ClinicoEconomics and Outcomes Research

Dovepress
open access to scientific and medical research

Open Access Full Text Article

REVIEW

A systematic review of the effectiveness of taxes on nonalcoholic beverages and high-in-fat foods as a means to prevent obesity trends

This article was published in the following Dove Press journal:
ClinicoEconomics and Outcomes Research
18 October 2013
Number of times this article has been viewed

Nikolaos Maniadakis[1]
Vasiliki Kapaki[1,2]
Louiza Damianidi[3]
Georgia Kourlaba[4]

[1]Department of Health Services Organization and Management, National School of Public Health, Athens, [2]University of Peloponnese, Peloponnese, [3]Department of Allergy, Second Pediatric Clinic, National and Kapodistrian University of Athens School of Medicine, Athens, [4]The Stavros Niarchos Foundation – Collaborative Center for Clinical Epidemiology and Outcomes Research (CLEO), First and Second Departments of Pediatrics, National and Kapodistrian University of Athens School of Medicine, Athens, Greece

Background: As part of the efforts to curb obesity, a new focus seems to be put on taxing foods that are perceived as being associated with obesity (eg, sugar-sweetened beverages and foods high in fat, sugar, and salt content) as a policy instrument to promote healthier diets.

Objective: To assess the possible effects of such taxation policies by identifying and analyzing all studies which investigate the impact of price increases on consumption, caloric intake, or weight outcomes.

Methods: Electronic data bases were searched with appropriate terms and their combinations. Thereafter, abstracts were reviewed and studies were selected based on predefined criteria. The characteristics of the selected studies and the results were extracted in a special form and consequently were reviewed and synthesized.

Results: Price increase may lead to a reduction in consumption of the targeted products, but the subsequent effect on caloric intake may be much smaller. Only a limited number of the identified studies reported weight outcomes, most of which are either insignificant or very small in magnitude to make any improvement in public health.

Conclusion: The effectiveness of a taxation policy to curb obesity is doubtful and available evidence in most studies is not very straightforward due to the multiple complexities in consumer behavior and the underling substitution effects. There is need to investigate in-depth the potential underlying mechanisms and the relationship between price-increase policies, obesity, and public health outcomes.

Keywords: price, fat tax, sugar-sweetened beverages, calorie(s), elasticity, weight, body mass index

Introduction

Obesity prevalence is increasing worldwide, affecting both developed and developing countries. The prevalence of overweight and obese adults was estimated at 1.5 billion globally in 2008 by the World Health Organization, and this figure is projected to reach 2.3 billion by 2015.[1] There is accumulated scientific evidence indicating that obesity is strongly related to a vast number of diseases, including hypertension, hypercholesterolemia, type 2 diabetes mellitus, respiratory conditions, arthritis, and certain types of cancer. Moreover, obesity reduces the quality of life of individuals.[2]

Along with morbidity and mortality, obesity also imposes a great economic burden upon society, which stems from the resources expended in the health care system to manage it, the expenditures incurred by sufferers and their families to cope with its consequences, and also the lost production caused by informal care, premature death, and inability to work.[2] Several studies in European countries estimate the health

Correspondence: Nikolaos Maniadakis
Department of Health Services Organization and Management, National School of Public Health, 196 Alexandras Avenue, Athens 115 21, Greece
Tel +30 213 201 0194
Fax +30 210 643 3980
Email nmaniadakis@esdy.edu.gr

care-related costs of obesity at 1.7%–3.0% of total health expenditure,[3] while in the USA, it has been estimated that obesity accounts for almost 5%–10% of the total health care expenditure.[4] At the individual level, studies indicate that an obese person incurs health care expenditures at least 25% higher than those of a normal-weight person.[5,6] On the other hand, indirect cost, ie, increased production as a result of a health condition, is also significant. Notably, employers in some countries often pay higher insurance premiums for employees who are obese in comparison to employees who are not.[7] In this context, some studies have also shown that obesity is associated with lower wages and lower household income.[8,9] In this light, obesity constitutes a growing public health problem and concern throughout the world. Therefore, strategies aiming to prevent obesity are of paramount importance for both health and economic reasons.

Several factors have been linked to obesity, including socioeconomic, environmental, behavioral, and genetic. Total energy intake increase in conjunction with physical activity decrease has been indicated as a contributor to the obesity trend.[10] In this context, it has been argued that overconsumption of sugar-sweetened beverages (SSBs) and high-in-fat, salt, and sugar foods (HFSSFs) may be associated with excess caloric intake and eventually increases in body weight.[11,12] Thus, some authors suggest that mediating consumption of SSBs and HFSSFs in populations that exhibit relatively excess consumption rates could prove an effective intervention in reducing subsequently obesity rates.[10] In this context, taxes on HFSSFs and SSBs, often called "fat or sugar taxes," have been introduced or are being considered in several countries as a means to regulate the consumption of these products and eventually to curb obesity, to trim health care costs, to raise revenue, and ultimately improve public health.[13] On the other hand, a number of countries have abandoned the policy route of taxing foods either by abolishing existing taxes, eg, Denmark and the Netherlands, or by shelving respective ideas, eg, Italy.[14]

In any case, such taxes have provoked considerable controversy among the various stakeholders: the government, academic, scientific, health, and medical communities, consumers and their associations, and the food industry. Based on economic theory, the main rationale underpinning the adoption of such policies is that a tax and price increase on the targeted products may avert consumers from their consumption and divert them to healthier alternatives, and in this way there may be improvements in diet quality, weight status, and health outcomes in the long-term. Supporters of the fat taxation often also emphasize its signaling power to the food industry and consumers and its efficiency in raising revenue.[15]

On the other hand, opponents of such taxes argue that there are many factors which make such policies ineffective and even detrimental in certain circumstances.[16] Firstly, interventions of these kinds of taxes/policies represent a violation of consumer sovereignty, ie, the freedom of individuals to choose freely for themselves in order to satisfy their needs. Regardless, it is difficult to attain the desired results because consumer behavior is complex and multifactorial and there are notable substitution effects which make the reduction in total energy intake by specific taxes unattainable. Taxes are also regressive in nature and the burden is proportionally higher on lower-income households, which generates significant equity concerns. Also, the approach presumes well-informed and price-sensitive consumers, which is not always the case, and hence there is a market failure that makes the specific policy ineffective. Therefore, many commentators argue that the aim of improving public health is unquestionably important, but taxes may not be the most appropriate policy measure to attain it.[13]

Hence, given the controversy around this issue, a systematic review was undertaken to synthesize the results of original studies examining the possible impact of tax policies and price increases upon the consumption of SSBs and HFSSFs and eventually upon caloric intake, weight, and outcomes in order to provide useful insights for decision makers and other stakeholders nationally and internationally.

Methods

Search strategy

Research papers were identified through web-based searches in PubMed, Web of Science, Cochrane Library, AgEcon, EconLit, and the National Agricultural Library databases and searches in other potentially relevant internet sources such as Google®. Searching in the aforementioned bibliographical databases was conducted in the title and abstract on grounds of all potential combinations of three groups of terms presented in Figure 1. The reference lists of all relevant papers originally selected for inclusion in the review and relevant reviews were also searched manually to identify potentially relevant articles which were not identified by the original electronic search. The search spanned from 1990 to February 2013. The stated aim of this fiscal measure was not only to offset this price imbalance but also – as is often the case with excise taxation – to raise revenue, in particular to collect resources to be invested in nutrition programs.[17,18]

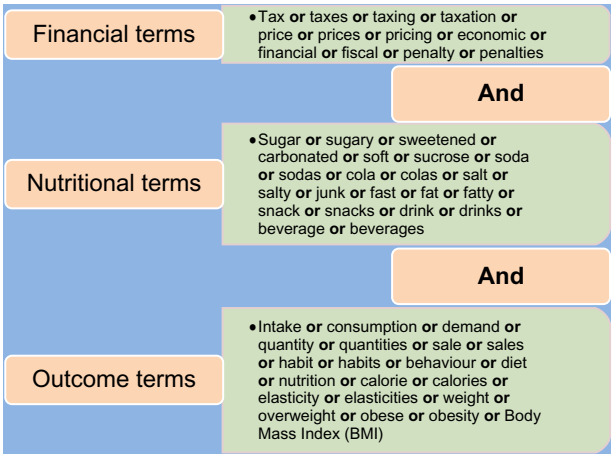

Figure 1 Search terms utilized.

Study selection and data extraction

Following the literature search, identified studies were checked to exclude duplicates. The remaining articles were independently screened by two researchers to identify studies that met the predetermined inclusion criteria. Original studies including the four types of primary research methods – existing data, experiments, surveys, and observation – that focused on the association between SSBs and HFSSFs prices and taxes and their corresponding consumption or energy intake or obesity-related outcomes were included in the present systematic review. On the other hand, systematic reviews, meta-analyses, qualitative studies, case studies, case reports, and letters to the editor were excluded. Moreover, only studies published in English with available full text and studies concerning human subjects were included.

The studies were selected following specific methodologically driven steps. Firstly, all identified studies were imported electronically into EndNote® bibliographic database (Thomson Reuters, New York, NY, USA) and were evaluated on the basis of titles and/or abstracts against the prespecified eligibility criteria. A check for double entries among the selected studies was made to ensure that the list contained unique studies for review. Subsequently, study abstracts and titles were reviewed and those which were deemed irrelevant were excluded and reasons for exclusion were noted. Obviously, rejected studies were those clearly not relevant to the subject of investigation. Whenever the information provided in titles/abstracts was insufficient to reach a clear decision on inclusion or exclusion or when the titles/abstracts indicated that studies met the inclusion criteria, the full papers were retrieved to be further screened. In cases where the information reported in the full text continued to be insufficient to make a decision about inclusion, studies were excluded. Then, essential details and data of studies meeting the inclusion criteria were extracted by two researchers into a spreadsheet and were classified according to their design – demand modeling, cross-sectional, longitudinal, mathematical modeling, cohort retrospective, and experimental. The overall study selection process was also documented through a flow chart showing the number of studies/papers remaining at each stage, although a screening process to identify articles using the studies bibliography had been done. The review was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria.

Results

The initial literature review identified 3,700 citations for screening. Of these, 3,250 were excluded on the basis of title/abstract and 395 after screening the full paper. Subsequently, a total of 55 were finally included in the review (Figure 2).

In terms of geographical location, most of the studies were conducted in the USA (n = 40) and the remaining in the UK (n = 2), Norway, Italy (n = 2), Denmark, Germany, France, the Netherlands, Mexico (n = 2), Brazil, Taiwan, Singapore, and Australia. In terms of methodologies utilized, there was significant variation in terms of the research designs applied. In particular, there were several demand studies (n = 22), followed by longitudinal studies (n = 11), cross-sectional studies (n = 11), modeling studies (n = 6), experimental studies (n = 4), and cohort studies (n = 1). The majority of the studies were mainly focused on estimating price elasticity of demand (n = 30), others mainly focused on the effects of imposing certain taxation (n = 18), and the remaining studies considered both elements (n = 8). Health-related food taxes

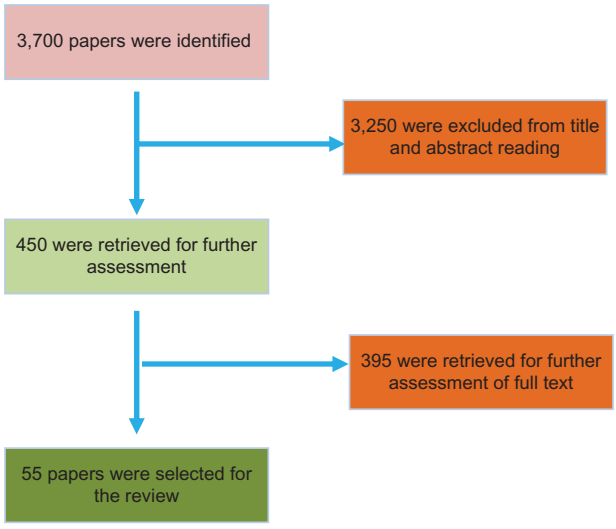

Figure 2 Flow chart of study selection.

were either considered as excise or sales taxes. In terms of the targeted products, about half (n = 28) of the studies focused on SSBs only and the remaining (n = 36) either on HFSSFs alone or on HFSSFs in conjunction with SSBs.

In terms of the main outcomes considered, about half of the studies (n = 24) were concerned mainly with the effects of various interventions upon the consumption of products and the remaining (n = 31) upon other outcomes such as energy intake and/or weight and/or body mass index (BMI). Notably, some studies reported results for all three outcomes of interest: energy intake, weight, and BMI.

The studies considered are presented in the Supplementary material. In particular, among the demand studies, nine presented the association between prices and taxes with the consumption of SSBs[19–27] and three with the consumption of HFSSFs.[28–30] These studies indicated that the price elasticity of demand for beverages is in the range of −0.5 to −1.6 depending on the beverage considered, with most of them falling below 1.0. This implies that the percentage changes in the quantities demanded were proportionally lower than the corresponding changes in prices. It should be noted that there was a lot of variation across the studies. There were also notable substitution effects detected between different products. The studies also pointed out that the negative effects on the consumption by price increases and taxes depend on factors such as the income group, and are more regressive towards the lowest income categories. Similar effects were found in the studies that focused on foods, also indicating a small or modest impact from price increase and taxes on the consumption of the targeted foods.

Moreover, six studies[28,29,31–34] and five studies[35–39] examined the association between beverage/food prices and taxes and energy and weight outcomes, respectively. These studies indicated that there is a very small impact of prices and taxes on energy intake and weight outcomes. These studies indicated that the caloric effect of a 10% increase in prices or a corresponding imposition of a tax reduces energy intake by a maximum of 50 calories per day, 450 per month, and up to 0.3 kilograms or 1.5 pounds per year, which cannot be considered significant. The specific studies also indicated the regressive nature of taxes and that their use is promoted mostly in order to generate revenue for the public purse.

Two studies assessed the effect of prices and taxes on the consumption of beverages and foods based on longitudinal studies.[40,41] These studies indicated that the price elasticity of demand for beverages and foods is in the range of −0.05 to −0.35 depending on the beverage and food considered. Notably, the figures reported are much lower than those reported in demand studies. The findings in this group of studies also indicated that there are negative effects on consumption in most cases, which are more significant in certain groups, eg, overweight.

All studies investigated the effect of beverages/food prices or taxes with possible outcomes. For two studies,[42,43] the outcome was energy intake, while for 16 studies,[35–50] weight outcomes were considered. Elasticities were low and in some cases not significant, and results were heterogeneous and dependent on income, weight, sex, and age group. Notwithstanding the above, these studies indicated that there is a modest and insignificant impact from price increases and taxes on energy intake, weight, and BMI, which makes the authors argue that any taxes would have to be quite large to generate any meaningful effect. These studies also highlighted the regressive nature of taxes and that their usefulness is to mostly generate revenue.

Barquera et al[51] and Claro et al[52] examined the effect of prices on beverages consumption; Sturm and Datar[53] examined the effect on food consumption only. However, elasticities on this occasion for beverages and foods were a bit contradictory. A Mexican and a Brazilian study derived elasticities for sodas to be about −1.0, indicating that soda consumption is elastic whilst other beverages are in the inelastic range. By contrast, a USA study indicated that the elasticity of fast foods and soda in students is inelastic and effects of prices are inconsistent and marginal.

Moreover, six cross-sectional studies[54–59] examined the association between prices and energy outcomes, while two other studies[60,61] examined the association between prices and weight outcomes. The majority of the studies concluded that taxes are having trivial or modest effects on weight outcomes. These studies also indicated the regressive nature of taxes and that their use is mostly to generate revenue.

Some of the studies included in the review conducted behavioral experiments in the Netherlands, Taiwan, Singapore, and the USA. Particularly, four studies[62–65] reported results on the effects of prices and taxes on the consumption and other outcomes of beverages and foods, respectively. Elasticities on this occasion between beverages and food were close to −1.0, ie, the association is in the elastic range. The effect on caloric intake and weight outcomes was higher in other studies, assumedly due to much higher taxes in the range of 35%–50%.

Finally, six of the 55 studies reviewed were modeling studies undertaken in the USA (n = 3), UK (n = 2), and Australia (n = 1). Two of them used cross-sectional data and the others were based on census data.

Discussion

The current study presents the results of a literature review undertaken to establish whether the available evidence supports use of fat taxes as a means to improve weight and health outcomes. The existing literature fails to draw consistent and undisputed evidence on the effectiveness of pricing and tax policies to reduce obesity rates. The heterogeneity observed in the findings of the included studies could be partially explained by the significant heterogeneity in policy settings and study designs employed to investigate the issue. It is evident that price and tax increases on beverages and fatty foods may reduce their consumption. However, there is controversy as to whether this also may result in meaningful reductions in caloric intake and weight. The studies that show some positive impact of economic policies also indicate that any potential reductions in weight are statistically insignificant to trigger desired effects. Moreover, elasticities indicate that significant weight outcome effects may be reached with very large tax rates, which would, however, exacerbate equity concerns related to their adverse implications for low-income groups.

At this point it should be noted that there are several important factors – obesity prevalence, consumption levels, behavioral patterns, and baseline tax rate – that should be considered within local contexts when contemplating the potential benefits of taxation.[66] When any of these factors shift, the potential impact of fat taxation becomes less certain and unpredictable. However, it is very difficult to estimate how a population would respond to a tax on certain foods.[67] Some consumers may respond by reducing their consumption of fruits and vegetables in order to pay for the more expensive HFSSFs, thus defeating the purpose of the tax. Others may seek substitutes for the taxed products, which may have similar or even higher fat, sugar, or salt content than the taxed products originally consumed. Thus, although there may be a decrease in the purchasing of the taxed food, consumers may end up consuming the same or even more calories from other substitute foods or drinks. This is in accordance with the findings of many studies in the literature.[57,68–72]

Moreover, to effectively apply policies to reduce consumption of high-calorie, high-fat, or high-carbohydrates foods, policy analysts need to disaggregate food-specific demand estimates according to socioeconomic status and assess the possible impacts of policy changes on food consumption and welfare outcomes at a more disaggregated level in addition to the total effects. This could be explained by the fact that the expenditure shared for food and consumption behaviors may differ significantly among different socioeconomic groups.[73] The Organization for Economic Co-operation and Development in 2010 reported that the impact of fiscal measures aiming to change behaviors may be unpredictable; because the price elasticity of demand varies across individuals and population groups, these measures can bear more heavily on low-income groups than on those with higher incomes, and substitution effects are not always obvious.[74] Further to considering the above, one needs to consider which products will be the targets of intervention.

Moreover, in regard to SSBs, the association between their consumption and overweight is a complex metabolic relationship and there are many behavioral and environmental factors that may be influencing beverage and food consumption and weight. Many of the food tax policies implemented are focusing on soft drinks as a number of influential reports assert that sugary drinks play a key role in the etiology of obesity. Contrary to this premise, a 2012 report from the National Center for Health Statistics, US Centers for Disease Control and Prevention examined data on consumption of added sugars among US children and adolescents and reported that added sugar from food (59%) was higher than sugar from beverages (41%).[75] Moreover, research published in 2010 from Queen Margaret University, Edinburgh, UK, shows that SSBs consumed in moderate quantities do not promote short-term weight gain, do not trigger additional carbohydrate intake, and do not generate changes in the moods of overweight women.[76] In 2007, there was a similar study performed on average-weight women and came out with similar conclusions.[77] Hence, evidence suggests that the hypothetic contribution of SSBs on weight gain perhaps has been overestimated.[78–80]

Moreover, broader taxes on HFSSFs would possibly allow less substitution than narrow taxes.[81] However, a concern with taxing a wide range of products would be the fact that people should be encouraged to consume a wide range of food and beverage products, eg, milk and olive oil, that would be difficult to include in the tax category.[81] Furthermore, in some cases, taxing many food groups could possibly lead to nutrient deficiencies, in which case economic policies may have harmful nutritional and health effects.[38,82]

Based on the above, there is no doubt that a public health approach to develop population-based strategies for the prevention of excess weight gain is of great importance.[83,84] Some effective strategies involve changes to personal, environmental, and socioeconomic factors associated with obesity. A proposed framework by Sacks et al[85] suggests that policy actions on the development and implementation of effective public health strategies on obesity prevention should (1) deal with the food environments, the physical activity environments, and the

broader socioeconomic environments; (2) directly influence behavior, aiming at improving eating and physical activity behaviors; and (3) support health services and clinical interventions. There are abundant examples of the effectiveness of such measures.[85–95] Lastly, a number of barriers to an effective obesity management program have been identified in the literature that policy makers need to be aware of in order to address them adequately.[96–107] However, the development and implementation of obesity prevention strategies should target those factors that can effectively control obesity.

For instance, in Greece it is proven that obesity is a growing health problem and concern. However, there is accumulating evidence indicating that SSBs may not be a determinant of obesity in Greece. For instance, a 2006 study examined energy intake, energy expenditure, diet composition, and obesity of adolescents in northern Greece, and showed that cola drink consumption did not significantly differ between overweight and non-overweight adolescents.[108] Additionally, in another recent study in children aged 10–12 years old, it was found that although Spain and Greece had the highest obesity rates among the European countries examined, they also had the lowest soft drink daily consumption.[109] It is important to note, however, that Greek children had lower physical activity levels and were reported to skip breakfast more often than their counterparts in other countries.[109] Finally, the European Prospective Investigation into Cancer and Nutrition (EPIC) study showed that Greek adults over 35 years have the lowest consumption of sugar among the European countries that participated in the research program. Additionally, in the same study, it was also shown that nonalcoholic and carbonated drinks contribute a minor percentage of total carbohydrate daily intake – indicatively 2.8% of total carbohydrate intake in men and 1.8% of total carbohydrate intake in women – and an even lower percentage of total energy daily intake.[110] The above data suggest that soft drink consumption may be a minor contributor to energy and carbohydrate intake in Greece in children, adolescents, and adults. The high obesity phenomenon in Greece is probably due to excess fat consumption in combination with lack of exercise. Therefore, targeting SSBs for obesity management or prevention in Greece is not an effective approach to curtailing obesity epidemic trends. Proper policies and interventions need to be designed based on the grounds of this local evidence.

The results of this review must be interpreted cautiously. First of all, in many studies, transformation of consumption figures to energy and weight outcomes was often based on extrapolation models, which require careful consideration. Caution must be directed to the model that is used to translate energy intake changes to weight changes. Using static weight models may provide quite different estimates in comparison to dynamic weight models. Static models generate a linear reduction in body weight over time, based on the assumption that every pound in weight reduction accounts for almost 3,500 calories, which is an assumption that has been challenged in the literature, and if not true undermines many findings. On the other hand, dynamic models account for the effects of weight loss by assuming changes in energy requirements due to weight reduction and fat and lean mass proportion, but they also involve various assumptions.[35] Secondly, when weight outcomes in certain studies are obtained directly and not through modeling, it is important to consider whether the measurements were obtained with objective assessments or were based on self-reporting.

Thirdly, in regards to the estimation of caloric intake effects, it is important to consider whether any potential changes are referring to energy intake related to the targeted product taxed or to the total energy intake in general. Due to the substitution effects, the total outcome is far more interesting from a policy perspective. Additionally, when total energy intake is considered, it is essential to clarify how it was estimated and whether possible substitution was taken into account as there are strong substitution dynamics between different foods. For instance, a soft drink tax may lead to reduction in calories due to consumption of soft drinks, but this reduction may be completely offset by the increase in the consumption of milk.[56]

Last but not least, in some studies, the populations investigated were not representative or adequately described and the studies have been undertaken in specific settings, which are difficult to extrapolate to European populations and policy environments in light of the fact that results are dependent on population behavioral aspects.

Conclusion

The systematic review of the literature demonstrated that the effect of price and tax increase upon the consumption of SSBs and HFSSFs and eventually upon caloric intake and obesity-related outcomes is controversial. To be more precise, there is strong evidence that such measures influence the consumption of SSBs and HFSSFs, but there is no significant effect on obesity-related outcomes, ie, weight, BMI, and obesity. Thus, more research is needed in this area to gain better insights on the use of economic policies aimed at addressing obesity trends, especially from a European perspective. Moreover, when considering environmental, socioeconomic, and genetic contributors to obesity, it is advisable that policies focus first on

cognitive behavioral changes and then on environmental factors. Such policies would create conscious people who are aware of the obesity problem and the main cause of weight gain, which is energy imbalance, and also its possible solutions, including encumbrances due to genetic or habitual factors.

Acknowledgment

This work was funded by Medical Consensus.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Obesity and overweight: fact sheet no 311 [webpage on the Internet]. Geneva: World Health Organization; 2012 [cited Nov 2012). Available from: http://www.who.int/mediacentre/factsheets/fs311/en/index.html. Accessed August 13, 2013.
2. Sassi F. *Obesity and the Economics of Prevention: Fit Not Fat*. Paris: OECD Publishing; 2010. Available from: http://www.oecd.org/els/health-systems/46044572.pdf. Accessed August 13, 2013.
3. Branca F, Nikogosian H, Lobstein T. *The Challenge of Obesity in the WHO European Region and the Strategies For Response*. Geneva: World Health Organization; 2007. Available from: http://www.euro.who.int/__data/assets/pdf_file/0008/98243/E89858.pdf. Accessed August 13, 2013.
4. Tsai AG, Williamson DF, Glick HA. Direct medical cost of overweight and obesity in the USA: a quantitative systematic review. *Obes Rev*. 2011;12(1):50–61.
5. Withrow D, Alter DA. The economic burden of obesity worldwide: a systematic review of the direct costs of obesity. *Obes Rev*. 2011; 12(2):131–141.
6. Cawley J, Meyerhoefer C. The medical care costs of obesity: an instrumental variables approach. *J Health Econ*. 2012;31(1):219–230.
7. Trogdon JG, Finkelstein EA, Hylands T, Dellea PS, Kamal-Bahl SJ. Indirect costs of obesity: a review of the current literature. *Obes Rev*. 2008;9(5):489–500.
8. Lehnert T, Sonntag D, Konnopka A, Reidel-Heller S, Konig H. Economic costs of overweight and obesity. *Best Pract Res Clin Endocrinol Metab*. 2013;27(2):105–115.
9. Hojgaard B, Olsen KR, Sogaard J, Sorenson TI, Gyrd-Hansen D. Economic costs of abdominal obesity. *Obes Facts*. 2008;1(3):146–154.
10. Malik VS, Willett WC, Hu FB. Global obesity: trends, risk factors, and policy implications. *Nat Rev Endocrinol*. 2013;9(1):13–27.
11. Vartanian LR, Schwartz MB, Brownell KD. Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. *Am J Public Health*. 2007;97(4):667–675.
12. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr*. 2006;84(2): 274–288.
13. Mytton OT, Clarke D, Rayner M. Taxing unhealthy food and drinks to improve health. *BMJ*. 2012;344:e2931.
14. Bomsdorf C. Denmark scraps much-aligned "fat tax" after a year. *The Wall Street Journal*. November 11, 2012;Sect A:12.
15. Leigh S. "Twinkie tax" worth a try in fight against obesity. *U S A Today*. December 2, 2004; Sect A:13.
16. Cash SB, Sunding DL, Zilberman D. Fat taxes and thin subsidies: prices, diet, and health outcomes. *Acta Agriculturae Scandinavica Section C – Food Economics*. 2005;2:167–174.
17. Brownell KD, Farley T, Willett WC, et al. The public health and economic benefits of taxing sugar-sweetened beverages. *N Engl J Med*. 2009;361(16):1599–1605.
18. Leicester A, Windmeijer F. *The "Fat Tax": Economic Incentives To Reduce Obesity (Briefing Note 49)*. London: The Institute for Fiscal Studies; 2004. Available from: http://eprints.ucl.ac.uk/14931/1/14931.pdf. Accessed August 13, 2013.
19. Brown GM. Impact of income on price and income responses in the differential demand system. *Journal of Agricultural and Applied Economics*. 2008;40(2):593–608.
20. Brown MG, Jauregui CE. *Conditional Demand System For Beverages*. Gainesville, FL: Florida Department of Citrus; 2011. Available from: http://ageconsearch.umn.edu/bitstream/104335/2/RP%202011-1.pdf. Accessed August 13, 2013.
21. Brown Mark G, Lee JY, Seale JL. Demand relationships among juice beverages: a differential demand system approach. *Journal of Agricultural and Applied Economics*. 1994;26(2):417–429.
22. Dharmasena S, Capps O Jr. Demand interrelationships of at home nonalcoholic beverage consumpion in the United States. Poster presented at: Agricultural and Applied Economics Association and American Council on Consumer Interests Joint Annual Meeting; July 28, 2009; Milwaukee, WI.
23. Dharmasena S, Capps O Jr. On taxing sugar-sweetened beverages to combat the obesity problem. Poster presented at: Agricultural and Applied Economics Association, Canadian Agricultural Economics Society, and Western Agricultural Economics Association Joint Annual Meeting; July 27, 2010; Denver, CO.
24. Gustavsen GW. Public policies and the demand for carbonated soft drinks: a censored quantile regression approach. Poster presented at: 11th Congress of the European Association of Agricultural Economists; August 23–27, 2005; Copenhagen, Denmark.
25. Pofahl GM, Capps O Jr, Clauson A. Demand for non-alcoholic beverages: evidence from the ACNielsen Home Scan Panel. Poster presented at: American Agricultural Economics Association Annual Meeting; July 24–27, 2005; Providence, RI.
26. Yen ST, Lin BH, Smallwood DM, Andrews M. Demand for nonalcoholic beverages: the case of low-income households. *Agribusiness*. 2004;20(3):309–321.
27. Zheng Y, Kaiser HM. Estimating assymetric advertising response: an application to US nonalcoholic beverage demand. *Journal of Agricultural and Applied Economics*. 2008;40(3):837–849.
28. Kuchler F, Tegene A, Harris JM. Taxing snack foods: manipulating diet quality or financing information programs? *Applied Economic Perspectives and Policy*. 2005;27(1):4–20.
29. Pieroni L, Lanari D, Salmasi L. Food prices and overweight patterns in Italy. *Eur J Health Econ*. 2013;14(1):133–151.
30. Zhen C, Wohlgenant MK, Karns S, Kaufman P. Habit formation and demand for sugar-sweetened beverages. *Am J Agric Econ*. 2010;93(1): 175–193.
31. Chouinard HH, Davis DE, LaFrance JT, Perloff JM. Fat taxes: big money for small change. *Forum Health Econ Policy*. 2007;10(2): 1558–9544.
32. Dharmasena S, Capps O Jr. Intended and unintended consequences of a proposed national tax on sugar-sweetened beverages to combat the US obesity problem. *Health Econ*. 2012;21(6):669–694.
33. Gustavsen GW, Rickertsen K. The effects of taxes on purchases of sugar-sweetened carbonated soft drinks: a quantile regression approach. *Appl Econ*. 2011;43(6):707–716.
34. Senarath D, Davis GC, Capps O Jr. Partial versus general equilibrium calorie and revenue effects of a sugar-sweetened beverage tax. Poster presented at: Agricultural and Applied Economics Association and Northeastern Agricultural and Resource Economics Association Joint Annual Meeting; July 26, 2011; Pittsburgh, PA.
35. 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(4):329–341.
36. Meyerhoefer CD, Leibtag ES. A spoonful of sugar helps the medicine go down: the relationship between food prices and medical expenditures on diabetes. *Am J Agric Econ*. 2010;92(5):1271–1282.

37. Smed S, Jensen JD, Denver S. Differentiated food taxes as a tool in health and nutrition policy. Poster presented at: 11th Congress of the European Association of Agricultural Economists; August 23–27, 2005; Copenhagen, Denmark.
38. Thiele S. Fat tax: a political measurement to reduce overweight? The case of Germany. Poster presented at: 1st Joint European Association of Agricultural Economists and Agricultural and Applied Economics Association Seminar; September 15–17, 2010; Freising-Weihenstephan, Germany.
39. Zhen M, Beghin JC, Jensen HH. *Accounting for Product Substitution in the Analysis of Food Taxes Targeting Obesity*. Ames, IA: Center for Agricultural and Rural Development; 2011. Available from: http://www.card.iastate.edu/publications/dbs/pdffiles/10wp518.pdf. Accessed August 13, 2013.
40. Allais O, Bertail P, Nichele V. The effects of a "fat tax" on the nutrient intake of French households. Poster presented at: 12th Congress of the European Association of Agricultural Economists; August 26–29, 2008; Ghent, Belgium.
41. Gordon-Larsen P, Guilkey DK, Popkin BM. An economic analysis of community-level fast food prices and individual-level fast food intake: a longitudinal study. *Health Place*. 2011;17(6):1235–1241.
42. Khan LK, Sobush K, Keener D, et al. Recommended community strategies and measurements to prevent obesity in the United States. *MMWR Recomm Rep*. 2009;58(RR-7):1–26.
43. Sturm R, Powell LM, Chriqui JF, Chaloupka FJ. Soda taxes, soft drink consumption, and children's body mass index. *Health Aff (Millwood)*. 2010;29(5):1052–1058.
44. Auld CM, Powell LM. Economics of food energy density and adolescent body weight. *Economica*. 2009;76(304):719–740.
45. Duffey KJ, Gordon-Larsen P, Shikany JM, Guilkey D, Jacobs DR Jr, Popkin BM. Food price and diet and health outcomes: 20 years of the CARDIA Study. *Arch Intern Med*. 2010;170(5):420–426.
46. Finkelstein EA, Zhen C, Nonnemaker J, Todd JE. Impact of targeted beverage taxes on higher- and lower-income households. *Arch Intern Med*. 2010;170(22):2028–2034.
47. Powell LM. Fast food costs and adolescent body mass index: evidence from panel data. *J Health Econ*. 2009;28(5):963–970.
48. Powell LM, Chaloupka FJ. Food prices and obesity: evidence and policy implications for taxes and subsidies. *Milbank Q*. 2009;87(1):229–257.
49. Wendt M, Todd JE. *The Effect of Food and Beverage Prices on Children's Weights*. Washington, DC: US Department of Agriculture; 2011. Available from: http://www.ers.usda.gov/media/123670/err118.pdf. Accessed August 13, 2013.
50. Wendt M, Todd JE. Do low prices for sugar-sweetened beverages increase children's weights? Poster presented at: Agricultural and Applied Economics Association, Canadian Agricultural Economics Society, and Western Agricultural Economics Association Joint Annual Meeting; July 27, 2010; Denver, CO.
51. Barquera S, Hernandez-Barrera L, Tolentino ML, et al. Energy intake from beverages is increasing among Mexican adolescents and adults. *J Nutr*. 2008;138(12):2454–2461.
52. Claro RM, Levy RB, Popkin BM, Monteiro CA. Sugar-sweetened beverage taxes in Brazil. *Am J Public Health*. 2012;102(1):178–183.
53. Sturm R, Datar A. Regional price differences and food consumption frequency among elementary school children. *Public Health*. 2011;125(3):136–141.
54. Beydoun MA, Powell LM, Chen X, Wang Y. Food prices are associated with dietary quality, fast food consumption, and body mass index among US children and adolescents. *J Nutr*. 2011;141(2):304–311.
55. Fletcher JM, Frisvold D, Tefft N. Taxing soft drinks and restricting access to vending machines to curb child obesity. *Health Aff (Millwood)*. 2010;29(5):1059–1066.
56. Fletcher JM, Frisvold D, Tefft N. Can soft drink taxes reduce population weight? *Contemp Econ Policy*. 2010;28(1):23–35.
57. Fletcher JM, Frisvold DE, Tefft N. The effects of soft drink taxes on child and adolescent consumption and weight outcomes. *J Public Econ*. 2010;94(11–12):967–974.
58. Powell LM, Zhao Z, Wang Y. Food prices and fruit and vegetable consumption among young American adults. *Health Place*. 2009;15(4):1064–1070.
59. Wang YC, Coxson P, Shen YM, Goldman L, Bibbins-Domingo K. A penny-per-ounce tax on sugar-sweetened beverages would cut health and cost burdens of diabetes. *Health Aff (Millwood)*. 2012;31(1):199–207.
60. Arroyo P, Loria A, Mendez O. Changes in the household calorie supply during the 1994 economic crisis in Mexico and its implications on the obesity epidemic. *Nutr Rev*. 2004;62(7 Pt 2):S163–S168.
61. Beydoun MA, Powell LM, Wang Y. The association of fast food, fruit and vegetable prices with dietary intakes among US adults: is there modification by family income? *Soc Sci Med*. 2008;66(11):2218–2229.
62. Block JP, Chandra A, McManus KD, Willet WC. Point-of-purchase price and education intervention to reduce consumption of sugary soft drinks. *Am J Public Health*. 2010;100(8):1427–1433.
63. Epstein LH, Dearing KK, Roba LG, Finkelstein E. The influence of taxes and subsidies on energy purchased in an experimental purchasing study. *Psychol Sci*. 2010;21(3):406–414.
64. Nederkoorn C, Havermans RC, Giesen JC, Jansen A. High tax on high energy dense foods and its effects on the purchase of calories in a supermarket. An experiment. *Appetite*. 2011;56(3):760–765.
65. Yang CC, Chiou WB. Substitution of healthy for unhealthy beverages among college students. A health-concerns and behavioral-economics perspective. *Appetite*. 2010;54(3):512–516.
66. Jou J, Techakehakij W. International application of sugar-sweetened beverage (SSB) taxation in obesity reduction: factors that may influence policy effectiveness in country-specific contexts. *Health Policy*. 2012;107(1):83–90.
67. Hawkes C. Food taxes: what type of evidence is available to inform policy development? *Nutr Bull*. 2012;37(1):51–56.
68. Waterlander WE, Steenhuis IH, de Boer MR, Schuit AJ, Seidell JC. Introducing taxes, subsidies or both: the effects of various food pricing strategies in a web-based supermarket randomized trial. *Prev Med*. 2012;54(5):323–330.
69. Smith TA, Lin BH, Morrison RM. Taxing caloric sweetened beverages to curb obesity. *Amber Waves*. 2010;8(3):22–27.
70. de Castro JM. Genetic influences on daily intake and meal patterns of humans. *Physiol Behav*. 1993;53(4):777–782.
71. Hasselbalch AL. Genetics of dietary habits and obesity – a twin study. *Dan Med Bull*. 2010;57(9):B4182.
72. Bell CG, Walley AJ, Froguel P. The genetics of human obesity. *Nat Rev Genet*. 2005;6(3):221–234.
73. Amarasinghe A, D'Souza G. *Obesity Prevention: A Review of the Interactions and Interventions, and some Policy Implications*. Morgantown, WV: West Virginia University Regional Research Institute; 2010. Available from: http://rri.wvu.edu/wp-content/uploads/2012/11/wp2010-2_Amarasinghe_DSouza_Obesity.pdf. Accessed August 13, 2013.
74. Organization for Economic Co-operation and Development. Healthy choices. Poster presented at: Organization for Economic Co-operation and Development Health Ministerial Meeting; October 7–8, 2010; Paris, France.
75. Ervin RB, Kit BK, Carroll MD, Ogden CL. Consumption of added sugar among US children and adolescents, 2005–2008. *NCHS Data Brief*. 2012;(87)1–8.
76. Reid M, Hammersley R, Hill AJ, Skidmore P. Long-term dietary compensation for added sugar: effects of supplementary sucrose drinks over a 4-week period. *Br J Nutr*. 2007;97(1):193–203.
77. Reid M, Hammersley R, Duffy M. Effects of sucrose drinks on macronutrient intake, body weight, and mood state in overweight women over 4 weeks. *Appetite*. 2010;55(1):130–136.
78. Forshee RA, Anderson PA, Storey ML. Sugar-sweetened beverages and body mass index in children and adolescents: a meta-analysis. *Am J Clin Nutr*. 2008;87(6):1662–1671.
79. Gibson S. Sugar-sweetened soft drinks and obesity: a systematic review of the evidence from observational studies and interventions. *Nutr Res Rev*. 2008;21(2):134–147.

80. Barclay AW, Brand-Miller J. The Australian paradox: a substantial decline in sugars intake over the same timeframe that overweight and obesity have increased. *Nutrients*. 2011;3(4):491–504.
81. Fletcher J. Soda taxes and substitution effects: will obesity be affected? *Choices*. 2011;26(3).
82. Crowle JT, Turner E. *Childhood Obesity: An Economic Perspective*. Melbourne: Australian Government Productivity Commission: 2010.
83. World Health Organization. *Obesity: Preventing and Managing the Global Epidemic. Technical Report Series 894.* Geneva: World Health Organization; 2000.
84. Aranceta J, Morena B, Moya M, Anadon A. Prevention of overweight and obesity from a public health perspective. *Nutr Rev*. 2009;67(Suppl 1): S83–S88.
85. Sacks G, Swinburn B, Lawrence M. Obesity Policy Action framework and analysis grids for a comprehensive policy approach to reducing obesity. *Obes Rev*. 2009;10(1):76–86.
86. Swinburn B, Egger G. Preventive strategies against weight gain and obesity. *Obes Rev*. 2002;3(4):289–301.
87. Dietz WH, Benken DE, Hunter AS. Public health law and the prevention and control of obesity. *Milbank Q*. 2009;(8791):215–227.
88. Craven BM, Marlow ML, Shiers AF. Fat taxes and other interventions won't cure obesity. *Economic Affairs*. 2012;32(2):36–40.
89. Sallis JF, Glanz K. Physical activity and food environments: solutions to the obesity epidemic. *Milbank Q*. 2009;87(1):123–154.
90. Foster GD, Sherman S, Borradaile KE, et al. A policy-based school intervention to prevent overweight and obesity. *Pediatrics*. 2008;121(4): e794–e802.
91. van Zutphen M, Bell AC, Kremer PJ, Swinburn BA. Association between the family environment and television viewing in Australian children. *J Paediatr Child Health*. 2007;43(6):458–463.
92. Golan M, Weizman A. Familial approach to the treatment of childhood obesity: conceptual mode. *J Nutr Educ*. 2001;33(2):102–107.
93. Colby JJ, Elder JP, Peterson G, Knisley PM, Carleton RA. Promoting the selection of healthy food through menu item description in a family-style restaurant. *Am J Prev Med*. 1987;3(3):171–177.
94. Winett RA, Wagner JL, Moore JF, et al. An experimental evaluation of a prototype public access nutrition information system for supermarkets. *Health Psychol*. 1991;10(1):75–78.
95. Chu C, Driscoll T, Dwyer S. The health-promoting workplace: an integrative perspective. *Aust N Z J Public Health*. 1997;21(4 Spec No): 377–385.
96. Villagra VG. An obesity/cardiometabolic risk reduction disease management program: a population-based approach. *Am J Med*. 2009; 122(4 Suppl 1):S33–S36.
97. Frank A. A multidisciplinary approach to obesity management: the physician's role and team care alternatives. *J Am Diet Assoc*. 1998; 98(10 Suppl 2):S44–S48.
98. MacLean L, Edwards N, Garrard M, Sims-Jones N, Clinton K, Ashley L. Obesity, stigma and public health planning. *Health Promot Int*. 2009;24(1):88–93.
99. Villagra V. Strategies to control costs and quality: a focus on outcomes research for disease management. *Med Care*. 2004;42(Suppl 4): III24–III30.
100. Alemanno A, Carreno I. Fat taxes in the European Union between fiscal austerity and the fight against obesity. *European Journal of Risk Regulation*. 2011;2(4):571–576.
101. Shields M, Tremblay MS. Sedentary behaviour and obesity. *Health Rep*. 2008;19(2):19–30.
102. Lajunen HR, Keski-Rahkonen A, Pulkkinen L, Rose RJ, Rissanen A, Kaprio J. Are computer and cell phone use associated with body mass index and overweight? A population study among twin adolescents. *BMC Public Health*. 2007;7:24.
103. Fotheringham MJ, Wonnacott RL, Owen N. Computer use and physical inactivity in young adults: public health perils and potentials of new information technologies. *Ann Behav Med*. 2000;22(4):269–275.
104. McDonald CM, Baylin A, Arsenault JE, Mora-Plazas M, Villamor E. Overweight is more prevalent than stunting and is associated with socioeconomic status, maternal obesity, and a snacking dietary pattern in school children from Bogota, Colombia. *J Nutr*. 2009;139(2): 370–376.
105. Berteus Forslund H, Torgerson JS, Sjostrom L, Lindroos AK. Snacking frequency in relation to energy intake and food choices in obese men and women compared to a reference population. *Int J Obes (Lond)*. 2005;29(6):711–719.
106. Block JP, He Y, Zaslavsky AM, Ding L, Ayanian JZ. Psychosocial stress and change in weight among US adults. *Am J Epidemiol*. 2009;170(2):181–192.
107. De Vriendt T, Moreno LA, De Henauw S. Chronic stress and obesity in adolescents: scientific evidence and methodological issues for epidemiological research. *Nutr Metab Cardiovasc Dis*. 2009;19(7): 511–519.
108. Hassapidou M, Fotiadou E, Maglara E, Papadopoulou SK. Energy intake, diet composition, energy expenditure, and body fatness of adolescents in northern Greece. *Obesity (Silver Spring)*. 2006;14(5): 855–862.
109. Brug J, van Stralen MM, Te Velde SJ, et al. Differences in weight status and energy-balance related behaviors among schoolchildren across Europe: the ENERGY project. *PLoS One*. 2012;7(4):e34742.
110. von Ruesten A, Steffen A, Floegel A, et al. Trend in obesity prevalence in European adult cohort populations during follow-up since 1996 and their predictions to 2015. *PLoS One*. 2011;6(11):e27455.

Supplementary material

Table S1 Studies on price and tax interventions and their effects on different outcomes

Authors	Objectives	◊ Country / ○ Methods / □ Outcomes / ♯ Products	Data/population	Price/tax variable	Results	Conclusion
DEMAND STUDIES ON CONSUMPTION OF BEVERAGES						
Gustavsen et al[1]	Explore soda purchasing and factors influencing demand; the effect of price changes due to tax on consumers; model demand; analyze policies	◊ Norway ○ Demand study □ Consumption ♯ Carbonated soft drinks	Cross sectional samples from the household expenditure surveys of Statistic Norway (1989–1999) with 14,000 observations from 1,200–1,400 households; prices from CPI monthly index	10.8% price increase due to tax; 7.3% price increase due to tax; Use of Swedish prices that are 29.8% lower	–5.1 L/year/capita^{NS} (–9.5%^{NS}); –12.9 L/year/capita^{NS} (–24%^{NS}); 10.2 L/year/capita^{NS} (19.1%^{NS})	Taxes on carbonated soft drinks lead to a small reduction in the consumption for small and moderate consumers, and larger one for heavy consumers
Yen et al[2]	Investigate the effects of economic policies and other variables on household beverage consumption	◊ USA ○ Demand study □ Consumption ♯ Milk, soft drinks, juice, coffee and tea	Cross sectional samples of 908 households from a nationally representative sample coming from the National Food Stamp Program Survey (1996–1997)	Price elasticity of demand	Uncompensated elasticities: soft drinks, –0.80*; juice, –0.52*; whole milk, –0.69*; low fat milk, –1.40*; coffee and tea, –0.89* Compensated elasticities: soft drinks, –0.52*; juice, –0.35*; whole milk, –0.59*; low fat milk, –1.36*; coffee and tea, –0.47*	Prices do not explain the displacement of milk by soft drink; demand for both is responsive to prices; price interventions can be effective tool in controlling soft drink use; education and advertising campaigns may also be effective policies
Brown et al[3]	Study how income and prices influence consumer juice beverage demand	◊ USA ○ Demand study □ Consumption ♯ Juices, soda, tea and milk	Panel data, Nielsen Scan Track data on juice beverage consumption (1988–1992) of weekly observations	Price elasticity of demand	Elasticities: juices, –0.70* to –1.81*; soda, –1.56*; tea, –0.787*; milk, –0.62*	Goods have quite price elastic demand functions and exhibit high substitution effects
Pofahl et al[4]	Investigate the demand for various nonalcoholic beverages, get elasticities of demand, test different analytical models	◊ USA ○ Demand study □ Consumption ♯ Juices, tea and milk, carbonated soft drinks, powdered soft drinks, isotonics, bottled water	Individual and economic data from 26,255 households from a nationally representative sample from the AC Nielsen Home Scan panel data (1998–2001) set	Price elasticity of demand	Compensated elasticities: milk, –1.16*; carbonated soft drinks,–0.64*; powdered soft drinks, –0.68*; isotonics, –1.93*; fruit juices, –0.67*; bottled water, –0.67*; coffee, –1.14*; tea, –0.93*	Elasticities for milk, isotonics, water and coffee are elastic, whilst those of soft drinks, fruit juices, and tea are in the inelastic range; prominent substitution effects are evident

Dharmasena et al[5]	Model the demand and the interrelationships of at home nonalcoholic beverage consumption	◊ USA ○ Demand study ☐ Consumption # Isotonics, drinks, juices, milk, water, coffee and tea	Nielsen Home Scan panel data, (1998–2003) with 72 monthly observations which are demographically balanced in 53 markets, adjusted using the consumer price index	Price elasticity of demand	Uncompensated elasticities: isotonics, –5.97^{NS}; soft drinks, –2.19^{NS}; diet soft drinks, –1.13^{NS}; fruit drinks, –0.18^{NS}; fruit juices, –0.93^{NS}; Compensated elasticities: isotonics, –5.94^{NS}; soft drinks, –1.90^{NS}; diet soft drinks, –0.98^{NS}; fruit drinks, –0.08^{NS}; fruit juices, –0.82^{NS}	Isotonics were the most elastic beverage, followed by regular soft drinks; milk was complemented with fruit drinks, fruit juices, water and tea; diet and regular soft drinks were complements; fruit juice and fruit drinks were net substitutes
Dharmasena et al[6]	Estimate own and cross price elasticities of selected no alcoholic beverages and the direct and indirect effects of a proposed excise tax on SSBs consumption	◊ USA ○ Demand study and modeling ☐ Consumption # Isotonics, drinks, juices, milk, water, coffee and tea	Nielsen Home Scan panel data, (1998–2003) 72 monthly observations which are demographically balanced in 53 markets, which were adjusted using the consumer price index	Excise ad valorem tax 20% tax on sugar sweetened nonalcoholic beverages	Total percentage per capita change: regular soft drinks, –14.33%^{NS}; diet soft drinks, 2.70%; fruit drinks, –13.43%^{NS}; fruit juices, 12.75%^{NS}; high fat milk, –5.48%^{NS}; low fat milk, 9.26%^{NS}; bottled water, –3.40%^{NS}; coffee, 21.05%^{NS}; tea, 6.64%^{NS}; isotonics, –79.05%^{NS}	There are direct and indirect effects from the taxation, often moving in opposite directions; soft drinks had a serious negative direct and a strong positive indirect effect on consumption; overall tax had negative soft drinks consumption effect
Brown et al[7]	Estimation of a conditional demand system for different beverages	◊ USA ○ Demand study ☐ Consumption # Juices, milk, soda	Nielsen Panel data, with 160 weekly observations, based on retail scanner sales (2007–2010)	Price elasticity of demand	Elasticities: juice, –1.56^{NS}; milk, –1.20^{NS}; soda, –0.61^{NS}	Beverages are normal goods with price elastic demands, with relatively large own and cross promotion affect
Brown[8]	To analyze the impacts of income levels on the price and income responses in the differential demand system	◊ USA ○ Demand study ☐ Consumption # Juices, tea and milk, carbonated water, regular and diet soda	Nielsen data based on retail scanner sales of a consumer weekly data (2003–2006) thus with 154 weekly observations	Price elasticity of demand	Elasticities: juices, –1.42 to –2.17; sodas,–1.57; milk, –1.10; tea, –1.17; carbonated water, –1.61	Negative price elasticities with small income specific impacts on the demand responses to prices
Zheng et al[9]	To model nonalcoholic beverage demand and to measure the effects of advertisement on the demand	◊ USA ○ Demand study and modeling ☐ Consumption # SSBs	Annual time series US data (1974–2005) from the US Bureau of Labor Statistics and the Food Availability Data from the Economic Research Service of the Agriculture Department	Price elasticity of demand	Elasticities: soft drinks, –0.52; milk, –0.30; juice, –0.27; bottled water, –0.50; coffee and tea, –0.42	The findings indicated that price changes in soft drinks may affect consumption, as well as advertisement of them

(*Continued*)

Table S1 Studies on price and tax interventions and their effects on different outcomes (*Continued*)

Authors	Objectives	◊ Country / ○ Methods / □ Outcomes / ♯ Products	Data/population	Price/tax variable	Results	Conclusion
Zhen et al[10]	To estimate demand for nine nonalcoholic beverages under habit formation	◊ USA ○ Demand study and modeling □ Consumption ♯ SSBs	Nielsen Home Scan household scanner data (2004–2006), from a panel of more than 1,00,000 households recording purchases made at retail outlets on a weekly basis over a period of at least a year	Elasticities estimation and modeling effects of a half-cent per ounce tax on store purchased regular CSD, sports and energy and sugar sweetened drinks	Elasticities: regular CSD, –0.36 to –0.53; diet CSD, –0.65 to –0.79; energy drinks, –0.34 to –0.49; fruit juice, –0.52 to -0.59; sugar sweetened fruit drinks, –0.46 to 0.75; long run tax effect on SSB annual demand, –110 to –135	A half-cent per ounce tax on SSBs will result in moderate reduction in consumption for both income strata; long run tax revenue is 15% to 20% lower to short-run; results indicate that a sugar-sweetened beverage tax is regressive in nature
DEMAND STUDIES ON CONSUMPTION OF FOODS						
Pieroni et al[11]	To examine the role of relative food prices in determining the recent increase in bodyweight in Italy	◊ Italy ○ Demand study □ Consumption ♯ Many different foods	A series of cross sections of the Italian Household Budget Survey (1997–2005); the IHBS provides information about the socio-demographic characteristics and expenditure levels of Italian households	Price elasticity of demand	Compensated elasticities of demand: healthy food, –0.77, 0.40 and 0.97; unhealthy foods, 0.56, –0.57, and 0.04; other goods, 0.08, 0.01 and –0.09	The relative increase of healthy food prices has produced nontrivial substitution elasticities towards higher consumption of unhealthy foods, affecting disadvantaged groups
Kuchler et al[12]	Investigate consumer likely response to a proposed tax on snack foods, that addresses public health issues generated by rising US obesity rates	◊ USA ○ Demand study and modeling □ Consumption, energy, weight ♯ Potato chips, all chips, salty snacks	AC Nielsen Home Scan panel data, 7,195 representative households (1999)	Price elasticity of demand and effects of 1%, 10% and 20% tax rate imposition	Annual consumption effect (per ounces per capita): potato chips tax, –0.28, –2.77, –5.54; potato and all chips tax, –0.09, –0.93, –1.87; all snack and all chips tax, –0.23, –2.26, –4.51; all salty and other salty snacks tax, –0.28, –2.79, –5.57	The impact on dietary quality are small and negligible for lower tax rates and insufficient at higher tax rates; price changes are not effective and a tax could be used only to raise revenues for nutrition education
Chouinard et al[13]	Estimate demand systems for dairy products, which are used to simulate substitution effects among dairy products and the welfare impacts of fat taxes on various consumer groups	◊ USA ○ Demand study and modeling □ Consumption and energy intake ♯ Milks, creams, cheeses, ice creams, yogurts, butters	Weekly information resources incorporated's (IRI) Infoscan scanner data, with 3,583 observations years (1997–1999) for 23 cities	Price elasticity of demand and modeling effects of 10% and 50% and valorem fat tax	Elasticities: milks, –0.63^{NS} to –2.05^{NS}; cream, –0.41^{NS}; cheeses, –0.40^{NS} to –0.73^{NS}; butter, –0.30^{NS}; ice cream, –0.74^{NS}; yogurts, –0.91^{NS} to -0.80^{NS}; impact of 10%^{NS}/50%^{NS} tax (fat grams per household per week):	A 10% tax would reduce consumption only by 1% and thus given the inelastic demand a tax is a good means mainly to raise revenue; fat taxes are unattractive because they are extremely regressive, and the elderly and poor suffer much

					milks, −1.44^{NS} to 0.59^{NS} /−1.75^{NS} to 0.51^{NS}; cream, 0.64^{NS}/0.88^{NS}; cheeses, −1.22^{NS} to −1.84^{NS} /−1.17^{NS} to −2.10^{NS}; butter, −1.86^{NS}/−7.50^{NS}; ice cream, 1.21^{NS}/1.92^{NS}; yogurts, −0.03^{NS} to 0.09^{NS}/0.00^{NS} total−13.22^{NS}	greater welfare losses from the taxes than do younger and richer consumers
DEMAND STUDIES ON ENERGY INTAKE and WEIGHT OUTCOMES OF BEVERAGES						
Dharmasena et al[14]	Estimate own and cross price elasticities of selected no alcoholic beverages and the direct and indirect effects of a proposed excise tax on SSBs consumption	◊ USA ○ Demand study and modeling ☐ Caloric intake and weight # Isotonics, drinks, juices, milk, water, coffee and tea	Nielsen Home Scan panel data, (1998–2003) 72 monthly observations, which are demographically balanced in 53 markets and adjusted using the consumer price index	Impose a 20% tax on SSBs	Per capita change in calories per month: regular soft drinks, −552.04; diet soft drinks, −2.81; fruit drinks, −112.69; fruit juices, 207.67; high fat milk, −15.94; low fat milk, 45.02; coffee, 6.76; tea, 0.43; isotonics, −26.04; total average, −449; body weight, −1.54 pounds/ year; −0.13 pounds/ month	There is a reduction is energy intake and also a reduction in body weight, which is relatively small if direct and indirect effects from the tax and are considered; the total reduction in body weight may be between 1.54 and 2.55 pounds per year
Dharmasena et al[14]	To ascertain stochastic partial and general calorie body weight and revenue effects of a tax on SSBs as well as incidence of such tax	◊ USA ○ Demand study and modeling ☐ Caloric intake and weight # SSBs	AC Nielsen Home Scan panel data, 132 observations for each nonalcoholic beverage, (1998–2008)	Tax on SSBs	Impact on total calories per person per month from beverages: -450 kcal (−707 to −199); impact on weight in pounds per person per year: −1.5 (−2.6 to −0.7)	Calorie reduction due to direct and indirect tax effects: 199 to 707 calories per person per month; impact on weight: 2.6 to 0.7 pounds per person per year
Gustavsen et al[15]	Investigate the effects on purchases of increasing the VAT for SSBs from 13% to 25%	◊ Norway ○ Demand study and modeling ☐ Consumption and weight # Sugar sweetened carbonated soft drinks	Panel data of 16,000 cross sectional observations of household expenditure surveys of Statistics Norway (1989–2001)	Elasticities estimation and modeling of effect of 10.6% price increase due to increase of the VAT from 13% to 25%	Own price elasticities, −2.41 ^{NS} to −0.84^{NS}; consumption per annum:—light drinkers, 5.1 L^{NS}; moderate drinkers, −6.8 L^{NS} to −11.5 L^{NS}; heavy drinkers, −13.9 L^{NS} to −19.2 L^{NS}; weight per annum/capita, −0.3 kg^{NS}(−0.3 to −1.0 kg^{NS} range)	Low-purchasing households will reduce their purchases by about 5L and the reduction in high purchasers will be 20L per year, yielding a 0.3 kg of body weight reduction on an annual perspective

(*Continued*)

Table S1 Studies on price and tax interventions and their effects on different outcomes (*Continued*)

Authors	Objectives	◊ Country / ○ Methods / □ Outcomes / ♯ Products	Data/population	Price/tax variable	Results	Conclusion
Lin et al[16]	Demonstrate the bias of a static model of 3,500 calories for one pound of body weight	◊ USA ○ Demand study □ Consumption, weight, BMI ♯ Many different beverages	Individual data from 7,291 children, 8,322 adults of the National Consumer Panel dataset and the National and Nutritional Examination Survey (CDC), NHANES, (1998–2007, 2003–2006) and price NCP data (1998–2007)	Price elasticity of demand and effects of a 20% tax	Uncompensated elasticities of demand in low/high income population: sugary drinks, –0.95^{NS} to 0.05^{NS}/–1.30^{NS} to 0.06^{NS}; Effects on sugary drinks (kcal/d) of a 20%^{NS} tax: adults, –38^{NS}/–35^{NS}; children, –46 ^{NS}/–54^{NS}; Weight change (kg) after 10 years: dynamic model, –1.84^{NS}; static model, –15.98^{NS}	Taxes may cause reductions in consumption and body weight; however notably the static model overestimates the effects of a tax compared to the dynamic model; this is due to the 3500 calorie rule which is biased and that he energy requirements of the body are determined by body weight amongst others
DEMAND STUDIES ON ENERGY INTAKE and WEIGHT OUTCOMES OF FOODS						
Smed et al[17]	Analyze the effects of using economic policy tools in nutrition policy by developing a system of an two models: an econometric consumption one and another that converts it to nutrition intake	◊ Denmark ○ Demand study and modeling □ Caloric intake ♯ Fat, sugar, milk, eggs, cheese, pork, fish, flour, fruit, vegetables	About 2,000 households from a representative panel data of Danish food consumers from GfK Consumer Scan Panel data (1997–2000) which has weekly home purchased data	Tax on all fats: 7.75DKK/kg; Tax on saturated fats: 7.90DKK/kg. Tax on added sugar: 6.23DKK/kg	Energy intake/day/scenario: –17 to –11% (/age): –7 to 2% (/social class); –9 to –1% (/ location); –12 to –4% (/age); –6 to 3% (/social class); –8 to –4% (/location); –2 to –1% (/age); –2 to 2% (/social class); 5 to –2% (/location)	Differing effects of tax per age, social class and location; tax on fat as greater impact than on sugar; tax on fat increases energy intake from sugar and vice versa; taxes cannot solve obesity problems, but may interact well with other instruments
Thiele[18]	Calculate food price elasticities and estimate the effects of a fat tax	◊ Germany ○ Demand study and modeling □ Consumption, energy, weight ♯ Beverages, milk, sweets, meat, fish, eggs, cream, fruits, vegetables, fruits, potatoes, bread, cereals	Cross sectional data of 12,000 households, representative of German population (2003)	Tax of 0.5 cents per gram of saturated fat	Consumption: –4g/d^{NS} of food; fat intake, –7.4 g/d^{NS} (–8.7%^{NS}); saturated fat,–3.1 g/d^{NS} (–8.5%^{NS}); Energy intake: purchases, –68 kcal/d^{NS}; intake, –20.4 kcal/d; Weight, –1.0 kg/year^{NS}	Taxation of fat changes purchasing structure; there may be deficient nutrient intake in low income groups; net health effects per group are unclear; higher fat tax premiums oriented to obese may be preferable

Meyerhoefer et al[19]	Investigate the impact of changes in the relative price of low and high carbohydrate foods on medical expenditures for diabetes care	◊ USA ○ Demand study and modeling ☐ Consumption and BMI # Carbohydrate foods	Nielsen Home Scan price data (2000–2005) merged to Medical Expenditure Panel data Survey, from which a diabetic sample of 3,990 men and 4,984 women was derived	Price elasticity of demand and modeling	An increase of 10% in the price of low carbohydrate foods impacts BMI by 1.1%* in men and by –0.7%* in women	There are only small impacts of food prices on body mass index, which also differ little by gender
Zhen et al[20]	Estimate demand with more sophisticated substitution modeling and assess the impact of food taxes on total calorie intake with focus on the case of a 10% tax to sugar	◊ USA ○ Demand study and modeling ☐ Consumption and calorie intake # Many foods and drinks	Cross Sectional data of 3,015 individuals, age >20 years, nonpregnant, from the NHANES, (2003–2004) survey	Elasticities estimation and modeling of increases in prices by a 10% food tax proportional to calories from added sugar in different foods	Tax consumption effect: carbonated soft drinks,–8.92%; fruit juices and non-alcoholic beverages, –3.29%; fruits,–0.43%; fats, 0.05%; Calories/day: carbonated soft drinks, –16.89%; fruit juices and nonalcoholic beverages,–2.98%; total, –2.17% or 47 calories/day	The paper gives more emphasis on methodological aspects; small reductions in energy intake are estimated
Allais et al[21]	Assess effects of a fat tax on the nutrients purchased by French households across different income groups	◊ France ○ Demand study and modeling ☐ Consumption and calories intake # Many foods and drinks	TNS World panel data in France, with 5,000 households (1996–2001), which is an annual survey with weekly observations	Elasticities estimation and modeling of 10% increase in price done for one month due to tax	Elasticities of soft drinks, -0.97^{NS} to -0.99^{NS}; Effect of sugar products tax on nutrients purchased: well-off, -0.79^{NS}; modest, -1.20^{NS}; Effect on nutrients purchased from cheese/ butter/cream tax: well-off, -1.23^{NS}; modest, -1.17^{NS}	A fat tax has small and ambiguous effects on nutrients purchased and a slight effect on body weight and is highly regressive, whilst it generates revenue; thus, the threat may be more beneficial than its imposition
LONGITUDINAL STUDIES ON CONSUMPTION OF BEVERAGES AND FOODS						
Gordon-Larsen et al[22]	Examine how community-level food price variation is associated with individual-level fast food intake	◊ USA ○ Longitudinal study ☐ Consumption # Sodas and burgers	Data from waves II (1996) and III (2001–2002) of the national Longitudinal Study of adolescent Health (Add Health), a cohort study of 20,745 adolescents representative of the US school based population; Price data from the Council for Community and economic research (C2ER)	Effect of a 20% price increase	Effect on fast foods eating occasions for burger/soda: male White, –0.15/–0.05; male Black, –0.10/–0.24; male Hispanic, –0.09/–0.16; male Asian, –0.20/0.13; female White, –0.11/–0.00; female Black, –0.06/–0.16; female Hispanic,–0.05/–0.19; female Asian, –0.15/0.08	Increase in the prices of fast food and soda are associated with decreases in their consumption; there was greater sensitivity for males versus females and soda versus burgers; a price increase on average will end to a reduction of one quarter visits to fast food per week

(*Continued*)

Table S1 Studies on price and tax interventions and their effects on different outcomes (*Continued*)

Authors	Objectives	◊ Country / ○ Methods / □ Outcomes / ♯ Products	Data/population	Price/tax variable	Results	Conclusion
Khan et al[23]	To examine the relationship between children's fast food consumption and prices of fast food and food at home and also whether price responsiveness differ across subpopulations	◊ USA ○ Longitudinal study □ Consumption ♯ Fast food	Individual level data (2004, 2007) from the ECLS-K and price data from the American Chamber of Commerce Researchers Association (ACCRA)	Price elasticity and 0.17 USA dollars increase in price that is one standard deviation	Weekly fast food consumption price elasticity, –0.57*; coefficient of income per $10,000 increments, –0.13*; high school mother, –0.22*; mother in college, –0.35*; hours of television watching, 0.14*	Higher fast food prices were associated with lower frequency of fast food consumption; price elasticity of home food is half that of fast food; price of fast food has stronger relation with consumption in overweight
LONGITUDINAL STUDIES ON ENERGY INTAKE and WEIGHT OUTCOMES OF BEVERAGES						
Sturm et al[24]	Examine whether small taxes on soda are likely to change consumption and weight gain or whether larger tax increases would be needed	◊ USA ○ Longitudinal study □ Consumption and BMI ♯ Sodas	Individual data from 7,300 children, 9–13 years on the ECLS-K and tax and price data from the Robert Wood Johnson Foundation (2004)	Price elasticity	BMI will change by –0.013 if tax increases by 1%; there is no significant change in consumption	Small taxes are not having significant effect on overall levels of soda consumption or obesity rates; larger effects are observed in heavier children from low income who watch a lot of television
Finkelstein et al[25]	Investigate the differential impact of targeted beverage taxes on energy intake and weight of higher- and lower-income households	◊ USA ○ Longitudinal study □ Consumption, energy, weight ♯ Carbonated SSBs and all SSBs	Nationally representative sample of households from the Nielsen Home Scan Panel, (2006)	Effect of 20%/40% tax on carbonated SSBs and 20% / 40% tax on all SSBs	Effect on purchase of tax on CSSBs, –6.0/–10.4 kcal/d per person; SSBs price elasticity, –0.73; annual weight change, –0.20/–0.37; Effect on purchase of tax on all SSBs, –11.0/–17.0 kcal/d; SSBs price elasticity, –0.87; annual weight change, –0.32/–0.59	The results of the study indicate that large taxes on SSBs have the potential to positively influence weight outcomes, especially for middle-income households; these taxes may generate significant revenue which could be used to fund obesity preventions efforts
LONGITUDINAL STUDIES ON ENERGY INTAKE and WEIGHT OUTCOMES OF FOODS						
Powel et al[26]	Examine the relationship between adolescent BMI and fast food prices and fast food restaurant availability	◊ USA ○ Longitudinal study □ BMI ♯ Fast food	Individual data (11,900 person years) of adolescents (12–17 years) from the National Longitudinal Survey of Youth (NLSY97) in 392 USA counties; price data are from the ACCRA cost of living index reports; outlet density data from the Dun and Bradstreet business list	Price elasticity	BMI fast food price elasticity: adolescents, –0.12; low income, –0.26; near low income, –0.04; middle income, –0.16; near high income, –0.06; high income, –0.20; mother at high school, –0.13; mother at college or above, 0.02	Higher fast food prices are associated with lower BMI, but results were not statistically significant; fiscal food pricing policies may have modest but measurable effects, on average, on the weight outcomes of children ages 6 to 17

Wendt et al[27]	Explore the effect of food prices on children's BMI	◊ USA ○ Longitudinal study ☐ BMI # Carbonated beverages, fruit drinks, juices, milk, vegetables, snacks, thrifty food	Individual data from 5,090 children 4–16 years old, of a nationally representative sample of the ECLS-K (1998–1999); price data from the Quarterly Food-at-Home Price Database (QFAHPD)	Price elasticity of BMI: 1st quarter price elasticities in fixed effects/ O LS models; 1st year price elasticities in fixed effects/OLS models	Carbonated beverages, –0.01/–0.03; fruit drinks, 0.01/–0.01; juices, –0.01/–0.01; milk, 0.00/ –0.01; snacks, –0.03/0.01; carbonated beverages, –0.04/–0.03; fruit drinks, –0.01/0.01; juices, –0.03/–0.03; milk, 0.01/ –0.02; snacks, 0.01/0.00	Food prices have small statistically significant effects on children BMI; there is a significant delay between price changes and BMI effects; there are heterogeneous responses to changes in price across household incomes and the distribution of BMI
Powell et al[28]	Examine the association between fast food prices and restaurant and food store outlet availability with adolescents BMI	◊ USA ○ Longitudinal study ☐ BMI # Fast food	Individual panel data of about 6,594 observations of NLSY79 survey for 1998, 2000, 2002 on adolescents and price data from the American Chamber of Commerce researchers Association and density data from Dun and Bradstreet list	Price elasticity	BMI change per dollar of price increase and BMI price elasticity: OLS model, –0.78 and –0.10; longitudinal fixed effects model, –0.65 and –0.08; longitudinal random effects model, –0.70 and –0.08	Higher fast food prices are related to lower BMI in the teens; maternal working status and parental income did not influence BMI; the low elasticities mean that taxes would have to be significant to have any effect
Duffey et al[29]	Assess the associations between food price, dietary intake, overall energy intake, weight, and homeostatic model assessment insulin resistance (HOMA-IR) scores	◊ USA ○ Longitudinal study ☐ Consumption, energy, weight # Sodas, pizza, milk, burgers	Individual data from the CARDIA longitudinal study with 5,115 young adults (18–30 years), followed periodically from 1985 to 2006 and price data from the American Chamber of Commerce Research Association	Price elasticity	Consumption: soda, –0.19; milk, -0.07; burgers, 0.07; pizza, –0.43; Energy: soda, –0.71; milk, 0.24*; burgers, 0.20; pizza, –1.15; calories (daily kcals), –124; milk, –130; burgers, –71; pizza, –42; weight (pounds), –2.3; milk, –0.3; burgers, –0.5; pizza, –1.3	Policies aimed at altering the price of soda or away-from-home pizza may be effective mechanisms to steer USA adults toward a more healthful diet and help reduce long-term weight gain or insulin levels over time
Wendt et al[30]	Investigate the impact of prices of soda, fruit drinks and alternative beverages on children's BMI	◊ USA ○ Longitudinal study ☐ BMI # Sodas, fruit drinks, juices, milk	Individual data from the ECLS-K with a representative sample of 8,730 students in the school (1998–1999), and price data from the Quarterly Food at Home Price Database (QFAHPD) (1998–2006)	Price elasticity	BMI price elasticities: soda, –0.02; fruit drinks, –0.02; juices, –0.03; low fat milk, 0.01; whole milk, 0.01; sweet snacks, –0.01; salty snacks, -0.03	Only the juices and salty snacks exhibit statistically significant reductions in BMI when prices increase; there is some indication that decreases in prices of healthier foods could reduce BMI by a small margin

(*Continued*)

Table S1 Studies on price and tax interventions and their effects on different outcomes (*Continued*)

Authors	Objectives	◊ Country / ○ Methods / □ Outcomes / ♯ Products	Data/population	Price/tax variable	Results	Conclusion
Auld and Powell[31]	To show that decrease in the price of energy dense foods increase body weight if the price of obtaining a calorie from dense food is lower than that of less dense food	◊ USA ○ Longitudinal study □ Consumption, weight, BMI ♯ Fast food, fruits, vegetables	Individual level national data for eighth and tenth grade students from the MTF surveys, 1997–2003 and price data from ACCRA and outlet density data from Dun and Bradstreet (2007)	Price elasticity	Male BMI/weight elasticities: fast food price, –0.03/–0.42; fast food restaurant density, 0.00/–0.016; Female BMI/ weight elasticities: fast food price, –0.03/–0.72; fast food restaurant density, –0.01/0.02	The price of energy dense food is negatively associated with weight, whereas the price of less energy dense foods is positively associated with weight outcomes; taxing fast food may be effective policy in addressing obesity, but is hinder by potential adverse effects
Zhang et al[32]	To examine the interactive effect between the price of unhealthy foods and food stamp program participation on body weight status among low income women in the US	◊ USA ○ Longitudinal study □ BMI and weight ♯ Unhealthy food: meats, dairy, beverages, Sodas, burgers, fried chicken, pizza	Panel data of the National Longitudinal Survey of Youth (NLSY) 1979 cohort (1985–2002) with 12,686 individuals, and price data from the ACCRA	Price elasticity	BMI elasticity in two models: unhealthy basket 1, –0.13/–0.11; unhealthy basket 2, –0.06/–0.05; unhealthy basket 3, –0.04/ –0.041 Obesity odds ratios in two models: unhealthy basket 1, 0.58/0.98; unhealthy basket 2, 0.99/097; unhealthy basket 3, 1.0/0.97	The higher prices for unhealthy food can partially offset the positive association between food stamp program participation and bodyweight among low income women; considerable interactions exist
COHORT RETROSPECTIVE STUDY ON ENERGY INTAKE and WEIGHT OUTCOMES OF FOOD						
Han et al[33]	Examine the extent to which various food prices were associated with the obesity status of young adults	◊ USA ○ Cohort Retrospective Study □ Obesity ♯ Soft drinks, fast food, fruits and vegetables	Individual data from the MTF study, (1992–2003), annual follow up, 11,861 observations (6,537 men, 5,324 women) 14–32 years old and price data from the ACCRA	Price elasticity	Obesity probability change in women: fast food, –1.88; soft drinks, –2.03; fruits and vegetables, 1.26 Obesity probability change in men: fast food, –2.07; soft drinks, –1.01; fruits and vegetables, 0.40	The findings indicate a significant negative association of the probability of obesity with the prices of fast food and soft drinks and a positive one with the prices of vegetables and fruits
CROSS SECTIONAL STUDIES ON CONSUMPTION OF BEVERAGES						
Barquera et al[34]	Calculation of own price elasticities, cross price elasticities of demand, and income elasticities of demand for beverages	◊ Mexico ○ Repeated Cross Sectional Study □ Consumption ♯ Soda, juice, sweet drinks and whole milk	Individual data from a national representative sample of 416 adolescents and 2,180 adults from the Mexican Nutrition Survey (1999)	Price elasticity	Purchase: soda, –1.09; whole milk, 0.05; sweet drinks, –0.11; juice, –0.20; mL/capita/day: overall, –5.00; poor, –5.30; rich, –4.61; income, 0.16	Income elasticities indicate that intakes will increase if incomes increase; soda price elasticities were both modest and increasing over time

			and 7,464 adolescents and 21,113 adults from the Mexican Health and Nutrition Survey (2006)			indicating the potential use of price measures
Claro et al[35]	Investigate whether taxing SSBs would improve the diets of households in Brazil	◊ Brazil ○ Cross Sectional Study ☐ Consumption # SSBs	Individual and economic data from 443 geographically and socioeconomically homogenous Households Budget Survey from the Brazilian Institute of Geography and Statistics, (2002–2003)	Price elasticity	Elasticities: all groups, –0.85*; first income quartile, –1.03*; second, third and fourth income quartiles, –0.63*	High SSB price elasticity indicates that a tax on purchased volume may lead to reductions in consumption, even though it is not possible to predict how diet quality will change
CROSS SECTIONAL STUDIES ON CONSUMPTION OF FOODS						
Sturm and Datar[36]	To examine price of food is associated with consumption patterns among different socio economic and at risk groups of students	◊ USA ○ Cross Sectional Study ☐ Consumption # Fast food and SSBs	ECLS-K (1998–1999) and economic data from the ACCRA	Price elasticity	Own price elasticity: SSBs, 0.10; fast food, 0.21^{NS} Cross price effects: SSBs, 0.29; fast food,–0.14	The price effects for fast food and soft drink consumption were very small and inconsistent
CROSS SECTIONAL STUDIES ON ENERGY INTAKE and WEIGHT OUTCOMES OF BEVERAGES						
Fletcher et al[37]	Evaluate of the impact of changes in state soft drink taxes on BMI, obesity, and overweight	◊ USA ○ Repeated Cross Sectional Study ☐ Obesity, weight, BMI # Soft drinks	Individual data from 2,709,422 adults older than 17 years, from BRFSS (1990–2006), nationally representative survey and price and tax data from the Book of the States, the All States Tax Handbook, and web searches	Price elasticity	Tax effect on BMI, –0.003; male, 0.57; age, 0.31 Tax effect on obese, –0.01; male, –0.01; age, 0.06; Tax rate effect on overweight, –0.0002; male, 0.14; age, 0.00	Soft drink taxes may influence BMI, but the impact is small and different across socio economic groups; a down side of the tax is that is regressive
Fleltcher et al[38]	Investigate of the potential for soft drink taxes to combat rising levels of child and adolescent obesity through a reduction in consumption	◊ USA ○ Repeated Cross Sectional Study ☐ Consumption, weight, BMI # Soft drinks, juice, milk	Individual data: youths aged 3–18 years from NHANES III (1988–1994) and IV (1999–2006) and price and tax data from the published annually Book of the States (1990–2007), LexisNexis academic, state departments of revenue and websites	Price elasticity	Soft drink calories, –5.92*; soft drink grams, –18.05; consumption of soft drink, –0.01; total caloric intake, –7.84; BMI, 0.02; obese, 0.01; overweight, 0.002; underweight, –0.002	Taxation may cause a modest reduction in soft drink consumption by children and adolescents; but is offset by increases in consumption of other high-calorie drinks, and there is no effect on BMI and weight

(*Continued*)

Table S1 Studies on price and tax interventions and their effects on different outcomes (*Continued*)

Authors	Objectives	◊ Country / ○ Methods / □ Outcomes / ♯ Products	Data/population	Price/tax variable	Results	Conclusion
Powel et al[39]	Examine the associations between state-level grocery store and vending machine soda taxes and adolescent BMI	◊ USA ○ Repeated Cross Sectional Study □ BMI ♯ Soft drinks	Individual data from 1,53,673 students (13–19 years) of Panel data from the MTF study (1997–2006) and price data from the ayaTech Corporation for the Robert Wood Johnson Foundation (1997–2006)	Price elasticity	BMI: grocery store tax, 0.01; presence of grocery store tax, 0.06; vending machine soda tax, 0.01; presence of soda vending machine tax, 0.05; at risk of overweight tax, –0.01; risk of overweight tax presence, –0.03	Taxes are not significantly associated with adolescent weight outcomes; it is likely that taxes would need to be raised substantially to affect adolescent weight; there is a small negative association in overweight adolescents
Fletcher et al[40]	Examine the effects of taxing soft drinks on children consumption	◊ USA ○ Repeated Cross Sectional Study □ Consumption, BMI, energy ♯ Soft drinks	Individual data from 22,438 subjects, 3–18 years from the NHANES III (1988–1994) and IV (1999–2006) representative sample surveys and price data from states and sales data	Price elasticity and tax scenario	Non statistically significant results on BMI, calories intake, obesity prevalence from a 6% tax, as children may substitute soda with other high in calories goods; little difference in obesity in states with an without tax	Neither vending machines restrictions nor soft drink taxes will lead to noticeable weight reduction in children; typically imposed taxes aren't significant and transparent enough for behavior changes
Wang et al[41]	Examine the potential impact on health and health spending of a nationwide penny-per-ounce excise tax on these beverages	◊ USA ○ Cross Sectional and Modeling □ Consumption and energy intake ♯ SSBs	NHANES data for subjects 25–64 years the age (2003–2006) and Heart Disease Policy Model	Effect of 1 penny per ounce excise tax (~ 22%)	SSB consumption, –15%*; energy intake, –9 kcal/d*; weight, 0.9 pounds* (~0.45 kg); obesity prevalence, –1.5%*	The tax may reduce consumption of SSBs, by 15% among adults, improve health outcomes and reduce health care costs
Beydoun et al[42]	Study the associations of price indices of fast foods (FF-PI) and fruits and vegetables (FV-PI) with dietary intakes and BMI among US children and adolescents	◊ USA ○ Cross Sectional Study □ Consumption, energy, BMI, ♯ SSBs	Individual data from a nationally representative multi-stage stratified sample of 6,759 children (2–9 years) and 1,679 adolescents (10–18 years) from CSFII, (1994–1998) and price data from the ACCRA	Price elasticity	Children/adolescents: energy (kj/d), 324.0/253.3; fat (% energy), –2.1/-0.9; sodium (mg/d), –141.8 /–87.1; sugar (g/d), 10.0/6.9; dairy products (g/d), 172.5/195.5; calcium (mg/d), 225.7/309.2; fiber (g/d), 2.7/2.5; BMI, –0.2/-0.4 kg/m^2	Among children higher fast food price is associated with better dietary quality and lower BMI; association exists between fast food and vegetable consumption; price varied by family income; higher taxes may improve dietary quality but not weight outcomes

CROSS SECTIONAL STUDIES ON ENERGY INTAKE and WEIGHT OUTCOMES OF FOODS						
Arroyo et al[43]	To characterize the effects of the 1994 economic crisis on calorie sources of Mexican households	◊ Mexico ○ Repeated Cross Sectional Study ☐ Consumption and energy # Cereals, condiments, eggs, milk, dairy, fish, fruits, legumes, meat, oils, soft drinks, sugars	Data from 5 biannual surveys (1992–2000) with >10,000 Mexican representative households, collected by ENEGI (National Institute of Statistics, Geography and Informatics)	Price elasticity	Price elasticities of kcal/year: cereals, −10.5; condiments, 1.5; eggs-milk-dairy, 0.2; legumes, −2.5; meat, 0.01; sugars, −1.5; soft drinks, 2.1	The economic crisis did not affect total calories intake and in fact calorie sources were contrary to any crisis effect
Beydoun et al[44]	Examine the effects of prices of fast foods and fruits and vegetables on dietary intake, BMI and obesity risks and across family income groups	◊ USA ○ Cross Sectional Study ☐ Consumption, energy, BMI, # Fast foods	Individual data of 7,331 adults (20–65 years) from the USA Department of Agriculture of a nationally representative Survey of Food Intakes by Individuals (CSFII) (1994–1996); price data from the American Chamber of Commerce Researchers Association	Price elasticity	Energy (kcal/d), 55.8; fat (kcal), −2.2; cholesterol (mg/d), 16.6; sodium (mg/d), 15.1; sugar (mg/d), 5.1; dairy products (g/d), 4.1; calcium (mg/d), −13.7; fiber (g/d), 2.8; diet quality index, 3.16; consumption, −0.29; BMI, 0.6 kg/m^2	Fast food prices conform to economic models; changing fast food prices may affect dietary quality and to some extent adiposity; but there are differences across socio economic groups; a tax on fast food may be effective but with equity concerns
EXPERIMENTAL STUDIES ON CONSUMPTION OF BEVERAGES						
Block et al[45]	Investigate whether a price increase on regular (sugary) soft drinks and an educational intervention would reduce their sales	◊ USA ○ Experimental study ☐ Consumption # Soft drinks	Individual data from consumers in two hospitals in Boston in 2008; prices were increased and consumption was evaluated	Effect of a $0.45 or 35% increase in price on soft drinks	Impact on sales of regular soft drinks, −26%; impact on sales of regular soft drinks, 20%	A price increase may be an effective policy to decrease sales of regular sodas
EXPERIMENTAL STUDIES ON CONSUMPTION OF FOODS						
Yang et al[46]	Study the effect of beverage price changes on purchases and substitution patterns	◊ Taiwan ○ Experimental study ☐ Consumption and BMI # SSBs	Individual data from 108 undergraduates 18–22 years old recruited through online and printed advertisements	Students were given money to purchase different beverages in different price scenarios	Own price elasticity: unhealthy beverage, −0.91*; healthy, 0.69; BMI, 0.14; cross price elasticity—healthy, 0.53; cross price elasticity—unhealthy, 0.69	Findings support price elasticity; increase/decrease in prices decrease/increase consumption of unhealthy/healthy food staff and substitution effects
Nederkoorn et al[47]	Examine whether a high tax on high calorie dense foods reduces the purchased calories in a web based supermarket	◊ Netherlands ○ Experimental study ☐ Consumption and energy intake # High energy dense foods	Individual data from 306 participants >18 years old (76% women) recruited through advertisements on Dutch websites, GoogleAds	In the tax group a 50% price increase on high energy dense foods was applied versus no tax in the other group	Impact, -14%*; total, −419 kcal/d*	A food tax may be a beneficial tool along with other measures in promoting a diet with fewer calories

(Continued)

Table S1 Studies on price and tax interventions and their effects on different outcomes (*Continued*)

Authors	Objectives	◊ Country / ○ Methods / □ Outcomes / ♯ Products	Data/population	Price/tax variable	Results	Conclusion
EXPERIMENTAL STUDIES ON ENERGY INTAKE and WEIGHT OUTCOMES OF FOODS						
Epstein et al[48]	Examine the effects of price changes in high and low calorie-for-nutrient foods on mothers' purchases for 68 common foods and drinks	◊ Singapore ○ Experimental study □ Consumption and energy ♯ Many different foods	Data from individuals recruited from a family data base, including: 42 mothers, 20 lower income/22 higher income, of whom 45% were obese	Price increase of high calorie for nutrient foods by 12.5% or by 25%	Price elasticity of energy intake for healthy foods, –0.98* Tax elasticity of total calories purchased, –0.647*	Taxing less healthy food reduces energy intake and fat purchases, and increases the proportion of protein purchased
MODELING STUDIES ON CONSUMPTION OF BEVERAGES						
Andreyeva et al[49]	Develop a method for estimating revenues from an excise tax on SSBs that governments could direct towards obesity prevention	◊ USA ○ Modeling study □ Consumption ♯ Carbonated soft drinks, fruit beverages, teas	Estimated state and city data based on 2008sales in the USA allocated and combined with Census population projections from 2007 to 2015 and price elasticities from the literature	Consumption and revenue impact from a penny-per- ounce excise tax on SSBs and diet varieties	Consumption: CSDs, –17.8%; fruit drinks, –11.4%; sports drinks, –16.0%; teas, -8.9%; energy drinks, –4.6%; coffees, 4.0%; flavored water, –14.6; total, –16.3%	A modest tax on SSBs could both raise significant revenues and improve public health by reducing obesity
MODELING STUDIES ON ENERGY INTAKE and WEIGHT OUTCOMES OF FOODS						
Mytton et al[50]	Examine the effects on nutrition, health and expenditure of extending VAT to a wider range of foods in the UK	◊ UK ○ Modeling study □ Consumption, energy, health outcomes ♯ Beverages, milk, cheese, cream, eat, fish, eggs, fats, sugar, fruits, vegetables, potatoes, bread, cereals	Cross sectional data on consumption and elasticities were obtained from the National Food Survey in Britain of 2000; these were combined with data on effect on dietary fat and cardiovascular, metabolic and other health outcomes from meta-analyses	17.5% price increase due to extending the VAT on ◊ Food with saturated fat ○ Food with SSCg3d score ≥ 9 □ A greater range of foods selected to meet best outcomes	◊Calories consumed, 2.2%[NS]; annual number of CVD deaths, 2,500 to 3,500 ○ Calories consumed, -4.3%; annual number of CVD deaths, –2,500 to—3,500 □ Calories consumed, –6.1%; annual number of CVD deaths, 2,600 to 3,200	Taxing can have unpredictable effects if cross elasticities are ignored, due to consumptions interdependence; a carefully targeted fat tax could have modest but meaningful results in food consumption and cardiovascular outcomes
Schroeter et al[51]	Identify conditions under which price and income changes are most likely to change weight, based on a three good model (low and high calorie food and exercise) used to estimate metabolic equivalents (MET) in energy accounting models	◊ USA ○ Modeling study □ Consumption, energy, weight ♯ Meats, dairy, fruit, vegetables, cereals, bakery, eggs, fats, oils, home and away home food, Sugar, suites, beverages	Modeling based on price energy and weight elasticities from the literature; baseline cross sectional population data from 1963–1965 National Health Examination Survey (NHES) and 1999–2002 NHANES	◊10% tax on food away from home and ○ 10% tax on soft drinks	◊Male weight change, 0.170 kg (0.196%); female weight change, 0.146 kg (0.196%); □ Male weight change, 0.086 kg (0.099%); female weight change, 0.091 kg (0.122%)	Income increase and food subsidies increase weight; a tax on food away from home would also increase body weight; a tax on soft drinks may decrease weight modestly; a tax to be equitable must be combined with income redistribution

Nnoaham et al[52]	To examine the effects, by income group, of targeted food taxes and subsidies on nutrition, health and expenditure in the UK	◊ UK ○ Modeling study ☐ Consumption, energy, health outcomes # Beverages, milk, cheese, cream, meat, fish, eggs, fats, sugar, fruits, vegetables, potatoes, bread, cereals	Cross sectional data from the Expenditure and Food Survey 2003–2006 and National Food Survey for price elasticities and health outcome data from meta-analysis	◊ 17.5% tax on food with saturated fat ○ Tax on a less healthy food based on nutritional profiling model WXYfm, ☐ Second scenario along two level subsites for fruits and vegetables	◊ Calories intake, –0.54%*; deaths, 110 to 2,300 ○ Calories intake, –0.66%*; deaths, 35 to 1,300; ☐ Calories intake, –0.92%* to 0.35%; deaths, –1600 to -6400	A targeted food taxes could be optimized combined with appropriate subsidies on fruits and vegetables, to reduce deaths from CVD and cancer, but measures also needed to address financial burden for certain groups
Finkelstein et al[53]	To estimate the changes in energy, fat and sodium purchases resulting from a tax that increases the price of SSBs by 20% and the effect of such a tax on body weight	◊ USA ○ Modeling study ☐ Consumption, energy, weight # SSBs (regular soda, fruit drinks, sports energy drinks), beverages (fruit juices, milk, diet soda), foods (candy, cookies, fried, salty snacks, ice cream, yoghurt, pizza, cereal, frozen dinners, canned soups, fruits and vegetables)	This analysis relies on data from the Nielsen Home Scan National Consumer Panel combined with the USDA National Nutrient Database for Each quarter of 2006, giving a sample of 114,336 observations over 28,584 households	Increase in prices by 20% tax on SSBs	Calories/day/person: SSBs, –21.2/–13.2; beverages, 2.9/1.0; foods, –3.2/–11.2; total, –21.2 /–24.3; fat/day/person due SSBs, –0.3/-0.1; beverages, 0.8/–1.8; foods, –31.3/-32.8; total, –30.4/-35.7; weight,–1.6 pounds during first year,–2.9 pounds in over 10 years	The tax on SSBs would reduce the energy purchased per household member across 19 food categories by 4.7% and would also have an effect on weight; substitution by other beverages was limited
Sacks et al[54]	To estimate the cost-effectiveness of two commonly used obesity prevention policy interventions: traffic light labeling and unhealthy food tax	◊ Australia ○ Modeling study ☐ Consumption, energy, weight # Biscuits, cakes, pastries, butter products, cereals, muffins, snack foods, confectionery, soft drinks	Data on elasticities were obtained from the National Food Survey in Britain; these were combined with data from the 1995 National Nutrition Survey	Effect of a 10% tax	Daily energy intake for male/female, –174/–121 kJ; weight change, –1.9 kg/1.3 kg	Both strategies are value for money and dominant options in obesity prevention, even in lower educated and less wealthy groups

Notes: *statistically significant results; [NS]no reported statistical significance.

Abbreviations: SSBs, sugar-sweetened beverages; CSSBs, carbonated SSBs; BMI, body mass index; VAT, value added tax; ACCRA, American Chamber of Commerce Researchers Association; ECLS-K, Early Childhood Longitudinal study, Kindergarten Class; MTF, Monitoring The Future; NHANES, National Health and Nutrition Examination Survey; CPI, consumers price index; CVD, cardiovascular disease; CSFII, Continuing Survey of Food Intakes by Individuals; BRFSS, Behavioral Risk Factor Surveillance System; CARDIA, Coronary Artery Risk Development in Young Adults; DKK, Danish Krone per kilogram; CSD, carbonated soft drinks; NLSY79, National Longitudinal Survey of Youth.

References

1. Gustavsen GW. Public policies and the demand for carbonated soft drinks: a censored quantile regression approach. Poster presented at: 11th Congress of the European Association of Agricultural Economists; August 23–27, 2005; Copenhagen, Denmark.
2. Yen ST, Lin BH, Smallwood DM, Andrews M. Demand for nonalcoholic beverages: the case of low-income households. *Agribusiness*. 2004;20(3):309–321.
3. Brown MG, Lee JY, Seale JL. Demand relationships among juice beverages: a differential demand system approach. *Journal of Agricultural and Applied Economics*. 1994;26(2):417–429.
4. Pofahl GM, Capps O Jr, Clauson A. Demand for non-alcoholic beverages: evidence from the ACNielsen Home Scan Panel. Poster presented at: American Agricultural Economics Association Annual Meeting; July 24–27, 2005; Providence, RI.
5. Dharmasena S, Capps O Jr. Demand interrelationships of at home non-alcoholic beverage consumpion in the United States. Poster presented at: Agricultural and Applied Economics Association and American Council on Consumer Interests Joint Annual Meeting; July 28, 2009; Milwaukee, WI.
6. Dharmasena S, Capps O Jr. On taxing sugar-sweetened beverages to combat the obesity problem. Poster presented at: Agricultural and Applied Economics Association, Canadian Agricultural Economics Society, and Western Agricultural Economics Association Joint Annual Meeting; July 27, 2010; Denver, CO.
7. Brown MG, Jauregui CE. *Conditional Demand System For Beverages*. Gainesville, FL: Florida Department of Citrus; 2011. Available from: http://ageconsearch.umn.edu/bitstream/104335/2/RP%202011–1.pdf. Accessed August 13, 2013.
8. Brown GM. Impact of income on price and income responses in the differential demand system. *Journal of Agricultural and Applied Economics*. 2008;40(2):593–608.
9. Zheng Y, Kaiser HM. Estimating assymetric advertising response: an application to US nonalcoholic beverage demand. *Journal of Agricultural and Applied Economics*. 2008;40(3):837–849.
10. Zhen M, Beghin JC, Jensen HH. *Accounting for Product Substitution in the Analysis of Food Taxes Targeting Obesity*. Ames, IA: Center for Agricultural and Rural Development; 2011. Available from: http://www.card.iastate.edu/publications/dbs/pdffiles/10wp518.pdf. Accessed August 13, 2013.
11. Pieroni L, Lanari D, Salmasi L. Food prices and overweight patterns in Italy. *Eur J Health Econ*. 2013;14(1):133–151.
12. Kuchler F, Tegene A, Harris JM. Taxing snack foods: manipulating diet quality or financing information programs? *Applied Economic Perspectives and Policy*. 2005;27(1):4–20.
13. Chouinard HH, Davis DE, LaFrance JT, Perloff JM. Fat taxes: big money for small change. *Forum Health Econ Policy*. 2007;10(2):1558–9544.
14. Dharmasena S, Capps O Jr. Intended and unintended consequences of a proposed national tax on sugar-sweetened beverages to combat the US obesity problem. *Health Econ*. 2012;21(6):669–694.
15. Gustavsen GW, Rickertsen K. The effects of taxes on purchases of sugar-sweetened carbonated soft drinks: a quantile regression approach. *Appl Econ*. 2011;43(6):707–716.
16. 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(4):329–341.
17. Smed S, Jensen JD, Denver S. Differentiated food taxes as a tool in health and nutrition policy. Poster presented at: 11th Congress of the European Association of Agricultural Economists; August 23–27, 2005; Copenhagen, Denmark.
18. Thiele S. Fat tax: a political measurement to reduce overweight? The case of Germany. Poster presented at: 1st Joint European Association of Agricultural Economists and Agricultural and Applied Economics Association Seminar; September 15–17, 2010; Freising-Weihenstephan, Germany.
19. Meyerhoefer CD, Leibtag ES. A spoonful of sugar helps the medicine go down: the relationship between food prices and medical expenditures on diabetes. *Am J Agric Econ*. 2010;92(5):1271–1282.
20. Zhen M, Beghin JC, Jensen HH. *Accounting for Product Substitution in the Analysis of Food Taxes Targeting Obesity*. Ames, IA: Center for Agricultural and Rural Development; 2011. Available from: http://www.card.iastate.edu/publications/dbs/pdffiles/10wp518.pdf. Accessed August 13, 2013.
21. Allais O, Bertail P, Nichele V. The effects of a "fat tax" on the nutrient intake of French households. Poster presented at: 12th Congress of the European Association of Agricultural Economists; August 26–29, 2008; Ghent, Belgium.
22. Gordon-Larsen P, Guilkey DK, Popkin BM. An economic analysis of community-level fast food prices and individual-level fast food intake: a longitudinal study. *Health Place*. 2011;17(6):1235–1241.
23. Khan LK, Sobush K, Keener D, et al. Recommended community strategies and measurements to prevent obesity in the United States. *MMWR Recomm Rep*. 2009;58(RR-7):1–26.
24. Sturm R, Powell LM, Chriqui JF, Chaloupka FJ. Soda taxes, soft drink consumption, and children's body mass index. *Health Aff (Millwood)*. 2010;29(5):1052–1058.
25. Finkelstein EA, Zhen C, Nonnemaker J, Todd JE. Impact of targeted beverage taxes on higher- and lower-income households. *Arch Intern Med*. 2010;170(22):2028–2034.
26. Powell LM. Fast food costs and adolescent body mass index: evidence from panel data. *J Health Econ*. 2009;28(5):963–970.
27. Wendt M, Todd JE. *The Effect of Food and Beverage Prices on Children's Weights*. Washington, DC: US Department of Agriculture; 2011. Available from: http://www.ers.usda.gov/media/123670/err118.pdf. Accessed August 13, 2013.
28. Powell LM, Chaloupka FJ. Food prices and obesity: evidence and policy implications for taxes and subsidies. *Milbank Q*. 2009;87(1):229–257.
29. Duffey KJ, Gordon-Larsen P, Shikany JM, Guilkey D, Jacobs DR Jr, Popkin BM. Food price and diet and health outcomes: 20 years of the CARDIA Study. *Arch Intern Med*. 2010;170(5):420–426.
30. Wendt M, Todd JE. Do low prices for sugar-sweetened beverages increase children's weights? Poster presented at: Agricultural and Applied Economics Association, Canadian Agricultural Economics Society, and Western Agricultural Economics Association Joint Annual Meeting; July 27, 2010; Denver, CO.
31. Auld CM, Powell LM. Economics of food energy density and adolescent body weight. *Economica*. 2009;76(304):719–740.
32. Zhang Q, Chen Z, Diawara N, Wang Y. Prices of unhealthy foods, food stamp program participation, and body weight status among US low-income women. *J Fam Econ Issues*. 2011;32(2):245–256.
33. Han E, Powell LM. Effect of food prices on the prevalence of obesity among young adults. *Public Health*. 2011;125(3):129–135.
34. Barquera S, Hernandez-Barrera L, Tolentino ML, et al. Energy intake from beverages is increasing among Mexican adolescents and adults. *J Nutr*. 2008;138(12):2454–2461.
35. Claro RM, Levy RB, Popkin BM, Monteiro CA. Sugar-sweetened beverage taxes in Brazil. *Am J Public Health*. 2012;102(1):178–183.
36. Sturm R, Datar A. Regional price differences and food consumption frequency among elementary school children. *Public Health*. 2011;125(3):136–141.
37. Fletcher JM, Frisvold D, Tefft N. Can soft drink taxes reduce population weight? *Contemp Econ Policy*. 2010;28(1):23–35.
38. Fletcher JM, Frisvold DE, Tefft N. The effects of soft drink taxes on child and adolescent consumption and weight outcomes. *J Public Econ*. 2010;94(11–12):967–974.
39. Powell LM, Zhao Z, Wang Y. Food prices and fruit and vegetable consumption among young American adults. *Health Place*. 2009;15(4):1064–1070.

40. Fletcher JM, Frisvold D, Tefft N. Taxing soft drinks and restricting access to vending machines to curb child obesity. *Health Aff (Millwood)*. 2010;29(5):1059–1066.
41. Wang YC, Coxson P, Shen YM, Goldman L, Bibbins-Domingo K. A penny-per-ounce tax on sugar-sweetened beverages would cut health and cost burdens of diabetes. *Health Aff (Millwood)*. 2012;31(1):199–207.
42. Beydoun MA, Powell LM, Chen X, Wang Y. Food prices are associated with dietary quality, fast food consumption, and body mass index among US children and adolescents. *J Nutr*. 2011;141(2):304–311.
43. Arroyo P, Loria A, Mendez O. Changes in the household calorie supply during the 1994 economic crisis in Mexico and its implications on the obesity epidemic. *Nutr Rev*. 2004;62(7 Pt 2):S163–S168.
44. Beydoun MA, Powell LM, Wang Y. The association of fast food, fruit and vegetable prices with dietary intakes among US adults: is there modification by family income? *Soc Sci Med*. 2008;66(11):2218–2229.
45. Block JP, Chandra A, McManus KD, Willet WC. Point-of-purchase price and education intervention to reduce consumption of sugary soft drinks. *Am J Public Health*. 2010;100(8):1427–1433.
46. Yang CC, Chiou WB. Substitution of healthy for unhealthy beverages among college students. A health-concerns and behavioral-economics perspective. *Appetite*. 2010;54(3):512–516.
47. Nederkoorn C, Havermans RC, Giesen JC, Jansen A. High tax on high energy dense foods and its effects on the purchase of calories in a supermarket. An experiment. *Appetite*. 2011;56(3):760–765.
48. Epstein LH, Dearing KK, Roba LG, Finkelstein E. The influence of taxes and subsidies on energy purchased in an experimental purchasing study. *Psychol Sci*. 2010;21(3):406–414.
49. 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(6):413–416.
50. Mytton O, Gray A, Rayner M, Rutter H. Could targeted food taxes improve health? *J Epidemiol Community Health*. 2007;61(8):689–694.
51. Schroeter C, Lusk J, Tyner W. Determining the impact of food price and income changes on body weight. *J Health Econ*. 2008;27(1):45–68.
52. Nnoaham KE, 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(5):1324–1333.
53. Finkelstein EA, Zhen C, Bilger M, Nonnemaker J, Farooqui AM, Todd JE. Implications of a sugar-sweetened beverage (SSB) tax when substitutions to non-beverage items are considered. *J Health Econ*. 2013;32(1):219–239.
54. 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(7):1001–1009.