BMJ

BMJ 2012;344:e2931 doi: 10.1136/bmj.e2931 (Published 15 May 2012)

ANALYSIS

Taxing unhealthy food and drinks to improve health

An increasing number of countries are introducing taxes on unhealthy food and drinks, but will they improve health? **Oliver Mytton**, **Dushy Clarke**, and **Mike Rayner** examine the evidence

Oliver T Mytton *academic clinical fellow*, Dushy Clarke *researcher*, Mike Rayner *director*

British Heart Foundation Health Promotion Research Group, Department of Public Health, University of Oxford, Oxford OX3 7LF, UK

In the past year Denmark has introduced a "fat tax," Hungary a "junk food tax," and France a tax on sweetened drinks.[1 2] Peru has announced plans to tax junk food, and other countries, notably Ireland, are also considering such taxes. Last year's UN high level summit on non-communicable disease recognised a role for food taxes,[3] and the UK prime minster, David Cameron has said the UK should consider them.[4]

Despite this recent interest among policy makers there has been relatively little critical analysis. Discussion of the evidence of health effects and the important question of what to tax has often been lacking. Government intervention in the food market, in the form of agricultural subsidies and taxation that is unrelated to health, is often overlooked.

The terms used in the debate can be unclear and misleading. A fat tax may refer to a tax on fat, saturated fat, or the dietary causes of obesity. We prefer the broader term: health related food taxes, which includes any tax levied at a higher rate on food items that are considered unhealthy. This suggests a focus on overall health, rather than just obesity, and opens up the possibility of targeting different nutrients or parts of the diet to maximise overall health gains. As the burden of diet related disease (cancer, cardiovascular disease, type 2 diabetes, and dental caries) is large and greater than that attributed solely to obesity,[5] this seems a more pragmatic approach.

Present taxes

The Hungarian and Danish health related food taxes are often held up as the first of a kind. While they are unusual in being explicit about their health aims, similar taxes can be found in other parts of the world (table 1⇓). Most of these other taxes are either goods and services taxes, levied principally on unhealthy food items, or small excise taxes levied on sugar sweetened beverages. Other countries have proposed introducing health related food taxes.[6 7]

Rationale

Price is an important determinant of food choices and diet.[8] Economic theory predicts that as the price of an item rises the consumption of that item will typically fall. Increasing the price of unhealthy foods, by taxation, should reduce consumption of the taxed foods. Observational data suggest that food consumption is relatively insensitive to price changes, the proportional change in consumption being less than the proportional change in price.[9-12] Moreover, when the price of one good rises, consumption of some goods that are co-consumed will fall and consumption of other goods (substitutes) rise. How much consumption changes in response to price is described by price elasticity values—that is, the percentage change in consumption for a one percentage change in price. The balance of these overall effects, as well as the health benefit of food items, will determine the overall health effect of any health related food tax.

Economists generally agree that government intervention, including taxation, is justified when the market fails to provide the optimum amount of a good for society's wellbeing. The argument has been applied for alcohol and tobacco. Suggested market failures for food include a failure to appreciate the true association between diet and disease, time inconsistency (preference for short term gratification over long term wellbeing), and not bearing the full health and social costs of consumption.[13]

Evidence of effectiveness

Evidence on the effectiveness of health related food taxes comes from three sources: natural experiments, controlled trials of price changes in closed environments, and modelling studies.

Correspondence to: O T Mytton oliver.mytton@dph.ox.ac.uk

Extra material supplied by the author (see http://www.bmj.com/content/344/bmj.e2931?tab=related#webextra)

Summary of controlled trials of price rises on food
Summary and comparison of modelling evidence of a saturated fat tax

Natural experiments

Natural experiments may provide the most convincing evidence of effect, but it can be difficult to tease apart the effects of other factors on any observed changes.[14] Only two studies have explicitly examined the health effects of actual food taxes. Both are from the US, where many states have introduced small taxes on sweetened drinks.[15 16] While neither study found a significant association between taxes and the prevalence of obesity at a state level, the taxation level, at 1-8%, may have been too low to observe an effect on population health.[17] A study of soft drinks taxation in Ireland, in place during the 1980s, found an 11% decrease in consumption for each 10% increase in price but did not examine health effects.[18]

A systematic review of the association between food price and population weight found weak evidence of an inverse association. It concluded that small price changes (from taxes or subsidies) were not likely to produce significant changes in obesity prevalence but that larger changes might.[19] Effects were greater for the young, poor, and those most at risk of being overweight.

Controlled trials

Randomised controlled trials are the preferred research design for studies of effectiveness, although they have limitations in assessing some public health interventions.[14] Several experiments have manipulated price in closed or simulated environments.[20] The results suggest that taxation of unhealthy food items is an effective means of reducing consumption of these foods (supplementary web table).[20] For example a 35% tax on sugar sweetened drinks ($0.45 (£0.28; €0.34) per drink) in a canteen led to a 26% decline in sales.[21] However, compensatory behaviour might occur away from the study environment—for example, the consumption of more drinks away from the canteen. It is also unclear how well simulated environments where artificial constraints, fixed budgets, and restricted choices are imposed on subjects predict actual life choices.[20]

Modelling studies

Most published work on the dietary or health effects of health related food taxes has used modelling.[22] This reflects the limited use of these taxes. The modelling studies use economic data (price elasticity measures) to estimate how price changes will affect consumption and diet. Some of these studies extend changes in diet to estimate the effect on health, based on the relationship between diet and health.

Particular interest has focused on sugar sweetened drinks because of their strong association with obesity and diabetes.[23] US studies predict a daily reduction in energy consumption of 29-209 kJ per person for a 20% tax (table 2⇓), the lower values coming from studies that considered only home consumption.[24 25]

Estimating the impact of these changes on weight and health requires an understanding of how any reduction in total energy consumed translates to weight loss. Newer techniques for modelling the effect of energy intake on weight show good agreement with empirical data. These techniques predict that a 20% tax on sugary drinks in the US would reduce the prevalence of obesity by 3.5%.[17 29] This rate is much higher than any of the taxes currently imposed by individual states.

The effect of a similar tax in the UK would be less than in the US, equivalent to around 12-29 kJ per person per day,[27] reflecting the lower consumption of sugar sweetened drinks. However, mean changes in the population will hide larger reductions in regular consumers, who are at greater risk of developing obesity and diabetes.

Studies that have examined taxes on other foods present a more complicated picture (table 3⇓). This reflects differences in taxation scenarios, datasets used, and health outcomes assessed. The studies suggest that the changes in food purchasing are small relative to the taxes introduced, both because food consumption is relatively inelastic and because of cross-price elasticity effects, whereby untaxed or cheaper foods are substituted for taxed foods, reducing the effect on nutrient intake. However, small changes in diet can lead to meaningful changes in important risk factors across the whole population, resulting in substantial health benefits.[30] The 1-3% reduction in incidence of ischaemic heart disease predicted by several studies modelling the effect of extending value added tax (at 17.5%) to unhealthy foods in the UK,[31-34] equates to 900-2700 fewer deaths a year. Some of these studies have also flagged important considerations for policy makers—taxing one nutrient (such as saturated fat) may have negative effects on consumption of other nutrients (such as salt or fibre).[31 32 35] The overall impact on health depends on the balance of these changes and could be negative.[31 32] Nutrient based taxes also seem to be more effective than food based taxes.

Despite recent advances, modelling the effects of diet on health is relatively new.[36] Its accuracy is limited by the quality of dietary, health, and economic data. There are concerns about how well the economic data, based on small weekly fluctuations in price, will predict the consumption changes that would result from sustained price changes due to taxation.[22] Other compensatory behaviour that might increase energy intake or reduce energy expenditure are not well captured in most models. Assumptions have to be made about how food purchases map to food consumption. Understanding the overall effect on health is complicated and depends on mapping the effect of multiple nutrient changes, including energy intake, to multiple health outcomes. However, modelling does highlight some of the key considerations surrounding these taxes.

Impact on the poor

Health related food taxes are regressive—that is, poor people pay a greater proportion of their income in tax than do the rich.[40] However the health gains may be progressive,[35 41] and, as is found with many population-wide health interventions, health inequalities may consequently narrow.[42] Progressive health gains are expected because poor people consume less healthy food and have a higher incidence of most diet related diseases, notably cardiovascular disease.[43] Consequently the absolute reduction in disease incidence would be greater among poorer groups, assuming similar dietary changes. Moreover there is some evidence that those who are poorer are more sensitive to price changes and so would experience greater dietary improvements.[19 35]

Acceptability and feasibility

Views on the acceptability of health related food taxes vary widely.[44 45] Opinion polls from the US put support for sugared beverage taxes at 37% to 72%, support being greater when the health benefits of the tax are emphasised.[14] These polls pre-date the era in which rising food prices and falling real incomes have raised concerns about food poverty.[46] None of this work has addressed the question of an acceptable level of taxation. Initially, cigarette taxes were low and gradually increased as public opinion changed.[19]

The food industry argues that the taxes would be ineffective, unfair, and would damage the industry leading to job losses.[47 48] Similar arguments were used by the tobacco industry against tobacco taxes.[49]

From a legislative point of view, it is still unclear how such taxes are best introduced and enforced. Should the tax be levied on the raw ingredients or on the final product? Should all sweetened drinks be taxed, as in France, or just sugar sweetened? How much sugar needs to be added before the drink is taxed?

Other approaches

While we have focused on the ability of taxes to change individual behaviour to improve health, others have advocated that the taxes be used to raise funds to treat diet related diseases, subsidise healthy foods, or to stimulate industry reformulation of food (such as removal of salt, sugar, or saturated fats from foods). Subsidies on healthy foods may alleviate the regressive nature of food taxes[32] as well as maximise the health gains.[22] Redesign of fishing and agricultural subsidies, to promote the health of consumers and environmental sustainability, has also been advocated. Such redesign will be challenging and could happen in parallel with the introduction of health related food taxes.

Conclusion

Health related food taxes could improve health. Existing evidence suggests that taxes are likely to shift consumption in the desired direction, although policy makers need to be wary of changes in other important nutrients. However, the tax would need to be at least 20% to have a significant effect on population health.

We thank Kelechi Nnoaham, Pete Scarborough and the *BMJ* reviewers for their critical review of the manuscript, and Roberta Friedman for advice on compilation of table 1.

Contributors and sources: MR has advised on nutrition policy at national, European, and international level, particularly around nutrient profiling, marketing of unhealthy foods and health related food taxes. OTM is a previous clinical adviser to the chief medical officer for England. He has modelled the effects of different health-related food taxes in the UK. This article arose from discussions between the three authors and from work that DC undertook for the National Heart Forum. OTM researched and wrote the article. DC undertook much of the preparatory work and produced the first draft. MR oversaw the work and critiqued the manuscript.

Competing interests: All authors have completed the ICJME unified disclosure form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that DC was funded by the National Heart Forum to undertake a review of literature on health related food taxes. They have no financial relationships with any organisations that might have had an interest in the submitted work in the previous three years and no other relationships or activities that could appear to have influenced the submitted work.

Provenance and peer review: Not commissioned; externally peer reviewed.

1 Villanueva T. European Nations launch tax attack on unhealthy foods. *CMAJ* 2011;183:E1229-30.
2 Holt E. Hungary to introduce broad range of fat taxes. *Lancet* 2011;378:75.
3 United Nations. Prevention and control of non-communicable diseases. A/66/83. United Nations, 2011.
4 Buck D. Obesity and public health—a taxing issue. 29 November 2011. http://blogs.bmj.com/bmj/2011/11/29/david-buck-obesity-and-public-health-%E2%80%93-a-taxing-issue.
5 Scarborough P, Bhatnagar P, Wickramasinghe KK, Allender S, Foster C, Rayner M. The economic burden of ill health due to diet, physical inactivity, smoking, alcohol and obesity in the UK: an update to 2006-07 NHS costs. *J Public Health* 2011:33:527-35.
6 Holt E. Romania mulls over fast food tax. *Lancet* 2010;375:1070.
7 Adamy J. Soda tax weighed to pay for healthcare reform. *Wall Street Journal* 2009 May 12. http://online.wsj.com/article/SB124208505896608647.html.
8 World Health Organization. Global strategy on diet, physical activity and health. WHO, 2004.
9 Tiffin R, Arnoult M. The demand for a healthy diet: estimating the almost ideal demand system with infrequency of purchase. *Eur Rev Agricultural Econ* 2010;37:501-21.
10 Kuchler F, Tegene A, Harris JM. Taxing snack foods: manipulating diet quality or financing information programs? *Rev Agricultural Econ* 2005;27:4-20.
11 Chouinard H, Davis D, LaFrance J, Perloff J. Fat taxes: big money for small change. *Forum Health Econ Policy* 2007;10:1-28.
12 Andreyeva T, Long MW, Brownell KD. The impact of food prices on consumption: a systematic review of research on the price elasticity of demand for food. *Am J Public Health* 2010;100:216-22.
13 Brownell KD, Farley T, Willett WC, Popkin BM, Chalopuka FJ, Thompson JW, et al. The public health and economic benefits of taxing sugar-sweetened beverages. *N Engl J Med* 2009;361:1599-605.
14 Medical Research Council. Using natural experiments to evaluate population health interventions: guidance for producers and users of evidence. MRC, 2011.
15 Kim D, Kawachi I. Food taxation and pricing strategies to "thin out" the obesity epidemic. *Am J Prev Med* 2006;30:430-7.
16 Powell LM, Chriqui J, Chaloupka FJ. Associations between state-level soda taxes and adolescent body mass index. *J Adolesc Health* 2009;45:S57-63.
17 Lin BH, Smith TA, Lee JY, Hall KD. Measuring weight outcomes for obesity intervention strategies: the case of a sugar-sweetened beverage tax. *Econ Hum Biol* 2011;9:329-41.
18 Bahl R, Bird R, Walker MB. The uneasy case against discriminatory excise taxation: soft drink taxes in Ireland. *Public Finance Rev* 2003;31:510.
19 Powell LM, Chaloupka FJ. Food prices and obesity: evidence and policy implications of taxes and subsidies. *Millbank Q* 2009;87:229-57.
20 Epstein LH, Jankowiak N, Nederkoorn C, Raynor HA, French SA, Finkelstein E. Experimental research on the relation between food price changes and food-purchasing patterns: a targeted review. *Am J Clin Nutr* 2012;95:789-809.
21 Block JP, Chandra A, McManus KD, Willett WC. Point-of-purchase price and education intervention to reduce consumption of sugary soft drinks. *Am J Public Health* 2010;100:1427-33.
22 Thow AM, Jan S, Leeder S, Swinburn B. The effect of fiscal policy on diet, obesity and chronic disease: a systematic review. *Bull World Health Organ* 2010;88:609-14.
23 Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr* 2006;84:274-88.
24 Finkelstein EA, Zhen C, Nonnemaker J, Todd JE. Impact of targeted beverage taxes on higher- and lower-income households. *Arch Intern Med* 2010;170:2028-34.
25 Dharmasena S, Capps O. Intended and unintended consequences of a proposed national tax on sugar-sweetened beverages to combat the US obesity problem. *Health Econ* 2011;21:669-94.
26 Andreyeva T, Chaloupka FJ, Brownell KD. Estimating the potential of taxes on sugar-sweetened beverages to reduce consumption and generate revenue. *Prev Med* 2011;52:413-6.
27 Ng SW, Mhurchu CN, Jebb SA, Popkin BM. Patterns and trends of beverage consumption among children and adults in Great Britain, 1986-2009. *Br J Nutr* 2011;20:1-16.
28 Schroeter C, Lusk J, Tyner W. Determining the impact of food price and income changes on body weight. *J Health Economics* 2008;27:45-68.
29 Hall KD, Sacks G, Chandramohan D, Chow CC, Wany YC, Gormaker LG, et al. Quantification of the effect of energy imbalance on bodyweight. *Lancet* 2011;378:826-37.
30 Rose G. The strategy of preventive medicine. Oxford University Press, 1992.
31 Mytton O, Gray A, Rayner M, Rutter H. Could targeted food taxes improve health? *J Epidemiol Community Health* 2007;61:689-94.
32 Nnoaham K, Sacks G, Rayner M, Mytton O, Gray A. Modelling income group differences in the health and economic impacts of targeted food taxes and subsidies. *Int J Epidemiol* 2009:38;1324-33.
33 Marshall T. Exploring a fiscal food policy: the case of diet and ischaemic heart disease. *BMJ* 2000;320:301-4.
34 Tiffin R, Arnoult M. The public health impacts of a fat tax. *Eur J Clin Nutr* 2011;65:427-33.
35 Smed S, Jensen JD, Denver S. Socio-economic characteristics and the effect of taxation as a health policy instrument. *Food Policy* 2007;32:624-39.
36 Scarborough P, Morgan RD, Webster P, Rayner M. Differences in coronary heart disease, stroke and cancer mortality rates between England, Wales, Scotland and Northern Ireland: the role of diet and nutrition. *BMJ Open* 2011;1:e000263.
37 Kuchler F, Tegene A, Harris JM. Taxing snack foods: what to expect for diet and tax revenues. *Curr Iss Econ Food Markets* 2004;707:1-11.
38 Jensen JD, Smed S. Cost-effective design of economic instruments in nutrition policy. *Int J Behav Nutr Phys Act* 2007;4:4-10.
39 Sacks G, Veerman JL, Moodie M, Swinburn B. Traffic-light nutrition labelling and junk-food tax: a modelled comparison of cost-effectiveness for obesity prevention. *Int J Obes (Lond)* 2011;35:1001-9.
40 Crawford I, Leicester A, Windmeijer F. The "fat tax." Institute of Fiscal Studies, 2004.
41 Brownell KD, Frieden TR. Ounces of prevention—the public policy case for taxes on sugared beverages. *N Engl J Med* 2009;360:1805-8.
42 Capewell S, Graham H. Will cardiovascular disease prevention widen health inequalities? *PLoS Med* 2010:7:e1000320.
43 Scarborough P, Bhatanagar P, Wickramasinghe K, Smolina K, Mitchell C, Scarborough P. Coronary heart disease statistics: 2010 edition. British Heart Foundation, 2010.
44 Clark R. Why a fat tax is the best way to save the NHS billions. *Daily Mail* 2011 Oct 5. www.dailymail.co.uk/debate/article-2044855/Why-fat-tax-best-way-save-NHS-billions.html.
45 Street-Porter J. The jaffa cake doughnuts that prove a fat tax will never work. *Daily Mail* 2011 Oct 10. www.dailymail.co.uk/femail/article-2047233/Obesity-UK-The-Jaffa-Cake-doughnuts-prove-fat-tax-work.html.
46 Lock K, Stuckler D, Charlesworth K, McKee M. Potential causes and health effects of rising global food prices. *BMJ* 2009;339:b2403.
47 Colombini D. Fat tax could "cripple" UK manufacturers. *Food Manufacture* 2011 Nov 25. www.foodmanufacture.co.uk/Business-News/Fat-tax-could-cripple-UK-manufacturers.
48 Food Drink Europe. Additional discriminatory food taxes hit poorest consumers most in current tough economic climate. *Food Drink Europe* 2011 Nov 30. www.fooddrinkeurope.eu/news/statement/additional-discriminatory-food-taxes-hit-poorest-consumers-most-in-current.

Key to a successful health related food tax

- Taxing a wide range of unhealthy foods or nutrients is likely to result in greater health benefits than would accrue from narrow taxes; although the strongest evidence base is for a tax on sugar sweetened beverages
- Taxation needs to be at least 20% to have a significant effect on obesity and cardiovascular disease
- Taxes on unhealthy foods should ideally be combined with subsidies on healthy foods such as fruit and vegetables

49 Gilmore A, Savell E, Collin J. Public health, corporations and the new responsibility deal: promoting partnerships with vectors of disease? *J Public Health* 2011;33:2-4.

Accepted: 2 April 2012

Cite this as: *BMJ* 2012;344:e2931

Tables

Table 1| Examples of health related food taxes

Country	Date introduced	Foods taxed	Tax rate
US	Various	Sugar sweetened drinks (in 23 states)	1- 8%
Norway	1981	Sugar, chocolate, and sugary drinks	Variable
Samoa	1984	Soft drinks	0.40 tala/L (£0.11; €0.14 $0.18)
Australia	2000	Soft drinks, confectionary, biscuits, and bakery products	10%
French Polynesia	2002	Sweetened drinks, confectionary, and ice cream	60 franc/L (£0.41; €0.55; $0.66) for imported drinks
Fiji	2006	Soft drinks	5% on imported drinks
Nauru	2007	Sugar, confectionary, carbonated drinks, cordial, and flavoured milks	30% import levy
Finland	2011	Soft drinks and confectionary	Soft drinks €0.075/L (£0.06; $0.10); confectionary €0.75/kg
Hungary	2011	Foods high in sugar, fat, or salt and sugary drinks	10 forint (£0.03; €0.04; $0.05) per item
Denmark	2011	Products with more than 2.3% of saturated fat: meat, dairy products, animal fats, and oils	Kr16/kg (£1.76; €2.15; $2.84) of saturated fat
France	2012	Drinks containing added sugar or sweetener	€072/L

Table 2| Summary of work modelling effects of taxes on sugar sweetened beverage

Study	Setting	Proposed tax	Outcome	Change (per person)	Comments
Ng[27]	UK	10 or 20% tax	Volume purchased	Consumption reduced by 53 and 104 mL a week	Found limited substitution with "diet" or other drinks
Lin[17]	US	20% sales tax	Energy intake	Reduction of 142-196 kJ among adults and 167-213 kJ among children per day	Consumption both at and away from home included
Andreyeva[26]	US	1 cent/ounce tax (~20% increase)	Energy intake	Reduction of 188-209 kJ per day	Assumed no substitution with other drinks
Dharmasena[25]	US	20% tax	Energy intake	Reduction of 63 kJ per day	Only considered consumption at home
Finkelstein[24]	US	20 or 40% tax	Energy intake	Reductions of 29 and 52 kJ per day	Only considered consumption at home; poorest and richest reduced their consumption the least
Schroeter[28]	US	10% tax	Weight	Loss of 0.086 kg for an average man and 0.091 kg for an average woman	Weight changes based on the 3500 kcal = 1 pound rule

Based on peer review articles from the Thow et al systematic review[22] updated and combined with the Yale Rudd Centre study synopses (www.yaleruddcenter.org/resources/upload/docs/what/policy/SSBtaxes/SSBStudies_Taxes.pdf).

Table 3| Summary of work modelling the effects of health related food taxes on food consumption22

Author	Setting	Proposed tax(es)	Outcome	Results	Key limitations
Effect on consumption					
Kuchler[37]	US	Tax on salty foods at 0.4-30%	Energy intake	Reduction of 117-43 500 kJ per year (predicted weight loss of 0.01-6.6 kg*)	Economic data based on estimates not empirical data
Kuchler[10]	US	Tax at 1%, 10%, and 20%; on potato crisps, all crisps, or all salty snacks	Energy intake	Reduction of 176-3470 kJ per year (predicted weight loss up to 0.5 kg*)	Not adequately accounted for substitution effects
Smed[35]	Denmark	Taxes on fatty meats, butter, and cheese at 5%; saturated fat at Kr7.9/kg; sugar at Kr10.3/kg	Nutrient intake	Decreases in saturated fat 1% to 9% and sugar 0-22%, but also up to 7% decrease in fibre; lower socioeconomic groups and younger people see greater dietary change	Absolute changes in saturated fat may be poor indicator of health gains; a better indicator is saturated fat as proportion of total energy
Jensen[38]	Denmark	Tax on (i) total fat at Kr8/kg; (ii) saturated fat at Kr14/kg; or (iii) sugar Kr5.6/kg	Nutrient intake	The effect of the different taxes on saturated fat was (i) −7.2%, (ii)−7.2%, (iii) 1.4%; effect on sugar was (i) 6.4%, (ii) 6.4%, and (iii)−15.8%	Absolute changes in saturated fat may be poor indicator of health gains; a better indicator is saturated fat as proportion of total energy
Chouinard[11]	US	Tax on fat at 10% or 50%	Fat consumption	Fat intake falls by 1% and 3% respectively	Not considered impact of changes in other nutrients
Health effects					
Marshall[33]	UK	Extension of VAT at 17.5% to foods high in saturated fat	Ischaemic heart disease	1800-2500 deaths averted annually	Only considered effects of dietary fat; economic data based on estimates not empirical data
Mytton[31]	UK	VAT at 17.5% on: (i) foods high in saturated fat; (ii) “unhealthy” foods	Cardiovascular disease	Annual change in deaths: (i) 2500-3500 additional deaths (ii) 2100-2500 deaths averted	Effect of reduced fruit and vegetable consumption on other diseases, like cancer, was not quantified
Schroeter[28]	US	A 10% tax on food bought away from home	Weight	Increase in mean body weight*: 0.17 kg male, and 0.15 kg female	Not considered other effects of dietary change
Nnoaham[32]	UK	VAT at 17.5% on: (i) foods high in saturated fat; (ii) “unhealthy foods”; (iii) “unhealthy foods” with subsidy	Cancer and cardiovascular disease	Annual change in deaths: (i) 1100-2300 additional deaths (ii) 0-1300 additional deaths (iii) 1600-6400 deaths averted	Analysis based on old economic data; not fully considered benefits from reduced body mass index
Sacks[39]	Australia	10% tax on unhealthy foods	Cancer and cardiovascular disease	560 000 DALYS averted (because of energy reduction of 121-176 kJ and fall in mean body mass index of 0.6)	Not considered effect of specific nutrients (salt, saturated fat) and fruit and vegetables
Tiffin[34]	UK	1% for every 1% of saturated fat in food with subsidy on fruit and vegetables	Cancer and cardiovascular disease	2-3% reduction in coronary heart disease; 2% for stroke; 3% lung cancer; 5% gastric cancer	Not considered the combined effect of different dietary changes on health

Kr1=£0.11; €0.13; $0.18. DALYS = disability adjusted life years.

*Weight loss estimates based on old rule of thumb that 3500 kcal reduction equates to one pound of weight lost.