of the Western Australian Go for 2&5@ campaign. *Public health nutrition*, 11(03), pp. 314-320.
- Shankar, B., Brambila-Macias, J., Traill, B., Mazzocchi, M. and Capacci, S., 2013. An evaluation of the UK Food Standards Agency's salt campaign. *Health economics*, 22(2), pp. 243-250.
- Sharma, A., di Falco, S. and Fraser, I., 2015. Consumption of Salt Rich Products in the UK: Impact of The Reduced Salt Campaign. MPRA Paper No. 62359.
- Sutherland, J., Edwards, P., Shankar, B. and Dangour, A.D., 2013. Fewer adults add salt at the table after initiation of a national salt campaign in the UK: a repeated cross-sectional analysis. *British Journal of Nutrition*, 110(03), pp. 552-558.
- Young, L. and Swinburn, B., 2002. Impact of the Pick the Tick food information programme on the salt content of food in New Zealand. *Health Promotion International*, 17(1), pp. 13-19.

Labelling regulations

- Boztuğ, Y., Juhl, H.J., Elshiewy, O. and Jensen, M.B., 2015. Consumer response to monochrome Guideline Daily Amount nutrition labels. *Food Policy*, 53, pp. 1-8.
- Deb, P. and Vargas, C., 2016. *Who benefits from calorie labeling?* an analysis of its effects on body mass. National Bureau of Economic Research, Working Paper 21992.

- Doell, D., Folmer, D., Lee, H., Honigfort, M. and Carberry, S., 2012. Updated estimate of trans fat intake by the US population. *Food Additives & Contaminants: Part A*, 29(6), pp. 861-874.
- Dumanovsky, T., Huang, C.Y., Nonas, C.A., Matte, T.D., Bassett, M.T. and Silver, L.D., 2011. Changes in energy content of lunchtime purchases from fast food restaurants after introduction of calorie labelling: cross sectional customer surveys. *Bmj*, 343, p. d4464.
- Elbel, B., Kersh, R., Brescoll, V.L. and Dixon, L.B., 2009. Calorie labeling and food choices: a first look at the effects on low-income people in New York City. *Health affairs*, 28(6), pp. w1110-w1121.
- Finkelstein, E.A., Strombotne, K.L., Chan, N.L. and Krieger, J., 2011. Mandatory menu labeling in one fast-food chain in King County, Washington. *American journal of preventive medicine*, 40(2), pp.122-127.
- Friesen, R. and Innis, S.M., 2006. Trans fatty acids in human milk in Canada declined with the introduction of trans fat food labeling. *The Journal of nutrition*, 136(10), pp. 2558-2561.
- Lee, J.H., Adhikari, P., Kim, S.A., Yoon, T., Kim, I.H. and Lee, K.T., 2010. Trans fatty acids content and fatty acid profiles in the selected food products from Korea between 2005 and 2008. *Journal of food science*, 75(7), pp. C647-C652.
- Patterson, M., Bhargava, S. and Loewenstein, G., 2017. An unhealthy attitude? New insight into the modest effects of the NLEA. *Journal of Behavioral Economics for Policy*, 1(1), pp. 15-26.
- Restrepo, B.J., 2016. Calorie labeling in chain restaurants and body weight: evidence from New York. *Health Economics*, early view 10.1002/hec.3389.
- Ricciuto, L., Lin, K. and Tarasuk, V., 2009. A comparison of the fat composition and prices of margarines between 2002 and 2006, when new Canadian labelling regulations came into effect. *Public health nutrition*, 12(08), pp. 1270-1275.
- Van Camp, D., Hooker, N.H. and Lin, C.T.J., 2012. Changes in fat contents of US snack foods in response to mandatory trans fat labelling. *Public health nutrition*, 15(06), pp. 1130-1137.
- Variyam, J.N., 2008. Do nutrition labels improve dietary outcomes? *Health economics*, 17(6), pp. 695-708.
- Brunello, G., De Paola, M. and Labartino, G., 2014. More apples fewer chips? The effect of school fruits chemes on the consumption of junk food. *Health policy*, 118(1), pp. 114-126.
- Capacci, S., Mazzocchi, M., Shankar, B., forthcoming. Breaking habits: The effect of the French vending machine ban on school snacking and sugar intakes. *Journal of Policy Analysis and Management*.
- Cohen, J.F., Richardson, S., Parker, E., Catalano, P.J. and Rimm, E.B., 2014. Impact of the new US Department of Agriculture school meal standards on food selection, consumption, and waste. *American journal of preventive medicine*, 46(4), pp. 388-394.
- Driessen, C.E., Cameron, A.J., Thornton, L.E., Lai, S.K. and Barnett, L.M., 2014. Effect of changes to the school food environment on eating behaviours and/or body weight in children: a systematic review. *Obesity reviews*, 15(12), pp. 968-982.
- Dubuisson, C., Lioret, S., Dufour, A., Calamassi-Tran, G., Volatier, J.L., Lafay, L. and Turck, D., 2015. The relationship between school lunch attendance and the food intakes of French schoolchildren aged 3–17 years. *Public health nutrition*, 18(09), pp. 1647-1657.
- Fletcher, J.M., Frisvold, D. and Tefft, N., 2010. Taxing soft drinks and restricting access to vending machines to curb child obesity. *Health Affairs*, pp. 10-1377.
- Fogarty, A.W., Antoniak, M., Venn, A.J., Davies, L., Goodwin, A., Salfield, N., Stocks, J., Britton, J. and Lewis, S.A., 2007. Does participation in a population-based dietary intervention scheme have a lasting impact on fruit intake in young children?. *International Journal of Epidemiology*, 36(5), pp. 1080-1085.
- Huang, R. and Kiesel, K., 2012. Does limited access at school result in compensation at home? The effect of soft drink bans in schools on purchase patterns outside of schools. *European Review of Agricultural Economics*, 39(5), pp. 797-820.
- Øvrum, A. and Bere, E., 2014. Evaluating free school fruit: results from a natural experiment in Norway with representative data. *Public health nutrition*, 17(06), pp. 1224-1231.
- Qian, Y., Nayga, R.M., Thomsen, M.R. and Rouse, H.L., 2016. The effect of the Fresh Fruit and Vegetable Program on childhood obesity. *Applied Economic Perspectives and Policy*, 38(2), pp. 260-275.

School environment regulations

- Bartlett, S., Olsho, L., Klerman, J., et al., (2013). *Evaluation of the Fresh Fruit and Vegetable Program (FFVP): Final Evaluation Report*. Alexandria, VA: U.S. Department of Agriculture, Food and Nutrition Service.
- Bertin, M., Lafay, L., Calamassi-Tran, G., Volatier, J.L. and Dubuisson, C., 2012. School meals in French secondary state schools: do national recommendations lead to healthier nutrition on offer?. *British Journal of Nutrition*, 107(03), pp. 416-427.
- Spence, S., Delve, J., Stamp, E., Matthews, J.N., White, M. and Adamson, A.J., 2013. The impact of food and nutrient-based standards on primary school children's lunch and total dietary intake: a natural experimental evaluation of government policy in England. *PLoS one*, 8(10), p. e78298.
- Spence, S., Matthews, J.N., White, M. and Adamson, A.J., 2014. A repeat cross-sectional study examining the equitable impact of nutritional standards for school lunches in England in 2008 on the diets of 4-7y olds across the socio-economic spectrum. *International Journal of Behavioral Nutrition and Physical Activity*, 11(1), p. 128.

Taber, D.R., Chiqui, J.F., Powell, L.M. and Chaloupka, F.J., 2012. Banning all sugar-sweetened beverages in middle schools: reduction of in-school access and purchasing but not overall consumption. *Archives of Pediatrics & Adolescent Medicine*, 166(3), pp. 256-262.

Taber, D.R., Chiqui, J.F., Powell, L. and Chaloupka, F.J., 2013. Association between state laws governing school meal nutrition content and student weight status: implications for new USDA school meal standards. *JAMA pediatrics*, 167(6), pp. 513-519.

Wells, L. and Nelson, M., 2005. The National School Fruit Scheme produces short-term but not longer-term increases in fruit consumption in primary school children. *British Journal of Nutrition*, 93(04), pp. 537-542.

Nutrition standards

Brinsden, H.C., He, F.J., Jenner, K.H. and MacGregor, G.A., 2013. Surveys of the salt content in UK bread: progress made and further reductions possible. *Bmj Open*, 3(6), p. e002936.

Curtis, C.J., Clapp, J., Niederman, S.A., Ng, S.W. and Angell, S.Y., 2016. US Food Industry Progress During the National Salt Reduction Initiative: 2009–2014. *American Journal of Public Health*, 106(10), pp. 1815-1819.

Eyles, H., Webster, J., Jebb, S., Capelin, C., Neal, B. and Mhurchu, C.N., 2013. Impact of the UK voluntary sodium reduction targets on the sodium content of processed foods from 2006 to 2011: Analysis of household consumer panel data. *Preventive Medicine*, 57(5), pp. 555-560.

Peters, S.A., Dunford, E., Ware, L.J., Harris, T., Walker, A., Wicks, M., van Zyl, T., Swanepoel, B., Charlton, K.E., Woodward, M. and Webster, J., 2017. The Sodium Content of Processed Foods in South Africa during the Introduction of Mandatory Sodium Limits. *Nutrients*, 9(4), p. 404.

Restrepo, B.J. and Rieger, M., 2016a. Denmark's policy on artificial trans fat and cardiovascular disease. *American Journal of Preventive Medicine*, 50(1), pp. 69-76.

Stender, S., Dyerberg, J. and Astrup, A., 2006. Consumer protection through a legislative ban on industrially produced trans fatty acids in foods in Denmark. *Scandinavian Journal of Food and Nutrition*, 50(4), pp. 155-160.

Temme, E.H., Millenaar, I.L., Van Donkersgoed, G. and Westenbrink, S., 2011. Impact of fatty acid food reformulations on intake of Dutch young adults. *Acta cardiologica*, 66(6), p. 721.

Trevena, H., Neal, B., Dunford, E. and Wu, J.H., 2014. An evaluation of the effects of the Australian Food and Health Dialogue targets on the sodium content of bread, breakfast cereals and processed meats. *Nutrients*, 6(9), pp. 3802-3817.

Accessibility measures

Li, K.Y., Cromley, E.K., Fox, A.M. and Horowitz, C.R., 2014. Evaluation of the Placement of Mobile Fruit and Vegetable Vendors to Alleviate Food Deserts in New York City. *Preventing Chronic Disease*, 11.

Angell, S.Y., Cobb, L.K., Curtis, C.J., Konty, K.J. and Silver, L.D., 2012. Change in Trans Fatty Acid Content of Fast-Food Purchases Associated With New York City's Restaurant Regulation: A Pre-Post Study. *Annals of Internal Medicine*, 157(2), pp. 81-86.

Restrepo, B.J. and Rieger, M., 2016b. Trans fat and cardiovascular disease mortality: Evidence from bans in restaurants in New York. *Journal of Health Economics*, 45, pp. 176-196.

Fiscal measures

Bartlett, S., Klerman, J., Olsho, L., et al., 2014. *Evaluation of the Healthy Incentives Pilot (HIP): Final Report*. U.S. Department of Agriculture, Food and Nutrition Service, September 2014.

Batis, C., Rivera, J.A., Popkin, B.M. and Taillie, L.S., 2016. First-year evaluation of Mexico's tax on nonessential energy-dense foods: An observational study. *PLoS Med*, 13(7), p. e1002057.

Berardi, N., Sevestre, P., Tépaut, M. and Vigneron, A., 2016. The impact of a 'soda tax' on prices: evidence from French micro data. *Applied Economics*, 48(41), pp. 3976-3994.

Bíró, A., 2015. Did the junk food tax make the Hungarians eat healthier? *Food Policy*, 54, pp. 107-115.

Bødker, M., Pisinger, C., Toft, U. and Jørgensen, T., 2015. The Danish fat tax—effects on consumption patterns and risk of ischaemic heart disease. *Preventive Medicine*, 77, pp. 200-203.

Colchero, M.A., Rivera-Dommarco, J., Popkin, B.M., and Ng, S.W., 2017. In Mexico, Evidence of Sustained Consumer Response Two Years After Implementing a Sugar-Sweetened Beverage Tax. *Health Affairs*, 36(3), pp. 564-571.

Fletcher, J.M., Frisvold, D. and Tefft, N., 2010a. Can soft drink taxes reduce population weight? *Contemporary Economic Policy*, 28(1), pp. 23-35.

Fletcher, J.M., Frisvold, D.E. and Tefft, N., 2010b. The effects of soft drink taxes on child and adolescent consumption and weight outcomes. *Journal of Public Economics*, 94(11), pp. 967-974.

Klerman, J.A., Bartlett, S., Wilde, P. and Olsho, L., 2014. The short-run impact of the Healthy Incentives Pilot Program on fruit and vegetable intake. *American Journal of Agricultural Economics*, 96(5), pp. 1372-1382.

Lu, W., McKyer, E.L.J., Dowdy, D., Evans, A., Ory, M., Hoelscher, D.M., Wang, S. and Miao, J., 2016. Evaluating the influence of the revised Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) Food Allocation Package on healthy food availability, accessibility, and affordability in Texas. *Journal of the Academy of Nutrition and Dietetics*, 116(2), pp. 292-301.

- Olsho, L.E., Klerman, J.A., Wilde, P.E. and Bartlett, S., 2016. Financial incentives increase fruit and vegetable intake among Supplemental Nutrition Assistance Program participants: a randomized controlled trial of the USDA Healthy Incentives Pilot. *The American Journal of Clinical Nutrition*, 104(2), pp. 423-435.
- Powell, L.M., Chiqui, J. and Chaloupka, F.J., 2009. Associations between state-level soda taxes and adolescent body mass index. *Journal of adolescent health*, 45(3), pp. S57-S63.
- Schultz, D.J., Shanks, C.B. and Houghtaling, B., 2015. The impact of the 2009 Special Supplemental Nutrition Program for Women, Infants, and Children food package revisions on participants: a systematic review. *Journal of the Academy of Nutrition and Dietetics*, 115(11), pp. 1832-1846.
- Smed, S., Scarborough, P., Rayner, M. and Jensen, J.D., 2016. The effects of the Danish saturated fat tax on food and nutrient intake and modelled health outcomes: an econometric and comparative risk assessment evaluation. *European Journal of Clinical Nutrition*, 70, pp. 681-686.
- Sturm, R., Powell, L.M., Chiqui, J.F. and Chaloupka, F.J., 2010. Soda taxes, soft drink consumption, and children's body mass index. *Health Affairs*, pp. 10-1377.
- WHO Europe (2015), Assessment of the Impact of a Public Health Product Tax. *Final report*, Budapest, November 2015.