Food Taxation and Pricing Strategies to "Thin Out" the Obesity Epidemic

Daniel Kim, MD, MPH, MSc, Ichiro Kawachi, MD, PhD

Abstract: This article highlights characteristics of two related yet distinct economic approaches to addressing the current obesity epidemic in the United States: the general taxation of soft drinks, snack foods, and/or fast foods, and the application of pricing incentives/disincentives on foods sold in schools and worksites. The article specifically focuses on the: (1) rationale for, (2) potential barriers and limitations to, and (3) possible unintended consequences of implementing these policy interventions at the state level. Novel empirical evidence showing strong positive associations between the presence of state-level taxation on soft drinks or snack foods between 1991 and 1998 and relative changes in obesity prevalence over the same time period is further presented. The article concludes by summarizing the similarities and dissimilarities of the two approaches, and by emphasizing some of the gaps and priorities regarding these strategies that should be addressed in future research and policies to best effect obesity prevention.
(Am J Prev Med 2006;30(5):430–437) © 2006 American Journal of Preventive Medicine

Introduction

The 2001 United States Surgeon General's report "A Call to Action to Prevent and Decrease Overweight and Obesity" declared obesity to have reached epidemic proportions in America.[1] Nearly one third of all American adults are obese[2] (defined as a body mass index [BMI] $\geq$30 kg/m^2),[3] and obese adults are approximately 1.5 to 2 times more likely to die prematurely of all causes, compared to those with a BMI in the healthy range (20–25 kg/m^2).[4] Overweight and obesity also pose a substantial burden as reflected in morbidity and loss of work productivity, with total costs of overweight and obesity in 2000 estimated at an overwhelming $117 billion ($61 billion in direct, $56 billion in indirect costs).[1] More recent estimates suggest that these costs may be even higher.[5]

Several individual-level behavioral factors have been shown prospectively to predict weight gain or obesity, including the consumption of fast foods[6] and sugar-sweetened beverages,[7–9] television viewing,[10] and leisure- or work-time physical inactivity.[11]

Beyond demonstrating risk factors for obesity at the individual level, there is a growing need to identify environmental etiologic factors to help explain the tremendous rise in obesity rates in the United States over recent decades, and thereby to address more effectively the current obesity epidemic using a public health approach.[12–14] Ecological and social ecological models provide theoretical frameworks linking physical, social, and political environmental characteristics, including institutional factors and public policies, to individual behaviors.[15,16] Consistent with these models, public health nutrition advocates and researchers have proposed a range of environmental intervention strategies to prevent obesity, such as restricting the sales of soft drinks, candy bars, and other minimally nutritious foods in schools; labeling food products and menu choices with nutritional information; providing incentives for communities to develop parks and other venues for physical activity; and implementing taxation and pricing incentives/disincentives to improve dietary intakes and physical activity levels.[17] These approaches possess an advantage over information-based ones such as food labeling, in that the former are "structural" or "environmental/ecological" by design, and do not rely upon an individual consumer's nutritional knowledge to make choices.

The specific focus of this article is on food-related economic approaches, assessing their utility apart from other potential weapons in the public health arsenal against obesity. Herein, attention is paid to the: (1) rationale for, (2) potential barriers and limitations to, and (3) possible unintended consequences of implementing the taxation of soft drinks, snack foods, and/or fast foods, and pricing incentives/disincentives on foods sold in schools and worksites. Moreover, in response to the recent recommendation by the Institute of Medicine's Committee on Prevention of Obesity in Children and Youth to study the examples of states currently taxing selected foods and beverages to better

From the Department of Society, Human Development, and Health, Harvard School of Public Health, Boston, Massachusetts

Address correspondence and reprint requests to: Daniel Kim, MD, MPH, Department of Society, Human Development, and Health, Harvard School of Public Health, 677 Huntington Avenue, Boston MA 02115. E-mail: dkim@hsph.harvard.edu.

© 2006 American Journal of Preventive Medicine • Published by Elsevier Inc.
0749-3797/06/$–see front matter
doi:10.1016/j.amepre.2005.12.007

assess such a policy,[18] new empirical evidence on state-level relationships between the implementation of soft drink taxes and relative changes in obesity prevalence is presented.

Taxation of Soft Drinks, Snack Foods, and/or Fast Foods

Jacobson and Brownell[19] have previously documented the status of state-level taxes on soft drinks and snack foods in the United States. In 2000, only Maine and the District of Columbia had snack food taxes in place, yet both jurisdictions subsequently repealed these taxes in 2000 and 2001, respectively. The Maryland legislature rejected a proposal in 2004 to reinstate a snack food tax, such that no U.S. states currently levy taxes on snack foods. At present, 18 U.S. states collect taxes on soft drinks, either as a fixed tax per volume or as a percentage of the sales price (with sales taxes ranging from 5% to 7.5%). However, nearly all of the states apply the taxes toward general revenues, with none earmarking the funds for either the subsidy of healthy foods, or diet or physical activity programs.[19] Meanwhile, no states currently impose a fast-food tax.

Rationale

One set of rationales for state-level taxation policies on soft drinks, snack foods, and/or fast foods is economically based. Government intervention through market failure can be argued for on the premise of asymmetric information between consumers and producers. Consumers' information about a healthy diet may have been potentially distorted as a result of the massive advertising budgets of fast-food companies (e.g., $1.2 billion for McDonald's in 2001, and $3.2 billion across all fast-food companies in 1998), which far surpass government advertising expenditures to promote healthy eating (e.g., the media and communications budget of the National Cancer Institute's 5 A Day for Better Health Program to promote fruit and vegetable consumption, which has remained at $1–$2 million annually since the program's inception in 1991).[20–22]

Obesity costs to society are an additional economic rationale for supporting the taxation of "junk foods." Negative externalities (i.e., costs imposed from one set of parties onto another as a result of the former's decisions) may occur from obese individuals onto individuals in the general populace in the form of increased premiums for health and disability insurance and Medicaid.[20] Economic analyses have estimated that smokers appear to "pay their way" through cigarette excise taxes, whereas alcohol drinkers fall far short.[23] A similar analysis for junk foods and obesity could usefully guide the appropriate level of excise taxes on such foods.

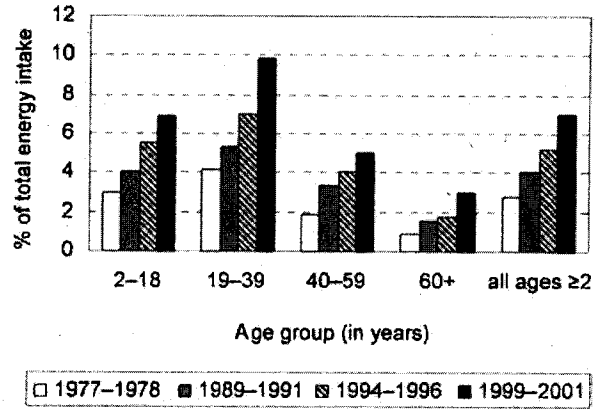

Figure 1. U.S. trends in soft drink consumption, by age group (1977–2001). From the 1977–1978 Nationwide Food Consumption Survey, 1989–1991 and 1994–1996 Continuing Surveys of Food Intake by Individuals, and 1999–2001 National Health and Nutrition Examination Survey.

Aside from economic arguments, a rationale for state-level taxation on these foods may stem from ecological and individual-level evidence linking consumption of the foods to the obesity epidemic, and from evidence of state-level relationships between the implementation of soft drink/snack food taxes and changes in obesity prevalence. Together, this body of evidence suggests the potential for taxation policies to modify consumption and to bring about large-scale obesity prevention.

Between 1977 and 1996, soft drink consumption among Americans aged 2 to 18 and 19 to 39 years increased by 83% (from 3% to 5.5% of total energy intake) and 71% (from 4.1% to 7.0% of total energy intake), respectively, while the intake of salty snack foods rose by 132% and 133%, respectively. Among those aged 40 to 59 years, consumption of soft drinks and salty snack foods increased by 111% and 171%, respectively (Figures 1 and 2).[24,25] Furthermore, be-

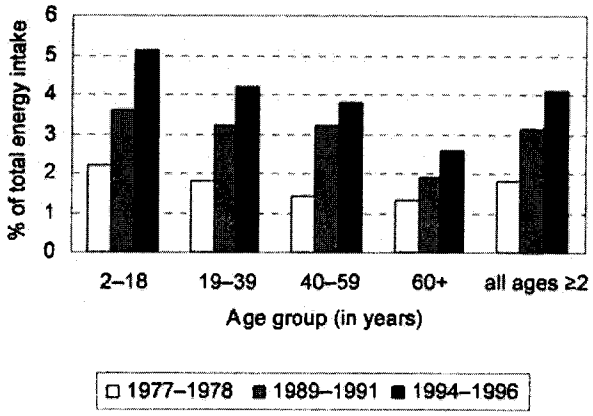

Figure 2. U.S. trends in salty snack food consumption, by age group (1977–1996). From the 1977–1978 Nationwide Food Consumption Survey, and 1989–1991 and 1994–1996 Continuing Surveys of Food Intake by Individuals.

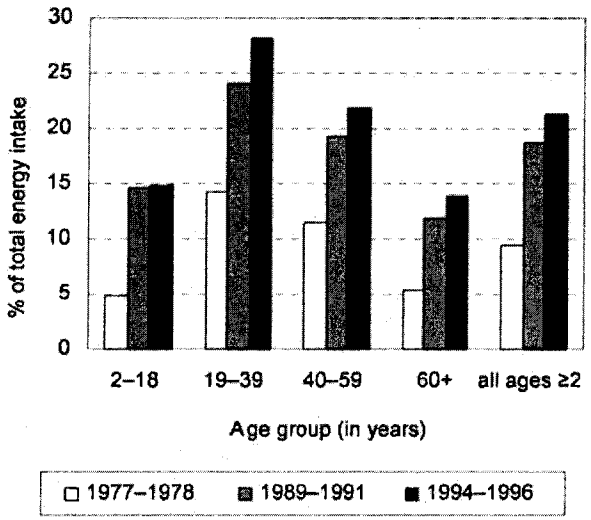

Figure 3. U.S. trends in restaurant/fast food consumption, by age group (1977–1996). From the 1977–1978 Nationwide Food Consumption Survey, and 1989–1991 and 1994–1996 Continuing Surveys of Food Intake by Individuals.

tween 1972 and 1997, the United States per capita number of fast-food restaurants doubled, and fast-food sales escalated from $51 billion to $94 billion between 1986 and 1996.[26] Across all ages, restaurant/fast-food intake as a proportion of total energy intake more than doubled between 1977–1978 and 1994–1996 (Figure 3).[24] All of these trends parallel those of U.S. adult obesity rates, which skyrocketed from 15% in 1976–1980 to 31% in 1999–2002 (Figure 4).[27] Likewise, since the 1970s, obesity rates have doubled among children aged 2 to 5 years and adolescents aged 12 to 19 years, and more than tripled among children aged 6 to 11 years.[18]

The highest proportions of total energy intake for soft drink consumption have been among youths and young adults, with proportions estimated at 6.9%, 9.8%, 5.0%, and 3.0% in the age groups 2–18, 19–39, 40–59, and ≥60 years, respectively, in 1999–2001 (Figure 1).[25] These estimates represent primarily the consumption of non-diet soft drinks, with only 4% of adolescents reportedly drinking diet soda.[28]

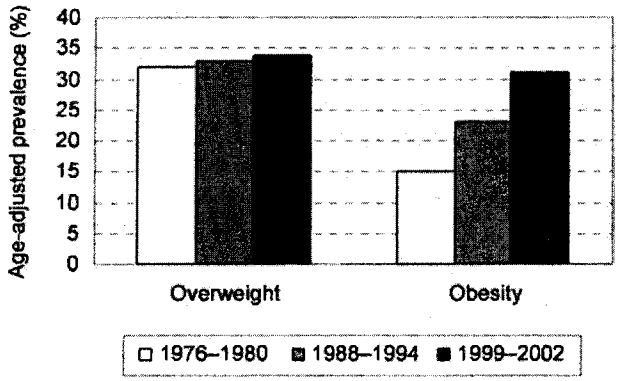

Figure 4. U.S. trends in age-adjusted prevalence of overweight and obesity, age 20–74 years (1976–2002). From the 1976–1980, 1988–1994, and 1999–2002 National Health and Nutrition Examination Surveys.

In a 19-month longitudinal study of 548 children in Massachusetts, it was shown that each additional serving of sugar-sweetened drink consumed was significantly associated with a 1.6 times higher obesity risk, controlling for demographic, dietary, and other lifestyle factors.[8] Another study found that children who drank at least 12 ounces per day of sweetened drinks had significantly greater weight gain than those who drank less.[9]

For the association between snack food consumption and weight status, a large prospective study (8203 girls, 6774 boys aged 9–14) and a smaller (196 girls aged 8–12) study of children and adolescents over 3- and 10-year periods, respectively, determined no significant relationship between higher intake of these foods and subsequent BMI.[29,30]

Meanwhile, an increase of one fast-food meal per week was significantly associated with a 0.7 kg higher weight gain over a 3-year period in a community-based sample of 891 women.[31] A cohort study of young adults further observed a significant positive relationship between greater increases in the frequency of fast-food consumption and subsequent increases in body weight among whites over 15 years.[6] Based on U.S. Census restaurant data and individual data on adults from the U.S. Behavioral Risk Factor Surveillance System (BRFSS) surveys, an increase in the average state-level real price of three franchised fast food was found to be inversely although non-significantly associated with the probability of an individual being obese.[32]

The presence of state-level taxes on soft drinks or snack foods also appears to be closely linked to obesity prevalence. State-level associations were examined between the presence of soft drink or snack food taxes between 1991 and 1998 and relative increases in obesity prevalence over the same time period (Table 1). Estimates for the latter were as previously reported for 43 U.S. states using BRFSS data.[33] Adjusting for state median age, mean income, proportion of the state population that was black according to the 1990 Census, and the political party carrying the state in the 1992 Presidential election, states without a soft drink or snack foods tax were more than four times as likely (odds ratio [OR]=4.2; 95% CI=0.4–48.3) than states with a tax to undergo a high relative increase in obesity prevalence (defined as ≥75th percentile in the relative increase). States that had repealed a soft drink or snack foods tax between 1991 and 1998 were >13 times more likely (OR=13.3; 95% CI=0.7–262.0) than states with a tax to experience a high relative increase. In addition, states without a soft drink or snack foods tax were three times more likely to exhibit a high

Table 1. U.S. state-level associations between presence of taxes on soft drinks or snack foods and relative increases in obesity prevalence, 1991–1998

	Total no. of states	No. of states ≥75%ile[a]	Multivariate-adjusted odds ratio[b] (95% CI)	*p* value
With a tax[c]	14	1	1.0	—
Without a tax	23	7	4.2(0.4–48.3)	0.25
Repealed tax	6	3	13.3(0.7–262.0)	0.09
With a 5% tax[c]	10	1	1.0	—
Without any tax	33	10	3.0(0.3–33.1)	0.38

[a]≥75th percentile in relative increase in state obesity prevalence between 1991 and 1998.
[b]Odds ratio for being ≥75th percentile, adjusted for state median age, mean income, and % black (all from 1990 U.S. Census), and political party carrying the state in the 1992 U.S. Presidential election (no odds ratio statistically significant at 0.05 level).
[c]Reference group.
CI, confidence interval.

relative increase than states that had levied at least a 5% sales tax (Table 1).

These findings are compatible with the contribution of taxes to attenuated increases in obesity prevalence over time through a direct consumption effect, although the absence of a large tax in any given state makes this effect less plausible. One alternative explanation is that social norms, beliefs, and/or values regarding obesogenic behaviors (e.g., poor diets, including soft drink consumption), obesity, and obesity prevention among the general population and policymakers may have been instilled over time within U.S. states, and subsequently shaped policymaking decisions, including the state legislation of food taxes and other obesity prevention measures.

A third main rationale for instituting state-level taxation policies derives from studies on the price elasticity (i.e., the responsiveness of the quantity demanded of a good to its price) of snack foods, which indicate the potential for taxation to raise large funds for obesity prevention programs. Kuchler et al.[34] analyzed 1999 AC Nielsen Homescan panel data from a stratified random sample of 7195 U.S. households that had scanned their food purchases to estimate the price elasticities of potato chips, all chips, and all salty snack foods, and to thereby predict the change in snack food quantities that would be purchased across a range of tax rates (1%, 10%, and 20%). Household demands of the foods were found to be relatively inelastic, and the estimated impact of the taxes on purchases, even at the 20% rate, were relatively small (at the 20% tax rate, amounting to reduced purchases of only 4–6 ounces per person per year). These results suggest that a snack food tax alone would be ineffective in lowering obesity prevalence through reduced consumption. Nevertheless, based on these estimates and the 2000 U.S. Census population, 1% and 20% tax rates on potato chips would generate approximately $27 million, and between $500 and $700 million per year, respectively.[34] Likewise, assuming a price inelasticity of soft drink consumption, if all U.S. states were to tax soft drinks at the rate of $.02 per 12-ounce can, approximately $3 billion could be raised annually.[28] Such potentially substantial revenues could be channeled into large-scale obesity prevention programs.

Potential Barriers/Limitations to Implementation

A major barrier to implementation of junk food taxes is special interest groups and moneyed interests, who have a history of strong lobbying against both soft drink and snack food taxes in the United States. For example, representatives of the Grocery Manufacturers of America (GMA) have testified before state senate committees on the regressiveness (i.e., with a larger proportion of income being spent on these foods by low-income individuals) and discriminatory nature of snack food taxes, by disproportionately affecting lower-income groups. During the 2003–2004 election cycle, food product manufacturers, including the GMA, contributed approximately $0.7 million to Democrats and $2.4 million to Republicans.[35]

General public opinion about taxation of these foods could also have contributed to the variable levying of these taxes across U.S. states, through policymakers' desires to appease their electorates (e.g., median voter preferences[36]). Recent national public opinion surveys (none of which have been state-stratified, however) have found support to be relatively low for taxation of foods for obesity prevention, unlike support for other health-related regulatory policies.[37–39] For instance, in a U.S. national survey in 2001, only 6% of respondents strongly agreed and 27% agreed with a proposal to tax snack foods to subsidize the cost of healthy foods, whereas 65% indicated support for cigarette taxation.[37]

The current lack of economic evaluation of tax policy options poses another barrier to implementation. If price elasticities of snack foods, soft drinks, and fast food are truly low, the overall utility of taxing these foods by funding obesity prevention programs would hinge upon the favorable economic evaluations of these programs. Such economic evaluations, however, are remarkably sparse.[40,41] Rajgopal et al.[40] retrospectively determined a positive cost-to-benefit ratio (i.e.,

with total benefits exceeding costs) for the Food and Nutrition Education Program in Virginia that was robust in sensitivity analyses (i.e., with similar conclusions reached across a range of possible costs and benefits). Wang et al.[41] used retrospective data to evaluate Planet Health, a school-based educational intervention designed to reduce obesity among middle-school children, and found that the program was both cost-effective (based on the net intervention cost per quality-adjusted life-year saved) and cost-saving across sensitivity analyses.

That so few economic evaluations have been conducted may derive from the fact that many relevant obesity initiatives are either in the process of being undertaken (as in the recent funding of states by the Centers for Disease Control and Prevention to develop and implement nutrition and physical activity interventions for obesity and chronic disease prevention),[42] or have not routinely collected program cost information and outcome data.[41] Additional potential barriers to economic evaluations of tax policy options are some of the present uncertainties in price elasticities of soft drinks, snack foods, and fast foods across population age groups. Nevertheless, the continued paucity of these evaluations will serve only to hinder the implementation and long-term sustainability of taxation policies on these foods if their economic feasibility cannot be demonstrated.

Gaps between research and policy may further present obstacles to implementation. For example, despite the dramatic rise in U.S. obesity rates since the 1970s, it was not until 2001 that obesity was formally declared an epidemic through the U.S. Surgeon General's report. By analogy, in the case of tobacco control, Richard Doll linked smoking to lung cancer in 1950, yet it took until 1957 for any legislative action to begin, and until 1964 for the U.S. Surgeon General to release its report on smoking and lung cancer.[43]

In spite of evidence for cigarette taxation as a highly effective policy intervention for curbing smoking prevalence rates,[44] and prior public health recommendations by nutrition advocates and researchers for taxation policies as a possible means of combating obesity,[17,45,46] neither the 2001 Surgeon General's report on obesity, the 2003 policy statement on the prevention of pediatric overweight and obesity from the American Academy of Pediatrics,[47] nor the Strategic Plan for the National Institutes of Health (NIH) Obesity Research[48] in 2004 (intended to guide the coordination of research activities across the NIH), makes explicit reference to taxation policy as a potential tool to address the obesity epidemic. The potential gaps in decision-making at the health institutional level may reflect weak linkages in information transfer from obesity researchers and/or institutional beliefs or values that do not view taxation on these foods to be effective or feasible.[43] Nonetheless, the 2004 report by the Institute of Medicine's Committee on Prevention of Obesity in Children and Youth commented on the utility of taxation on specific foods as a potential strategy, although it deemed that there was insufficient evidence to strongly recommend for or against taxation.[18]

Unintended Consequences

The potential for a food taxation policy to have adverse consequences on selected individuals should be noted. Based on evidence of a higher proportion of income spent on foods among low-income (versus higher-income) consumers,[49] and evidence for their higher consumption of added sugars and junk foods,[50] such an excise tax would likely be regressive toward these individuals.

Behavioral economic theory posits that access to some behaviors may positively or negatively reinforce the choices of other behaviors.[51,52] Coupled with the greater economic constraints among low-income individuals (who are generally at higher risk of obesity and chronic diseases), the direct health benefits from reduced consumption of junk foods through taxes might be offset by the substitution of these foods with other unhealthy foods, with harmful non-dietary health behaviors, such as smoking, or with the lack of substitution with other foods despite reduced consumption (i.e., increased food insecurity). While price elasticity estimates for snack foods in the average household would suggest minimal impacts,[34] such potential behavioral responses to junk food taxes among low-income individuals should be further explored.

The price elasticities of these foods, specifically among children and adolescents, should also be estimated. Tobacco price elasticities among youths have been shown to be several times larger than those among adult smokers, attributed to peer effects and the greater share of disposable income that young smokers spend on tobacco.[34,44] Similarly higher price elasticities among youths might hold for soft drinks, snack foods, and/or fast foods, and, if present, would favorably reduce consumption of these products, yet at the same time attenuate revenues that could be generated for obesity prevention programs. Based on evidence of the clustering of risky behaviors in adolescents,[53] taxation might further elevate the potential for substitution with other unhealthy behaviors, and thereby pose a threat to the overall aim of reducing obesity, and/or possibly introduce additional health risks.

Pricing Strategies in Schools and Worksites

Rationale

The pricing of foods—raising the price of unhealthy foods and/or lowering the price of healthy foods as an obesity prevention strategy—could be implemented in

specific settings, such as schools (middle and high schools) and worksites, with mandating at the state level. Several characteristics of school and workplace settings favor desired changes in consumption to prevent obesity, e.g., large portions of the day spent indoors with relatively limited numbers of food choices through cafeterias and vending machines, making these populations more likely to represent "captive audiences."[54] Positive behavioral reinforcements by peers within these settings may further contribute to the effectiveness of this approach.[55,56] Moreover, targeting youths through schools may help to establish healthy dietary habits early on in life,[57,58] and both school and work settings can, at least in principle, access large segments of the general population.

Evidence from one U.S. state supports the effectiveness of pricing strategies in school and workplace settings. Price reductions of 10%, 25%, and 50% of low-fat snacks sold in vending machines in 12 secondary schools and 12 work sites in Minnesota resulted in higher relative sales of these foods of 9%, 39%, and 93%, respectively, compared to usual price conditions.[59] Average vending machine profits were not significantly affected. In another study conducted in a suburban Minnesota high school over an entire school year, the prices of three popular high-fat foods were raised by about 10%, while those of four low-fat foods were lowered by approximately 25%.[60] Sales of the low-fat foods increased from 9% to 13% of total sales, while the estimated combined revenues from the seven foods were within 5% of projected revenues for usual-price conditions.[54,60] These results suggest that pricing interventions in schools and worksites may modify dietary intakes at the population level, while being implemented at minimal (if any) excess costs.

In addition, current public opinion appears to favor the application of pricing strategies within the context of schools. By contrast to the relatively low public support for the taxation of junk food, several national surveys suggest strong public support for efforts to change dietary behaviors in schools, even at individuals' own personal expense.[37,38,61] For example, in the 2003 Harvard Forums on Health obesity survey, 84% of respondents stated that they would strongly support healthier school lunches as a means of combating childhood obesity, while 76% indicated their support of such measures even if it meant an increase in their taxes, and 42% were willing to pay $100 more a year in taxes for them.[38]

Potential Barriers/Limitations

A notable drawback to these pricing strategies is the more limited population coverage compared to a taxation approach, primarily by the former affecting youths and working-age adults who purchase foods at these sites, typically limited to a single meal. Furthermore, coverage may be compromised by the fact that not all worksites contain cafeterias or vending machines, and some students and employees may bring their lunch or purchase meals at nearby food establishments.

Given the absence of state-level stratification in the public opinion surveys to date, an added potential hurdle is the possible presence of strong public opposition to these strategies in some states. For instance, such opposition might be motivated by libertarian arguments, or by concerns over the regressiveness of price controls targeting children in schools.

Meanwhile, the generalizability of these pricing interventions to more diverse populations, varied settings of schools and worksites, and other states has not yet been demonstrated. This is a critical gap to be filled if these interventions are to be scaled up to the state level and across states to effect widespread change.

As with junk food taxation policies, economic evaluations of different pricing strategies are also vital to show their economic feasibility and sustainability to politicians and policymakers. Overall, such evaluations would best be conducted with the prospective gathering of program cost information and individual-level outcome data.

Unintended Consequences

Although sales of reduced-price lower-fat foods were generally observed to rise in the school intervention studies, decreases in individual-level caloric intake have yet to be demonstrated. In fact, one potential hazard of this strategy is higher individual consumption of the lower-fat foods with an overall increase in total energy intake, which would counter the overall objective of reducing obesity risk and prevalence. Furthermore, dietary interventions in schools and workplaces may be ineffective if individuals compensate for their food choices at other meals of the day.[62,63] In future, individual-level dietary and physical assessments would aid in addressing these concerns.

Conclusion

Table 2 summarizes the key characteristics of state-level taxation policies on soft drinks, snack foods, and fast foods, along with food pricing strategies in schools and worksites. Future research and policy priorities should include additional epidemiologic, price elasticity, and efficacy and economic evaluation studies, as well as state-stratified public opinion surveys. Stronger linkages between researchers and decision-makers at the health institutional levels, and between researchers with the electorate (e.g., through the media) and policymakers should also be established. For these linkages to be successful, researchers must relay their findings in ways that will be most compelling to their audiences.[64]

Table 2. Key characteristics of U.S. state-level food taxation policies and food pricing strategies

	Food taxation policies[a]	Food pricing strategies (schools and worksites)[b]
Rationale	Economic (asymmetric information, costs of obesity to society) Potential to reduce consumption or generate funds for obesity prevention (based on population coverage and evidence from price elasticity studies and state-level analyses)	"Captive audiences," particularly for youth dietary behaviors Evidence from intervention studies Public support for school dietary interventions
Potential barriers/limitations	Opposition by food industry Public opinion Lack of economic evaluation Gaps between research and policy	Limited population coverage State variation in public opinion Lack of economic evaluation Generalizability
Potential unintended consequences	High price elasticity in youths and/or low-income groups (unhealthy behavioral substitutes) Regressiveness towards low-income groups	Inefficacy in reducing caloric intake

[a]On selected foods: soft drinks, snack foods, and/or fast foods.
[b]Price increases/decreases on selected foods sold in cafeterias and vending machines.

Despite similarities in the two approaches—including their environmental focus, lack of evidence at the individual level to demonstrate effectiveness (and absence of harm) of the strategy, and dearth of economic evaluations—there are sharp distinctions between them. As already highlighted, one important difference between the strategies is the potential degree of population coverage, with taxation on selected foods being more representative of a full population-wide strategy. By contrast, food pricing strategies in schools and worksites are more likely to reach a smaller proportion of the population. These strategies in schools could perhaps be viewed as akin to a high-risk population approach, if one considers children and adolescents as more likely to engage in high-risk behaviors, and at higher risk of adopting behaviors that track into adulthood and over the lifecourse.[58] While additional studies are needed on the price elasticities of soft drinks, snack foods, and fast foods in youths, a food taxation policy would appear better suited to generating funds for obesity prevention programs. Meanwhile, current evidence would suggest that food pricing strategies in schools and worksites may be more successful in ameliorating dietary intakes.

Echoing Geoffrey Rose's comments on the utility of both population and high-risk individual approaches,[65] both food taxation policies and pricing strategies in schools and worksites offer and pose unique opportunities and challenges, and could even complement one another or fuel one another's benefits. Implementing these strategies in tandem and in combination with other strategies, such as the restriction of sales of less nutritious foods in schools and the mandating of food product and menu labeling, may be just the best medicine in the ongoing public health battle against obesity.

Dr. Kim is supported by a Postdoctoral Fellowship through the Canadian Institutes of Health Research.

No financial conflict of interest was reported by the authors of this paper.

References

1. U.S. Department of Health and Human Services. The Surgeon General's call to action to prevent and decrease overweight and obesity. Washington DC: U.S. Government Printing Office, 2001.
2. Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trends in obesity among U.S. adults, 1999–2000. JAMA 2002;288:1723–7.
3. World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO Consultation. WHO Technical Report Series, No. 894, 2000.
4. National Institutes of Health. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. Bethesda MD: U.S. Department of Health and Human Services, 1998.
5. Finkelstein EA, Fiebelkorn IC, Wang G. National medical spending attributable to overweight and obesity: how much, and who's paying? Health Aff (Millwood) 2003(suppl web exclusives W3):21926.
6. Pereira MA, Kartashov AI, Ebbeling CB, et al. Fast-food habits, weight gain, and insulin resistance (the CARDIA study): 15-year prospective analysis. Lancet 2005;365:36–42.
7. Schulze MB, Manson JE, Ludwig DS, et al. Sugar-sweetened beverages, weight gain, and incidence of type 2 diabetes in young and middle-aged women. JAMA 2004;292:927–34.
8. Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. Lancet 2001;357:505–8.
9. Mrdjenovic G, Levitsky DA. Nutritional and energetic consequences of sweetened drink consumption in 6- to 13-year-old children. J Pediatr 2003;142:604–10.
10. Hu FB, Li TY, Colditz GA, Willett WC, Manson JE. Television watching and other sedentary behaviors in relation to risk of obesity and type 2 diabetes mellitus in women. JAMA 2003;289:1785–91.
11. Koh-Banerjee P, Chu NF, Spiegelman D, et al. Prospective study of the association of changes in dietary intake, physical activity, alcohol consumption, and smoking with 9-y gain in waist circumference among 16587 U.S. men. Am J Clin Nutr 2003;78:719–27.
12. Hill JO, Peters JC. Environmental contributions to the obesity epidemic. Science 1998;280:1371–4.
13. French SA, Story M, Jeffery RW. Environmental influences on eating and physical activity. Annu Rev Public Health 2001;22:309–35.
14. Nestle M. Food politics. Los Angeles CA: University of California Press, 2003.

15. Baranowski T, Cullen KW, Nicklas T, Thompson D, Baranowski J. Are current health behavioral change models helpful in guiding prevention of weight gain efforts? Obes Res 2003;11:23S–43S.
16. Emmons KM. Health behaviors in a social context. In: Berkman LF, Kawachi I, eds. Social epidemiology. New York NY: Oxford University Press, 2000:242–66.
17. Nestle M, Jacobson MF. Halting the obesity epidemic: a public health policy approach. Public Health Rep 2000;115:12–24.
18. Institute of Medicine. Preventing childhood obesity: health in the balance. Washington DC: The National Academies Press, 2004.
19. Jacobson MF, Brownell KD. Small taxes on soft drinks and snack foods to promote health. Am J Public Health 2000;90:854–57.
20. Cawley J. An economic framework for understanding physical activity and eating behaviors. Am J Prev Med 2004;27:117–25.
21. Olsen S. Online ad outlook brightens. CNET Networks, Inc. Available at: http://news.com.com/2100-1024-997369.html.
22. National Cancer Institute Cancer Control and Population Sciences. Report from the 5 A Day Evaluation Group. Available at: http://www.cancercontrol.cancer.gov/5aday_12-4-00.pdf
23. Manning WG, Keeler EB, Newhouse JP, Sloss EM, Wasserman J. The taxes of sin. Do smokers and drinkers pay their way? JAMA 1989;261:1604–9.
24. Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in energy intake in U.S. between 1977 and 1996: similar shifts seen across age groups. Obesity Res 2002;10:370–8.
25. Nielsen SJ, Popkin BM. Changes in beverage intake between 1977 and 2001. Am J Prev Med 2004;27:205–10.
26. Price C. Trends in eating out. Food Rev 1997;20:Sept–Dec.
27. National Center for Health Statistics. Prevalence of overweight and obesity among adults: United States, 1999–2002. Available at: http://www.cdc.gov/nchs/products/pubs/pubd/hestats/obese/obse99.htm
28. Center for Science in the Public Interest. Liquid candy: how soft drinks are harming Americans' health. Washington DC: Center for Science in the Public Interest, 2005.
29. Field AE, Austin SB, Gillman MW, Rosner B, Rockett HR, Colditz GA. Snack food intake does not predict weight change among children and adolescents. Int J Obes Relat Metab Disord 2004;28:1210–6.
30. Phillips SM, Bandini LG, Naumova EN, et al. Energy-dense snack food intake in adolescence: longitudinal relationship to weight and fatness. Obes Res 2004;12:461–72.
31. French SA, Harnack, L, Jeffery RW. Fast food restaurant use among women in the Pound of Prevention study: dietary, behavioral and demographic correlates. Int J Obes Relat Metab Disord 2000;24:1353–9.
32. Chou SY, Grossman M, Saffer H. An economic analysis of adult obesity: results from the Behavioral Risk Factor Surveillance System. J Health Econ 2004;23:565–87.
33. Mokdad AH, Serdula MK, Dietz WH, Bowman BA, Marks JS, Koplan JP. The spread of the obesity epidemic in the United States, 1991–1998. JAMA 1999;282:1519–22.
34. Kuchler F, Tegene A, Harris JM. Taxing snack foods: manipulating diet quality or financing information programs? Rev Agric Econ 2004;27:4–20.
35. Center for Responsive Politics. Food products manufacturing: top contributors to federal candidates and parties (2004). Available at: http://www.opensecrets.org/industries/contrib.asp?Ind=G2100&Cycle=2004
36. Congleton RD. The median voter model. Available at: http://rdc1.net/forthcoming/medianvt.pdf.
37. Lee T, Oliver JE. Public opinion and the politics of America's obesity epidemic. Available at: http://ksgnotes1.harvard.edu/Research/wpaper.nsf/d745629e080d1fe88525698900714934/e8b74076ad06f96385256bb100630b29/$FILE/Lee%20Oliver%20Obesity.pdf#search='lee%20oliver%20obesity%20epidemic%20american%20journal%20of%20political%20science'
38. Lake Snell Perry and Associates. Obesity as a public health issue: a look at solutions—results from a national poll. Available at: http://www.phsi.harvard.edu/health_reform/poll_results.pdf#search='Harvard%20forums%20on%20health%20snell%20obesity.
39. Evans WD, Finkelstein EA, Kamerow DB, Renaud JM. Public perceptions of childhood obesity. Am J Prev Med 2005;28:26–32.
40. Rajgopal R, Cox RH, Lambur M, Lewis EC. Cost-benefit analysis indicates the positive economic benefits of the Expanded Food and Nutrition Education Program related to chronic disease prevention. J Nutr Educ Behav 2002;34:26–37.
41. Wang LY, Yang Q, Lowry R, Wechsler H. Economic analysis of a school-based obesity prevention program. Obes Res 2003;11:1275–7.
42. National Center for Chronic Disease Prevention and Health Promotion, U.S. Department of Health and Human Services. Overweight and obesity: state-based programs. http://www.cdc.gov/nccdphp/dnpa/obesity/state_programs/. Accessed on August 10, 2005.
43. Lomas J. Connecting research and policy. Isuma 2000;1:140–4.
44. Guindon GE, Tobin S, Yach D. Trends and affordability of cigarette prices: ample room for tax increases and related health gains. Tob Control 2002;11:35–43.
45. Brownell, KD. Get slim with higher taxes (editorial). NY Times. December 15, 1994. pp. A29.
46. Jeffery RW. Public health approaches to the management of obesity. In: Brownell KD, Fairburn CG, eds. Eating disorders and obesity: a comprehensive handbook. New York NY: The Guilford Press, 1995:558–563.
47. American Academy of Pediatrics. Policy statement: prevention of pediatric overweight and obesity. Pediatrics 2003;112:424–30.
48. National Institutes of Health, U.S. Department of Health and Human Services. Strategic plan for NIH obesity research. Available at: http://www.obesityresearch.nih.gov/About/Obesity_EntireDocument.pdf.
49. Drewnowski A. Obesity and the food environment: dietary energy density and diet costs. Am J Prev Med 2004;27:154–62.
50. Bowman S. Diets of individuals based on energy intakes from added sugars. Family Econ Nutr Rev 1999;12:31–8.
51. Audrain-McGovern J, Rodriguez D, Tercyak KP, Epstein LH, Goldman P, Wileyto EP. Applying a behavioral economic framework to understanding adolescent smoking. Psychol Addict Behav 2004;18:64–73.
52. Green L, Freed, DE. The substitutability of reinforcers. J Exp Anal Behav 1993;60:141–58.
53. Rafiroiu C, Sargent RG, Parra-Medina D, Drane WJ, Valois RF. Covariations of adolescent weight-control, health-risk and health-promoting behaviors. Am J Health Behav 2003;27:3–14.
54. French SA. Public health strategies for dietary change: schools and workplaces. J Nutr 2005;135:910–2.
55. Bandura A, McDonald FJ. Influence of social reinforcement and the behavior models in shaping children's moral judgments. In: Puka B, ed. Defining perspectives in moral development. Moral development: a compendium. Vol. 1. New York NY: Garland Publishing, 1994.
56. Barr SI. Associations of social and demographic variables with calcium intakes of high school students. J Am Diet Assoc 1994;94:260–9.
57. Lien N, Lytle LA, Klepp KI. Stability in consumption of fruit, vegetables, and sugary foods in a cohort from age 14 to age 21. Prev Med 2001;33:217–26.
58. Dietz WH, Gortmaker SL. Preventing obesity in children and adolescents. Annu Rev Public Health 2001;22:337–53.
59. French SA, Jeffery RW, Story M, et al. Pricing and promotion effects on low-fat vending snack purchases: the CHIPS Study. Am J Public Health 2001;91:112–7.
60. Hannan P, French SA, Story M, Fulkerson JA. A pricing strategy to promote sales of lower fat foods in high school cafeterias: acceptability and sensitivity analysis. Am J Health Promot 2002;17:1–6.
61. Widmeyer Polling & Research. Summary of study findings: Americans' attitudes on fighting obesity. Washington DC: Widmeyer Polling & Research, 2003. Available at: www.apha.org/NPHW/2003/pressroom/findings.pdf.
62. Frazao E, Allshouse J. Strategies for intervention: commentary and debate. J Nutr 2003;133:844S–7S.
63. Burghardt J, Devaney B. The School Nutrition Dietary Assessment Study. Summary of Findings. Princeton NJ: Mathematica Policy Research, 1993.
64. Heymann SJ. Health and social policy. In: Berkman LF, Kawachi I, eds. Social epidemiology. New York NY: Oxford University Press, 2000:368–82.
65. Rose G. Sick individuals and sick populations. Int J Epidemiol 1985;14:32–8.