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Reducing Childhood Obesity through U.S. Federal Policy:

A Microsimulation Analysis

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Abstract

Background—Childhood obesity prevalence remains high in the U.S., especially among racial/ethnic minorities and low-income populations. Federal policy is important in improving public health given its broad reach. Information is needed about federal policies that could reduce childhood obesity rates and by how much.

Purpose—To estimate the impact of three federal policies on childhood obesity prevalence in 2032, after 20 years of implementation.

Methods—Criteria were used to select the three following policies to reduce childhood obesity from 26 recommended policies: afterschool physical activity programs, a \$0.01/ounce sugar-sweetened beverage (SSB) excise tax, and a ban on child-directed fast food TV advertising. For each policy, the literature was reviewed from January 2000 through July 2012 to find evidence of effectiveness and create average effect sizes. In 2012, a Markov microsimulation model estimated each policy's impact on diet or physical activity, and then BMI, in a simulated school-aged population in 2032.

Results—The microsimulation predicted that afterschool physical activity programs would reduce obesity the most among children aged 6–12 years (1.8 percentage points) and the advertising ban would reduce obesity the least (0.9 percentage points). The SSB excise tax would reduce obesity the most among adolescents aged 13–18 years (2.4 percentage points). All three policies would reduce obesity more among blacks and Hispanics than whites, with the SSB excise tax reducing obesity disparities the most.

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Conclusions—All three policies would reduce childhood obesity prevalence by 2032. However, a national \$0.01/ounce SSB excise tax is the best option.

Introduction

Although recent data suggest that childhood obesity has plateaued or begun to decline, prevalence remains high.^{1,2} In 2009–2010, nearly one in three U.S. youth aged 2–19 years were overweight or obese and 17% were obese.³ Significant disparities in obesity prevalence persist among racial/ethnic groups and by SES. More Hispanic (21.2%) and non-Hispanic black (24.3%) youth were obese in 2009–2010 than non-Hispanic white youth (14.0%).³ Obesity is also higher among lower-income children than higher-income children.⁴ Further, obese adolescents tend to remain obese as adults,^{5,6} making childhood the ideal time to prevent obesity. For these reasons, policymakers are interested in effective programs and policies to reduce childhood obesity.

States and localities are increasingly using laws, regulations, and other policy tools to promote healthy eating and physical activity (PA).⁷ However, federal policies can reach larger populations and fund programs that benefit populations at risk for obesity, and thus play an essential role in improving public health. Information is needed about which federal policies could reduce childhood obesity rates and by how much. The purpose of this study is to estimate the impact of three federal policies on childhood obesity prevalence in 2032, after 20 years of implementation.

Methods

The methods used in this analysis are summarized below; see the Appendix for more details. Microsimulation models are useful in informing health policy decision making.^{8,9} In 2012, a microsimulation model (developed in TreeAge, TreeAge Software, Inc., Williamstown MA) examined how three federal policies affect obesity-related behaviors (PA and diet), BMI, and obesity prevalence in a simulated school-aged U.S. population. The model generated annual values for these measures based on demographic and behavioral variables, and then aggregated individual estimates to create population-level results. The initial population was drawn randomly from a sample of simulated school-aged children (6–12 years) and adolescents (13–18 years) with demographic characteristics matching that of the U.S., using 2010 U.S. Census data.

The model's primary outcome variables were BMI and changes in the percentage of overweight or obese youth. Obesity and overweight were determined by comparing BMI values from the model to BMI values from CDC growth charts. The current CDC definitions of obesity (BMI at or above the 95th percentile for age and sex) and overweight (BMI at or above the 85th percentile and below the 95th percentile for age and sex) were used.¹⁰

The microsimulation model estimated yearly changes in PA, diet, and BMI using multivariable equations developed using 2001–2010 continuous National Health and Nutrition Examination Survey (NHANES) data. The equations included measures of PA expressed in METs and dietary recall measures, including total daily calories and grams of fat, carbohydrates, and sugar. NHANES data were used to assign initial health and BMI

measurements to the simulated population, and then to estimate the impact of changes in health behaviors on changes in BMI over time. Each simulated agent was initialized using a two-step process. First, age, sex, and ethnicity were assigned with the distribution of these demographic variables across the simulated population set equal to those in the 2010 U.S. Census. Second, each agent's initial BMI, level of PA, and diet were set conditioned on that agent's demographics. The distribution of each factor across the simulated population was set equal to the distribution observed for that agent's corresponding demographic group in the NHANES sample, scaled to the U.S. child and adolescent population.

The model represents changes in BMI for a simulated population over time, but the NHANES provides a series of cross-sectional estimates. To account for this difference, annual changes in BMI were estimated based on age, sex, and ethnicity trends. The relative BMI remains constant until a policy intervention causes it to trend downward to a new level consistent with expected changes in behavior from the intervention. Each policy was introduced in the model independently.

Next, a systematic process was used to search and review the literature on 26 recommended policies for preventing childhood obesity. Senior authors (RB, MA, ES, MS, and ST) narrowed the list to three policies in a two-step process using multiple criteria, including effectiveness, potential reach into the general population and high-risk groups, feasibility, acceptability, precision of information for modeling, and potential impact on childhood obesity. Effectiveness was rated as "unknown," "emerging," "promising," "effective (second tier)," or "effective (first tier)".¹¹ The other criteria were rated low, medium/moderate, or high. The policies would: (1) strengthen and expand federally funded afterschool programs to promote PA; (2) enact a \$0.01/ounce excise tax on sugar-sweetened beverages (SSBs); and (3) ban fast food TV advertising targeting children aged 12 years and under. These policies target key obesity-related behaviors through the federal policy mechanisms of appropriation, taxation, and regulation. Table 1 summarizes the policies.

Estimating Effect Sizes

PubMed and journal article references were searched from January 2000 through July 2012 to find effectiveness data for the three policies and create average effect sizes. A systematic strategy and policy definition limited the scope of the literature search and identified key data elements for the population groups targeted by each policy. The literature search and abstraction process followed methods previously described.¹² Owing to the varied nature of evidence, the general process to determine each policy's average effect size was modified as needed. Table 2 lists model inputs. Effects of interventions enter the model through increases in PA or reductions in calories, both of which are determinants of BMI z-scores.

Afterschool Physical Activity Programs

The literature search generated 55 potentially relevant articles. Inclusion and exclusion criteria identified 16 articles suitable for abstraction. To be abstracted, studies needed to evaluate an afterschool intervention or program, report measures that could be used in the model, have a sample size of at least 50, describe an intervention that resembled a typical afterschool program, use randomization or a pre-test/post-test design, require participants to

engage in PA, and be conducted in an Organisation for Economic Co-operation and Development country. One article was eliminated during abstraction because the intervention was unclear. Effect sizes for the 15 articles^{13–27} were summarized by sample size, sex, race, location, age (school grade), baseline BMI (normal or obese), program adherence, intervention design, and intervention intensity. Because most studies did not provide sample demographics, effect sizes were averaged across all racial/ethnic groups. The policy was modeled such that all programs were offered to all youth for the entire year. The modeled intervention combined individual interventions using sample sizes and demographic breakdowns as weighting factors.

Sugar-Sweetened Beverage Excise Tax

No well-controlled trials were found that directly assessed an excise tax's impact on youth SSB consumption or the relationship between SSB consumption and childhood obesity. Instead, the literature search yielded well-controlled, econometric studies using observational data that showed a negative association between increased taxes on SSBs and SSB purchases. Few studies quantified the impact of an SSB tax or price increase on childhood obesity prevalence and those that did were based on econometric forecasts. However, two key associations were found in the literature^{28–33}: (1) between SSB consumption and per-ounce excise taxes; and (2) between BMI and existing state-level soda taxes. From these studies, it was estimated that SSB consumption decreased by 25% among children and 35% among adolescents due to reduced purchasing resulting from the excise tax. The policy's impact on obesity resulted from reduced consumption of sugar and total calories, assuming complete substitution with a zero-calorie beverage. A composite SSB was created based on the nutritional content of ten calorically-sweetened beverages.

Ban on Fast Food Television Advertising Targeting Children

No studies were found that directly evaluated the impact of restricting advertising on youth consumption of high-calorie, low-nutrient foods/beverages. The literature search also did not identify any observational or experimental studies in the U.S. that examined the same issue. Instead, it yielded observational studies that explored the association between exposure to advertising and consumption of certain types of food, food purchases, or BMI. Direct evidence appears limited to observational data assessing the impact of Quebec's ban on child-directed advertising on fast food purchases.³⁴ Therefore, this analysis limits the impact of an advertising ban to fast food and uses age 12 years because research shows children under this age do not understand advertising's persuasive intent and cannot cognitively defend themselves from its effects.^{35,36}

Two estimates of changes in purchasing following the advertising ban were derived and applied to modeled individuals consuming two or more fast food meals per week. The ban's impact was assumed to be two to three fewer meals per week for children, whose parents purchase most fast food, and three to five fewer meals per week for adolescents, who can purchase fast food themselves. Although the policy targets children, the analysis included adolescents to show that the effect continues into adolescence. The policy's impact on obesity was modeled through dietary change (reduced sugar, carbohydrates, fat, and total calories). A composite fast food meal was created by averaging adult or children's portions

of main dishes, sides, and beverages from 23 large fast food chain restaurants. Adult portions were included because adolescents eat adult meals. These restaurant-specific meals were then averaged to create the composite meal. A meal meeting the 2012 National School Lunch Program standards was assumed to be substituted for each fast food meal not eaten, which would result in an average of 504 fewer calories and 94 fewer grams of sugar consumed per week.

Results

Table 3 summarizes baseline obesity rates and behaviors for the simulated school-aged population. Consistent with the underlying data, nearly 20% are obese and considerable racial and ethnic disparities exist. Just over one quarter of children get the recommended 1 hour of daily PA, whereas only one in five adolescents do. Approximately one third of the simulated youth consume SSBs at least twice per day (32.3%) and fast food at least twice a week (35.4%).

Table 4 summarizes each policy's predicted impact on PA or diet in 2032. Afterschool PA programs would increase the number of children and adolescents who met the daily PA recommendation by 7.7% and 7.4%, respectively. This change would represent an additional 25 minutes of moderate-to-vigorous PA per day. A \$0.01/ounce SSB excise tax would reduce the number of children and adolescents consuming two or more SSBs per day by 11.4% and 16.6%, respectively, which translates into an average daily reduction of 1.5 beverages in children and 2.2 beverages in adolescents. Of the three policies, the microsimulation predicted that the ban on child-directed fast food TV advertising would impact behaviors the most. The number of children eating two or more fast food meals per week would drop by almost 20%, and for adolescents by 18%. The policy would reduce consumption in children more than adolescents because children consumed more fast food at baseline and thus would have a greater potential for change.

Table 5 summarizes the policies' potential impact on rates of overweight and obesity in 2032. Obesity would decline, but overweight would increase slightly as obese individuals lose weight. The afterschool policy would reduce obesity prevalence in children by 1.8 percentage points and by 1.9 points in adolescents. The microsimulation predicted that disparities would decrease for black and Hispanic adolescents, with obesity decreasing by 2.3 and 2.4 percentage points, respectively, compared to 1.6 for whites. The change would be similar for children. The predicted impact of afterschool PA programs on disparities reflects higher baseline rates of obesity among blacks and Hispanics and the non-linear relationship between behavior change and BMI. For children, afterschool PA programs would have the largest impact on obesity of the three policies.

For adolescents, the \$0.01/ounce SSB excise tax had the largest predicted overall impact on obesity, resulting in a 2.4 percentage point decrease. Obesity would decrease by 1.6 percentage points for children. The tax would also reduce disparities, especially in adolescents. Obesity in blacks and Hispanics would drop by 3.0 and 2.9 percentage points, respectively, compared to 2.0 percentage points in whites. The greater predicted impact for black and Hispanic adolescents was despite whites' higher baseline SSB consumption. This

was due to two factors: compared to blacks and Hispanics, whites had higher income levels and are therefore less affected by a price increase, and had a lower baseline rate of obesity.

The child-directed ban on fast food TV advertising has the greatest predicted behavioral impact, but would reduce obesity prevalence the least. This is due to the substitution effect and the policy's narrow focus on fast food. Although its predicted impact on obesity is small, the large behavioral result shows that TV advertising affects what children eat. Like the other policies, its estimated impact is greater for blacks and Hispanics who watch more TV and are more heavily targeted by food marketers than whites, and thus are more impacted by reduced advertising.³⁷ Although this policy targets children aged 12 years and younger, it would also reduce obesity in adolescents because their baseline consumption of fast food is decreased because of less exposure to advertising as children.

The Appendix describes the key univariate results of a sensitivity analysis.

Discussion

This microsimulation analysis suggests that long-term implementation of three federal policies could reduce childhood obesity in the U.S. To our knowledge, this study provides the first quantitative estimate of the potential impact of afterschool PA programs on U.S. childhood obesity prevalence. The use of microsimulation contributes to the childhood obesity literature because behavior change can be modeled over time in the simulated population. This approach differs from models that derive estimates from population-level trends, and provides valuable information as to how policies may impact known disparities in health behaviors and obesity in different populations.

For the SSB and fast food advertising policies, this study's effect sizes are consistent with, but smaller than, prior work owing to the use of microsimulation, narrower policy definitions, and different assumptions. In this study, a \$0.01/ounce excise tax on SSBs would reduce obesity by 1.6 percentage points among 6–12-year-olds and 2.4 percentage points among 13–18-year-olds in 2032. Smith et al.²⁸ estimated that a 20% price increase (roughly equivalent to a \$0.01/ounce excise tax) on all SSBs could reduce childhood obesity prevalence by 2.9 percentage points. Sturm and colleagues²⁹ estimated that an 18% differential soda tax (i.e., the difference between the regular state sales tax and the higher soda tax) would correspond to a 20% reduction of the excess BMI gain seen between the third and fifth grades if the tax impact is linear.

According to the present study, a ban on child-directed fast food TV advertising would reduce obesity among children and adolescents by nearly 1 percentage point in 2032. Chou et al.³⁸ estimated that banning all TV fast food advertising would reduce the number of obese children aged 3–11 years by 18%. The model of Veerman and colleagues³⁹ predicts that a ban on all TV food advertising would reduce obesity prevalence among U.S. children aged 6–12 years by 2.5 percentage points. The bans in both studies are much broader than in this study.

All three policies could reduce childhood obesity prevalence, particularly among blacks and Hispanics, who have higher rates of obesity than whites, thus demonstrating that federal

policy could alter the childhood obesity epidemic. Although the microsimulation predicts that each policy would reduce obesity in children and adolescents, the \$0.01/ounce SSB excise tax has characteristics that make it the best option. It reduces obesity while generating significant revenue for additional obesity prevention activities. Andreyeva et al.⁴⁰ estimated that a national \$0.01/ounce SSB excise tax would have generated \$13.25 billion in 2010. It would also reduce obesity among adults who consume SSBs, does not require substantial federal funding to implement (unlike the afterschool policy), and would not face the legal hurdles that new regulations often encounter. Unfortunately, reduced federal spending, industry lobbying, a contentious political environment, and legal protection for commercial speech hinder near-term implementation of any of these policies. However, over the long timeframe included in this analysis, the infeasible may become feasible as the evidence base for these policies grows and changes in public knowledge increase calls for stronger governmental action. Research showing the harms of consuming SSBs coupled with the need for new revenue sources may spur Congress to consider a national SSB excise tax. The courts may recognize that young children need protection against the damaging influence of junk food advertising, as was done previously for tobacco and alcohol advertising, or the federal Interagency Working Group's voluntary marketing guidelines could be implemented. In the meantime, the findings support state- and local-level action to enact SSB excise taxes, promote PA in afterschool settings, and reduce marketing and advertising of unhealthy foods and beverages in public schools.

Limitations

This study has several limitations. Modeling childhood obesity is challenging and others believe attempts should stop at energy balance owing to insufficient data on the association between changes in behaviors and changes in BMI *z*-scores.⁴¹ We agree that the challenges are significant, but attempts to examine policy impact on childhood obesity have relevance. These results are only as accurate as the method used for translating short-term study results into multiple-year effects and the reliability of cross-sectional data in determining how changes in PA and diet impact BMI *z*-scores. Although strong survey surveillance systems allow robust estimation of baseline trends, there are little effectiveness data for the SSB and advertising policies, particularly in children, and existing data often come from observational studies. To broaden the evidence base, international studies were included in this analysis, which may limit applicability in the U.S. In addition, the estimated policy impact is sensitive to the model assumptions. For instance, substituting a caloric beverage, rather than a zero-calorie beverage, can reduce the SSB policy's estimated impact by over 60%. In the absence of data on substitution effects in food consumption resulting from an advertising ban, it was assumed that a lower-calorie meal would be available and consumed instead. Another limitation is the inability to assess interaction effects among the three policies or with existing policies, such as state-level physical education policies. In this analysis, policies were assessed independently, but to reverse the childhood obesity epidemic, a comprehensive set of national policies would need to be implemented.

Conclusions

The three federal policies in this analysis could each reduce childhood obesity prevalence by 2032. However, a national \$0.01/ounce SSB excise tax is the best option given its ability to

generate revenue for additional obesity prevention activities and reduce obesity among SSB-consuming adults.

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Appendix

This appendix provides detailed information about the methods used in this analysis.

I. Modeling Approach and Structure

Overview

This analysis used a microsimulation model originally developed to estimate the health impact of physical activity interventions recommended by the Community Preventive Services Task Force. In this study, the Obesity-Related Behavior Microsimulation Model (ORB) evaluated policies to reduce or prevent obesity in children and adolescents. The model is designed to examine how the policies affect obesity-related behaviors (physical activity and diet), and in turn, how changes in these behaviors affect BMI and obesity prevalence.

The model was developed with TreeAge 2012 to track the state (age, diet, physical activity, body mass index (BMI), and health status) of simulated individuals over time. TreeAge Pro 2013 R2. was used to create the estimates. Within the model, each agent is uniquely defined by a set of heterogeneous characteristics. All simulated agents are independent, in that the actions of one individual do not impact those of another. The distribution of demographic characteristic across individuals is determined by data abstracted from the literature and the population being modeled.

Demographic characteristics (sex, race and ethnicity) were assigned proportional to those of the U.S. school-age population using 2010 Census data. These individuals are then “aged” in yearly increments. Appendix Figure 1 summarizes the flow of the microsimulation.

Appendix Figure 1.
Flow of the Microsimulation Model

There are two discrete processes within the model: Initiation and Progression. The following section describes how agents are initialized and then aged.

Agent Initiation

At initiation, or baseline, demographics and health behaviors are set in a sequential manner as illustrated in Appendix Figure 1. This begins with the assumed time-invariant demographics of age, sex, and race/ethnicity. Appendix Table 1 lists the agent-level parameters tracked within the model, their conditioning factors, assumed distribution across the population, and the timing of their initialization in the model.

Initialization of time-invariant factors begins with the basic demographics of age, sex, and race/ethnicity. For each agent, these are determined by a random draw from a multinomial distribution set proportional to the population being modeled. The four racial/ethnic groups included were White, Black, Hispanic, and Other. (Note: Other was omitted from the results because it is impossible to draw policy conclusions when race is unknown).

Time varying agent-level behavioral factors are initialized by random draws from joint probability distributions. The time-varying factors that are initialized and tracked are: body mass index (BMI), physical activity level (expressed in metabolic equivalents of task or METs), and diet (total kilocalories and grams of protein, carbohydrates, dietary fiber, fat, and sugar). This begins with initialization of BMI whose conditioning factors are sex, ethnicity, and initial age. The other behavioral factors (physical activity and dietary factors), which are the target of the modeled policy interventions, are further conditioned upon initial BMI. Behavioral factors were conditioned upon BMI in order to sharpen focus upon each policy's impact upon rates of childhood obesity.

Model Progression

Youth obesity is a relative concept. Considerable changes in BMI are anticipated as a normal part of growth and development. A BMI of 20 is considered high for a 6-year-old, but normal for a 16-year-old. Thus, obesity and obesity risk are determined by comparing a youth's BMI to standardized BMI growth charts using standardized percentiles. The Centers for Disease Control and Prevention define childhood obesity as a BMI at or above the 95th percentile for age and sex, and overweight as a BMI that is at or above the 85th percentile and below the 95th percentile for age and sex.

The microsimulation reflects this growth pattern by modeling the change in BMI over time in terms of percentiles of the standardized BMI distribution conditioned upon agent age, sex, ethnicity, physical activity, and diet. As noted in Appendix Table 1, initial BMI is determined by a random draw from a distribution fit to continuous National Health and Nutrition Examination Survey (NHANES) data from 2001-2010 and conditioned on age, sex, and ethnicity. Similarly, the time-variant behaviors of physical activity and diet are determined from a random draw from a distribution conditioned on age, sex, ethnicity, and BMI. Each cycle, BMI, or more precisely BMI percentile, is adjusted according to age-, sex-, and ethnicity-based trends, as well as changes in diet and physical activity attributable to the policy intervention. For instance, an individual initialized into the model at the 60th percentile of the BMI distribution will stay at that percentile unless there is a significant change in their behavior.

Appendix Figure 2 illustrates the BMI growth path of a potential agent and plots that agent's BMI against CDC BMI growth charts. This chart pertains to the life of a simulated non-Hispanic white male from ages 2-18 and illustrates how baseline BMI and the impact of interventions are modeled. The individual is introduced into the model at age 2 with a BMI of 19.5. While this BMI corresponds to the 84th percentile of a BMI distribution conditioned upon sex and race (i.e. 2-year-old, non-Hispanic, white males), it corresponds to the 89th percentile of the population-wide distribution represented by the CDC BMI growth charts.

Appendix Figure 2.
BMI Growth and Policy Impact

At age 3, his BMI decreases to 18.5, which corresponds to the 84th percentile of the sex and ethnicity conditioned distribution at age 3. This process is repeated until age 18 and, assuming no significant behavioral changes, results in the BMI path shown by the black, triangled line.

The dotted line reflects the impact of a modeled policy intervention. In this instance, the intervention was an afterschool physical activity program initiated at age 9 and continuing until age 18. Thus, this individual has 10 years of exposure to the intervention, and the intervention resulted in a sustained, elevated level of physical activity. As a result, the individual's BMI at age 10 was reduced from 21.9 to 21 with the illustrated change in BMI percentile. At age 11, there is an additional decrease in BMI and the pattern continues until age 14 where a BMI path consistent with the increased level of physical activity is reached.

A more detailed example is provided in Appendix Table 2. There, a six-year-old experiences a dietary intervention that entails fewer calories, increased protein, and reduced sugar and fat. As the data in the table illustrates, the impact of the dietary change occurs across several dimensions, but there is a net decrease in BMI z-score. This leads to a lower starting BMI z-score in year two, and the pattern continues with the intervention's impact decreasing over time until a new steady-state is reached at approximately the 81st percentile.

A weighted regression using the NHANES continuous data (2001-2010) was used to estimate the relationship between youth BMI percentile (BMI z-score) and targeted youth behaviors (physical activity and diet). The results of this analysis were incorporated into the microsimulation. This analysis used a log specification in order to estimate BMI z-score sensitivity to a percentage change in caloric consumption and physical activity, respectively. In addition, it estimated BMI z-score sensitivity to discrete changes to the following macronutrients whose daily consumption is measured in grams: protein, carbohydrates, fiber, sugar, and fat. The following general specification was used:

$$\begin{aligned} BMI\ Z - Score = & \alpha + \beta_{ag} * age + \beta_r * race + \beta_s * sex + \beta_M * \ln(METS) + \beta_K * \ln(Kcal) \\ & + \beta_p * protein + \beta_c * carb + \beta_{SF} * SFat + \beta_{TF} * TFat + \beta_{sug} * sugar \\ & + \beta_f * fiber + \beta * INTERACTIONS \end{aligned}$$

where the term *INTERACTIONS* represents several interactions found to be significant at the .05 level. All of these are included in Appendix Table 3. Two of the covariates, METs and kilocalories, were heavily skewed and of several orders of magnitude larger than the other covariates. To protect against outlying values and put all covariates in the equation on a similar scale, both of these were log transformed. The log transformations, applied to both physical activity (measured in metabolic equivalents or METs) and kilocalories, allows their corresponding coefficient estimates to be interpreted as the change in BMI z-score that corresponds to a given percentage change in either physical activity or total energy consumption.

Appendix Table 4 contains estimates that are incorporated into the microsimulation model. As noted, the data used came from the continuous National Health and Nutrition Examination Survey (NHANES). Separate intercepts were included for each survey in order

to filter mean level shifts due to variation attributable to question rewording or measurement change. For instance, in 2008-09, a two-day food frequency questionnaire replaced a one-day questionnaire. Similarly, questions regarding types of physical activity varied slightly from year to year.

Similarly, an indicator, or dummy, variable for ages less than 12 was incorporated to adjust for known differences in how NHANES collects data regarding physical activity and diet. Prior to age 12, physical activity and diet were measured through parental interview and certain questions, such as the detailed daily activity questionnaire, were not used.

No significant interactions with either physical activity or energy consumption (kilocalories) were found.

II. Selecting the Policies

Once the microsimulation model had been adapted for this study, a comprehensive list of obesity prevention policies was developed and then narrowed in a two-stage process to the final three policies.

First, policy recommendations to improve nutrition, increase physical activity, or promote breastfeeding were collected. These policies were found by researching recommendations issued by health organizations (e.g., Yale Rudd Center, ChangeLab Solutions, the Center for Science in the Public Interest), federal task forces (the Community Preventive Services Task Force, The White House Task Force on Childhood Obesity), and entities such as the Institute of Medicine. THOMAS was also used to search for recently introduced federal legislation that pertained to children's nutrition, physical activity, or obesity. The policies were categorized by approach, as seen in the childhood obesity literature (e.g., environmental, economic, education/information). The study's senior authors (RB, MA, ES, MS, ST) refined the list and approved 26 policies.

Next, criteria were used to narrow the list to 7 policies to consider further. For each of the 26 policies, the literature was briefly reviewed to better understand the policy, identify possible federal policy mechanisms, and provide a rating for each criterion to be used in the selection process. The criteria used to select the 7 policies were: extent of the evidence base, effectiveness, reach (into the general population), reach (into high risk populations), feasibility (political), and feasibility (of implementation). Tables were created that included the information gathered from the brief literature review, plus a rating for each criterion. The senior authors (RB, MA, ES, MS, ST) reviewed those tables and chose the 7 policies each thought most worthy of further consideration. The selections were then tallied and discussed. The 7 policies were determined by consensus from those receiving either the most or next-to-most number of votes:

1. Subsidize fruits and vegetables for recipients of the Supplemental Nutrition Assistance Program (SNAP).
2. Regulate advertising of unhealthy foods to children and adolescents.

3. Provide funding for communities to build or make improvements to public parks, playgrounds, and other safe spaces for youth to be physically active.
4. Require states and metropolitan planning organizations to adopt “Complete Streets” principles into all federally-funded transportation projects.
5. Strengthen and expand federally-funded afterschool programs to promote physical activity.
6. Enact a 1-cent-per-ounce excise tax on sugar-sweetened beverages, and earmark revenue for obesity prevention strategies in high risk communities.
7. Increase students’ fruit and vegetable consumption by expanding federal programs, such as the Fresh Fruit and Vegetable Program and the Department of Defense Fresh Fruit and Vegetable Program.

Issue briefs were then written to summarize additional research conducted on the 7 policies. Each issue brief contained pertinent history and background information, plus a rating for the same criteria as those used to select the 7 policies, with the addition of acceptability (to the general public and policymakers), precision of information for modeling, and potential impact on childhood obesity. RB, MA, ES, MS, and ST reviewed the issue briefs and selected the final three policies to be analyzed. The afterschool policy was selected because it had the strongest evidence of effectiveness, due to a large number of intervention studies. The sugar-sweetened beverage excise tax had also been well-studied and would have very broad reach into both the general population and populations at-risk for obesity. The policy to regulate advertising, although controversial, was selected to address the known negative influence of advertising on children’s diets. Although this policy posed challenges, it was selected to illustrate what could happen if the federal government regulated advertising of unhealthy foods to children.

III. Estimating Policy Impact

Once the final three policies were selected, each one was defined and a Boolean search strategy was developed using key search terms specific to each policy. The search strategies were tested and refined to weed out unrelated literature threads. The policy definitions clarified the scope of the literature search, the key data elements that were to be abstracted from identified published manuscripts, and the population groups targeted by the policy. As noted in the manuscript, the literature search and abstraction process followed methods for article identification and standards for abstraction established in prior projects.

Structured literature reviews were then conducted for the three policies to find evidence of effectiveness. Titles and abstracts were scanned for relevance to the policy. Full articles were retrieved and key information identified. There were considerable differences in the literature base for each policy, and the development of interventions is discussed on a policy-by-policy basis.

Afterschool Physical Activity

Key search terms included “activity,” “physical,” “fitness,” “school,” “children,” and “adolescen*.” The literature search generated 55 potentially relevant articles. Inclusion and exclusion criteria were developed and applied to each relevant study to identify those to abstract. Studies were eliminated if the intervention was: school-based (i.e., occurred primarily during school hours), part of a larger multi-component intervention or initiative, primarily educational, or dissimilar from a typical afterschool program in the United States (e.g., included an intensive family component, specifically targeted overweight/obese children or adolescents). Sixteen articles were identified for abstraction. During abstraction, one study was eliminated because the intervention was unclear.

Next, effect sizes for the 15 abstracted articles were compiled by sample type, sex, race/ethnicity, location, age (school grade), baseline BMI (normal, obese), adherence, intervention design, and intervention intensity (frequency and level of physical activity). The term “sample type” refers to the different groups targeted by the intervention and how they were reported. For instance, Burguera reported on two intervention groups and Howe reported on Attendees and Non-Attendees. Appendix Table 5 summarizes studies by primary author and reported study group.

Effect sizes and intervention intensity were also reported in various ways. Obesity effect sizes were reported as average change in BMI, average weight loss, and percentage sample shift in obesity category (normal, overweight, and obese). Similarly, intervention design and intensity was reported variously and included: minutes in moderate-to-vigorous physical activity, minutes relative to a control group, and percentage change in physical activity.

Most studies did not provide complete sample demographics unless a particular group was targeted. In such cases, effect sizes were averaged across all the groups. The final modeled intervention was constructed by combining individual interventions using sample sizes and demographic breakdowns as weighting factors. This intervention included weighted estimates of both adherence and physical activity change.

Excise Tax on Sugar-Sweetened Beverages

Key search terms included “sugar-sweetened beverages,” “soft drinks,” and “soda.” The literature search failed to identify an evaluation of a \$0.01/ounce sugar-sweetened beverage excise tax on consumption of sugar-sweetened beverages. As mentioned in the manuscript, the evidence base linking tax policy to sugar-sweetened beverage consumption consists of well-controlled econometric studies. To develop a reliable estimate of the policy’s impact, a two-step approach was used. First, from the existing literature, a relationship between price and consumption of sugar-sweetened beverages was developed. Appendix Table 6 summarizes the articles used to establish this relationship.

The second step was to create a composite serving of a sugar-sweetened beverage. This was based upon the average caloric content and grams of sugar of 10 leading sugar-sweetened beverages. These beverages and the composite beverages are listed in Appendix Table 7.

Ban on Fast Food Television Advertising Targeting Children

Key search terms included “brand,” “marketing,” “advertis*,” “media,” “commercials,” “children,” and “food.” Consistent with the approach to assess the impact of an excise tax on sugar-sweetened beverages, a two-step approach was followed when examining the impact of reduced food advertising on obesity. First, a relationship between advertising and consumption of nutrient-poor, calorie-dense fast food was developed. Then, based upon the menus of 23 fast food restaurants, a composite meal was developed and compared to an alternative healthy meal, which was the 2012 National School Lunch Program standards. As noted in the manuscript, the relationship between consumption and advertising is based upon observational studies that explore the association between exposure to advertising and consumption.

The assumed effect size of 2-3 fewer meals per week for children from fast food-purchasing families and 3-5 fewer meals per week among adolescents was developed from Dhar’s analysis of a child-directed advertising ban in Quebec, Canada. The key impact of that advertising ban appeared to be a significant reduction in the number of households with children purchasing any fast food (13.4%). This value was applied to households with children purchasing fast food. Dhar also indicated a greater impact upon households with individuals under age 26 (38.7%). This adjustment was applied to adolescent consumption.

Next, a composite fast food meal was created. Appendix Table 8 lists, by restaurant, the composition of an average fast food meal.

IV. Sensitivity Analysis

Appendix Table 9 summarizes key univariate results for a sensitivity analysis on changes in obesity from the three policies, given different values for model parameters. For afterschool PA programs, three factors influenced changes in childhood obesity rates: baseline PA level, the intervention’s intensity (indicated by a percentage change in overall physical activity level), and participants’ adherence to the program. Obesity rates fell more under the following model assumptions: lower baseline physical activity, higher program intensity, and higher program adherence. The SSB excise tax and fast food television advertising ban, which affect obesity through dietary change, were sensitive to changes in baseline diet and assumptions regarding the composition of the SSB or fast food meal. The underlying factor for both policies is the number of calories consumed. For the excise tax, obesity rates fell more under the following assumptions: more baseline servings of SSBs and greater price sensitivity. For the advertising policy, obesity rates were most sensitive to the average number of fast food servings per week.

Appendix Table 1

Agent-level parameters within the model

Agent-Level Parameter	Conditioning Factors	Population Distribution	Time of Initialization	Fixed or Variable	Source for Baseline
Age	N/A	N/A	Model Introduction	Variable	U.S. Census
Sex	N/A	Binomial	Model Introduction	Fixed	U.S. Census
Race/Ethnicity	N/A	Multinomial	Model Introduction	Fixed	U.S. Census
BMI	Age, Sex, Race	Gamma	Model Introduction	Variable	NHANES
Calories	Age, Sex, Race, BMI	Gamma	Model Introduction	Variable	NHANES
Protein (gms/day)	Age, Sex, Race, BMI	Normal	Model Introduction	Variable	NHANES
Carbohydrates (gms/day)	Age, Sex, Race, BMI	Normal	Model Introduction	Variable	NHANES
Fiber (gms/day)	Age, Sex, Race, BMI	Normal	Model Introduction	Variable	NHANES
Fat (gms/day)	Age, Sex, Race, BMI	Normal	Model Introduction	Variable	NHANES
Sugar (gms/day)	Age, Sex, Race, BMI	Normal	Model Introduction	Variable	NHANES
Physical Activity (METs/day)	Age, Sex, Race, BMI	Gamma	Model Introduction	Variable	NHANES

Appendix Table 2

Illustration of a dietary intervention experienced by a simulated 6-year-old child

<i>Current Age</i>	6	7	8	9	10	11	12	13	14	15	16	17	18
<i>Starting BMI Percentile</i>	0.95	0.94	0.92	0.91	0.90	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.82
<i>Current BMI Z-score</i>	1.64	1.53	1.43	1.34	1.26	1.19	1.13	1.07	1.03	0.99	0.96	0.93	0.90
<i>Baseline Diet</i>													
<i>Current kcal</i>	2000	1940	1892	1854	1823	1798	1779	1763	1750	1740	1732	1726	1721
<i>Current Protein</i>	63	63	64	64	64	64	64	65	65	65	65	65	65
<i>Current Sugar</i>	150	138	128	121	115	110	106	103	100	98	96	95	94
<i>Current Fiber</i>	24	24	24	24	24	24	24	24	24	24	24	24	24
<i>Current sFat</i>	40	38	36	35	34	33	33	32	32	31	31	31	31
<i>Current tFat</i>	47	44	41	39	37	36	34	34	33	32	32	31	31
<i>Diet with Intervention</i>													
<i>New kcal</i>	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
<i>New Protein</i>	65	65	65	65	65	65	65	65	65	65	65	65	65
<i>New Sugar</i>	90	90	90	90	90	90	90	90	90	90	90	90	90
<i>New Fiber</i>	24	24	24	24	24	24	24	24	24	24	24	24	24
<i>New sFat</i>	30	30	30	30	30	30	30	30	30	30	30	30	30
<i>New tFat</i>	30	30	30	30	30	30	30	30	30	30	30	30	30
<i>BMI z-score change attributable to dietary intervention:</i>													
<i>kcal</i>	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
<i>Protein</i>	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Sugar</i>	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Fiber</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Sat. Fat</i>	-0.07	-0.06	-0.05	-0.04	-0.03	-0.02	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01
<i>Trans Fat.</i>	0.18	0.14	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.02	0.02	0.02	0.01
<i>Total Impact of Dietary Change</i>	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.03	0.03	0.02	0.02
<i>Final BMI Z-Score</i>	1.53	1.43	1.34	1.26	1.19	1.13	1.07	1.03	0.99	0.96	0.93	0.90	0.88
<i>Final BMI Percentile</i>	0.94	0.92	0.91	0.90	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.82	0.81

Appendix Table 3

Summary of NHANES datasets, variables,^a and formulas used

Description	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010
Sex	riagendr	riagendr	riagendr	riagendr	riagendr	riagendr
Age in years	ridageyr	ridageyr	ridageyr	ridageyr	ridageyr	ridageyr
Age in months at exam	redageex	redageex	redageex	redageex	redageex	redageex
Race/Ethnicity	ridreth1	ridreth1	ridreth1	ridreth1	ridreth1	ridreth1
Education for youth (grade level)	dmddeduc3	dmddeduc3	dmddeduc3	dmddeduc3	dmddeduc3	dmddeduc3
Household Income	indhinc	indhinc	indhinc	indhinc	indhinc	indhinc
Body Mass Index (kg/m ²)	BMXBMI	BMXBMI	BMXBMI	BMXBMI	BMXBMI	BMXBMI
Do you now smoke cigarettes	SMQ040	SMQ040	SMQ040	SMQ040	SMQ040	SMQ040
During the past 30 days, on how many days did you smoke cigarettes?	SMQ640	SMQ640	SMQ640	SMD641	SMD641	SMD641
How old were you when you smoked a whole cigarette for the first time?	smq630	smq630	smq630	smd630	smd630	smd630
How old {AGE in YRS} when {you/s/he} first started to smoke cigarettes fairly regularly?	SMD030	SMD030	SMD030	SMD030	SMD030	SMD030
METs from biking physical activity (bike_mets)	pad080	pad080	pad080	pad080	paq640*pad645*4/W Week	paq640*pad645*4/W Week
METs from yardwork home tasks or other activity	paq050q*pad080*4 Mets	paq050q*pad080*4 Mets	paq050q*pad080*4 Mets	paq050q*pad080*4 Mets	NA (as 99999)	NA (as 99999)
METs from general activity (gen_mets)	pad120*pad160*4. 5 Mets/30.5	pad120*pad160*4. 5 Mets/30.5	pad120*pad160*4. 5 Mets/30.5	pad120*pad160*4. 5 Mets/30.5	vig_gen_mets = 8Mets*paq610*pad615/wk mod_gen_mets = 4Mets*paq625*pad630/wk gen_mets = vig_gen_mets + mod_gen_mets NA (as 99999)	vig_gen_mets = 8Mets*paq610*pad615/wk mod_gen_mets = 4Mets*paq625*pad630/wk gen_mets = vig_gen_mets + mod_gen_mets NA (as 99999)
METs from strengthening activities (mus_mets)	pad460*60*4 Mets/30.5	pad460*60*4 Mets/30.5	pad460*60*4 Mets/30.5	pad460*60*4 Mets/30.5	NA (as 99999)	NA (as 99999)

Description	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010
METs during TV or inactivity (tv_mets)	30 * 1.2 Mets	30 * 1.2 Mets	30 * 1.2 Mets	30 * 1.2 Mets	pad590 * 60 * 1.2 Mets	pad590 * 60 * 1.2 Mets
METs from play or recreational activity (play_mets)	pad560/wk 60 * 7 Mets	pad560/wk 60 * 7 Mets	pad560/wk 60 * 7 Mets	pad560/wk 60 * 7 Mets	vig_play_mets = 8 Mets pad655 * pad660/wk mod_play_mets = 4 Mets pad670 * pad675/wk play_mets = vig_play_mets + mod_play_mets	pad706
METs from IAF physical activity	padmets * paddurat padtimes/30	padmets * paddurat padtimes/30	padmets * paddurat padtimes/30	padmets * paddurat padtimes/30	NA (as 99999)	NA (as 99999)
DAILY METs (From above variables)	bike_mets + yard_mets + gen_mets + mus_mets + tv_mets + play_mets + iaf_mets	bike_mets + yard_mets + gen_mets + mus_mets + tv_mets + play_mets + iaf_mets	bike_mets + yard_mets + gen_mets + mus_mets + tv_mets + play_mets + iaf_mets	bike_mets + yard_mets + gen_mets + mus_mets + tv_mets + play_mets + iaf_mets	bike_mets + gen_mets + tv_mets + play_mets	bike_mets + gen_mets + tv_mets + play_mets
Energy (kcal)	DRXTKCAL	DRXTKCAL	DRITKCAL+DR2T KCAL/2	DRITKCAL+DR2T KCAL/2	DRITKCAL+DR2T KCAL/2	DRITKCAL+DR2T KCAL/2
Protein (gm)	DRXTTPROT	DRXTTPROT	DRITTPROT+DR2P ROT/2	DRITTPROT+DR2P ROT/2	DRITTPROT+DR2P ROT/2	DRITTPROT+DR2P ROT/2
Carbohydrate (gm)	DRXTCARB	DRXTCARB	DRITCARB+DR2T CARB/2	DRITCARB+DR2T CARB/2	DRITCARB+DR2T CARB/2	DRITCARB+DR2T CARB/2
Total fat (gm)	DRXTTFAT	DRXTTFAT	DRITTFAT+DR2T TFAT/2	DRITTFAT+DR2T TFAT/2	DRITTFAT+DR2T TFAT/2	DRITTFAT+DR2T TFAT/2
Total saturated fatty acids (gm)	DRXTSFAT	DRXTSFAT	DRITSFAT+DR2T SFAT/2	DRITSFAT+DR2T SFAT/2	DRITSFAT+DR2T SFAT/2	DRITSFAT+DR2T SFAT/2
Total monounsaturated fatty acids (gm)	DRXTMFAT	DRXTMFAT	DRITMFAT+DR2T TMFAT/2	DRITMFAT+DR2T TMFAT/2	DRITMFAT+DR2T TMFAT/2	DRITMFAT+DR2T TMFAT/2
Dietary fiber (gm)	DRXTFIBE	DRXTFIBE	DRITFIBE+DR2TF IBE/2	DRITFIBE+DR2TF IBE/2	DRITFIBE+DR2TF IBE/2	DRITFIBE+DR2TF IBE/2
Total sugars (gm)	NA (.)	DRXTSUGR	DRITSUGR+DR2T SUGR/2	DRITSUGR+DR2T SUGR/2	DRITSUGR+DR2T SUGR/2	DRITSUGR+DR2T SUGR/2

^a = Specific NHANES variable names are listed as used, and composite variables are carried to create new row names.

* = indicates multiplication

** = indicates raised to a power

Appendix Table 4

BMI transition equations for youth model

Included Factor	Estimated Value	[95% Conf. Interval]	
Constant	1.572351	−4.43253	7.577234
2003-04	0.1072308	−0.01639	0.230848
2005-06	0.0319784	−0.10381	0.167765
2007-08	0.0226489	−0.10495	0.150247
2009-10	0.0991812	0.001308	0.197054
Black	0.2348633	0.162821	0.306905
Hispanic	0.256809	0.185804	0.327814
Other	−0.20231	−0.31039	−0.09424
Age	0.2679141	−0.1346	0.670423
Age: 6-12	0.0802496	−0.02549	0.185988
Log Kilocalories	0.577096	0.222726	0.931466
xAge	−0.086279	−0.11057	−0.06199
Protein (gm)	0.0050325	0.003479	0.006586
Carbohydrates (gm)	−0.000527	−0.0014	0.000348
Fiber (gm)	−0.011272	−0.01686	−0.00568
Sugar (gm)	0.0012338	0.000205	0.002263
Saturated Fat (gm)	−0.007902	−0.013	−0.00281
Trans Fat (gm)	0.0109678	0.005468	0.016467
Physical Activity (Log METs)	−0.810288	−1.56747	−0.05311
xAge	0.0530394	0.001293	0.104786

Appendix Table 5

Articles used to develop the modeled afterschool physical activity intervention

Author	Study Size			Race				Grade			Adherence		Lost to Followup		Absolute Change in Minutes of Physical Activity/Week (Intervention versus Control)				Relative Change in Minutes of Physical Activity/Week (Intervention versus Control)			METs Impact/Wk (Adjusting for Non-Adherence and Dropout)		
	Male	Female	Total	White	Black	Hispanic	Other	1-5	6-8	9-12	Control	Other	Control	Other	Low	Moderate	Vigorous	Low	Moderate	Vigorous	Total Increase in METs From Intervention	Increase in METs (Intervention-Control)	% Change in METs	
Gortmaker	63	51	114	NR	NR	NR	NR	114	NR	NR	47.0%	48.0%	NR	NR	NR	NR	NR	NR	NR	30.3%	Not Calculable	Not Calculable	18.6%	
Burguera (Gp1)	NR	NR	27	NR	NR	NR	NR	27	NR	NR	NR	NR	NR	27.4%	NR	NR	90.0	90.0	90.0	NR	Not Calculable	783.9	Not Calculable	
Burguera (Gp2)	NR	NR	29	NR	NR	NR	NR	29	NR	NR	NR	NR	NR	27.4%	NR	NR	60.0	60.0	60.0	NR	Not Calculable	522.6	Not Calculable	
deffer	NR	NR	292	NR	NR	292	0	NR	NR	NR	NR	NR	NR	7.9%	17.1%	NR	NR	NR	NR	NR	Not Calculable	Not Calculable	Not Calculable	
Hove (Attendees)	31		31	NR	31	NR	0	31	NR	NR	NR	82.9%	NR	NR	NR	NR	NR	NR	NR	NR	4812.2	Not Calculable	Not Calculable	
Hove (Non-Attendees)	31		31	NR	31	NR	0	31	NR	NR	NR	32.8%	NR	NR	NR	NR	NR	NR	NR	NR	1482.4	Not Calculable	Not Calculable	
Iversen (Normal BMI)	32	32	71	NR	NR	NR	71	47	24	NR	NR	NR	NR	NR	0.0	68.8	68.8	0.0	NR	NR	Not Calculable	825.3	Not Calculable	
Iversen (Obese)	22	22	48	NR	NR	NR	48	32	16	NR	NR	NR	NR	NR	0.0	339.5	339.5	0.0	NR	NR	Not Calculable	4074.0	Not Calculable	
Dzewaltowski	NR	NR	148	NR	NR	NR	0	148	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	2520.0	Not Calculable	Not Calculable	
Matvienko	35	35	70	57	NR	NR	0	70	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	900.0	Not Calculable	Not Calculable	
Robinson	NR	261	261	NR	261	NR	0	261	NR	NR	NR	21.0%	NR	15.7%	0.0	40.5	40.5	0.0	NR	NR	378.0	2212.3	Not Calculable	
Gutin	95	NR	206	NR	138	NR	0	206	NR	NR	NR	44.0%	NR	NR	0.0	280.0	280.0	0.0	NR	NR	Not Calculable	7656.4	Not Calculable	
Barbeau	NR	118	118	NR	118	NR	0	89	30	NR	54.0%	54.0%	NR	NR	NR	NR	NR	NR	NR	NR	1968.5	Not Calculable	Not Calculable	
Kedder	NR	NR	258	111	44	88	15	258	NR	NR	NR	NR	NR	NR	0.0	734.3	224.4	0.0	NR	NR	Not Calculable	5242.0	Not Calculable	
Pate	86	89	175	NR	154	NR	0	NR	NR	NR	NR	NR	NR	NR	0.0	-189.0	0.0	NR	NR	NR	Not Calculable	-945.0	Not Calculable	
Wilson	NR	NR	53	NR	NR	NR	0	NR	53	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	545.0	Not Calculable	Not Calculable	
Story	NR	54	54	NR	54	NR	0	NR	54	NR	53.0%	52.0%	NR	NR	NR	NR	NR	NR	NR	50%	355.7	Not Calculable	12.1%	
Madsen	NR	NR	NR	NR	32	84	45	178	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	918.0	Not Calculable	Not Calculable	

Appendix Table 6

Articles used to develop the relationship between price and SSB consumption

Author(s)	Journal Info	Population or Setting	Intervention or Policy	Outcome Measures and Results	Study Design & Analysis
Andreyeva T, Chaloupka FJ, Brownell KD	Prev Med. 2011;52(6): 413-416	U.S. census population projection from 2007 - 2015	A penny-per-ounce excise tax on all SSBs	A 24% decrease in SSB consumption	Used data available from consumer reports to develop a model to estimate the revenue which can be generated from an excise tax.
Andreyeva T, Long MW, Brownell KD	Am J Public Health. 2010;100(2): 216-222	The general public	N/A	Estimated price elasticity of soft drinks: .79 (aggregate measure for all SSBs)	Systematic review of studies on price elasticities of different foods, including SSBs.
Block JP, Chandra A, McManus KD, Williett WC	Am J Public Health. 2010;100(8): 1427-1433	Patrons of the cafeteria in Brigham and Women's Hospital in Boston, MA	Price increase of 45 cents on regular soft drinks sold in the cafeteria and a beverage cart (a 35% increase), plus an educational campaign	Change in sales of regular soft drinks (decreased by 26%)	A 5 phase intervention study. Used a comparison site.
Cradock AL, McHugh A, Mont-Ferguson H, Grant L, Barrett JL, Wang YC, Gortmaker SL	Prev Chronic Dis. 2011;8(4):A74	High school students in Boston, MA	School district policy restricting sales of SSBs in Boston schools	Change in daily consumption of SSBs	Quasi-experimental evaluation. Results from the Boston Youth Survey taken by 2,033 public high school students Feb-April '04 and Feb-April '06 were compared to national trends as reported in the '03-'04 and '05-'06 NHANES.
Dharmasena S, Capps O Jr	Health Econ. 2012;21(6): 669-694	U.S. households	A national 20% tax that is completely passed onto the consumer on 3 categories of SSB (sports drinks, regular soft drinks, and fruit drinks)	Consumption of both SSBs and non-SSBs (other non-alcohol beverages) based on 20% tax, net calories/month, and change in body weight/year	Uses a demand systems approach (Quadratic Almost Ideal Demand System) to delineate the effect of a SSB tax on consumption, calorie intake, and weight outcomes. Used Nielsen Homescan Panel data 1998-2003. Does not aggregate categories of SSB into one measure of price elasticity.
Duffey KL, Gordon-Larsen P, Shikany JM, Jacobs DR Jr, Popkin BM	Arch Intern Med. 2010;170(5): 420-426	5115 young adults (aged 18-30) in the Coronary Artery Risk Development in Young Adults (CARDIA) Study. Study is limited to whites and blacks.	Changes in price of soda and pizza that have occurred since 1985 (year 0 of the CARDIA study)	Price elasticity of % change in energy from foods associated w/ 10% change in price; est. model coefficients of association b/w price, the probability of consumption, and the amount consumed	CARDIA is a 20 year longitudinal study. Directly measured individual-level consumption and health-outcome data were linked with community price data to determine the secular trends in selected food and beverage prices and their association with consumption (price elasticity of demand), total energy intake, weight.

Author(s)	Journal Info	Population or Setting	Intervention or Policy	Outcome Measures and Results	Study Design & Analysis
Finkelstein EA, Zhen C, Nonnemaker J, Todd JE	Arch Intern Med. 2010;170(22):2028-2034	Households (Used 2006 Nielsen Homescan panel)	a 20% or 40% tax on (a) carbonated SSBs only (b) all SSBs	20% tax on all SSBs = 10 kcal/day fewer from SSBs (per capita) and 7 kcal/day fewer from all beverages (per capita) = avg weight loss of .32 kg/person per year. 40% tax on all SSBs = 17.1 kcal/day fewer from SSBs (per capita) and 12.4 kcal/day fewer from all beverages (per capita) = avg weight loss of .59 kg/person per year.	Multivariate regression models estimated the association between changes in monthly beverage prices and changes in monthly kcal purchased to predict the impact of 20% and 40% price increases. Accounted for substitution. Estimates are separated by household income quartile.
Fletcher JM, Frisvold D, Tofft N	J Public Econ. 2010;94:967-974	U.S. children and adolescents aged 3-18	State taxes on soft drinks	Reduction in calories consumed by soda resulting from a tax. For youth: a 1 percentage point increase in the soft drink tax rate results in 6 fewer calories consumed from soda. However, an increase of 8 calories results from increased whole milk consumption (net increase of 2 calories).	Uses soft drink tax data collected between 1989 and 2006 and restricted access NHANES data.
Fletcher JM, Frisvold D, Tofft N	Health Affairs. 2010;29(5):1059-1066	U.S. children and adolescents ages 3-18	State sales tax rates on soft drinks and school policies that restrict access to SSBs in vending machines and other school locations	Number of grams/calories consumed and BMI z-score, obese, and overweight by whether state ever had a soda tax.	Secondary analysis using data from NHANES '88-'94 and '99-'06 to examine the effects of soda taxes on soda consumption and weight.
Hall KD, Sacks G, Chandramohan D, Chow CC, Wang YC, Gortmaker SL, Swinburn BA	Lancet. 2011;378:826-837	U.S. population	20% tax on SSBs	Weight loss The tax would result in 2.2 lbs of average weight loss after year one. After 5 years, the tax would result in about 4 lbs of average weight loss.	Developed a dynamic model that simulates the body's metabolic response to losing weight (weight loss occurs quickly initially, then slows over time).
Lin BH, Smith TA, Lee JY, Hall KD	Econ Hum Biol. 2011;9(4):329-341	U.S. children 2-19 and adults 20+	A 20% specific excise tax on SSBs that is completely passed onto the consumer (a 20% price increase)	Change in calories, predicted weight loss among adults over 10-yr period, and predicted change in adult prevalence of overweight and obesity over a 10-yr period	Analysis used Nielsen Homescan data (1998-2007) and NHANES (2003-2006).
Lopez RA, Fantuzzi KL	Appl Econ. 2012;44:2859-2865	U.S. households in 20 cities	10% ad valorem tax on regular carbonated soft drinks	Consumption at the brand level	Uses Berry-Levinsohn-Pakes logit model to estimate demand. Used scanner data.

Author(s)	Journal Info	Population or Setting	Intervention or Policy	Outcome Measures and Results	Study Design & Analysis
Sacks G, Veerman JL, Moodie M, Swinburn B	Int J Obes. 2011;35(7): 1001-1009	Australia	A 10% tax on unhealthy food categories (including SSBs) that would raise the consumer price by 10%	Consumption of different food categories, costs, cost-effectiveness A 10% price increase on soft drinks would result in a decrease of 14.9 kcal/day for males and 6.7 kcal/day for females. BMI reduction per person would be 0.6 for males and 0.5 for females.	Modeling analysis. Used equations developed by Swinburn to model a change in mean population body weight. Used a multistate life table Markov model that simulates and compares two populations in separate life tables (a baseline pop and one that is identical but receives the intervention). Modeling was implemented in Excel 2003.
Schroeter C, Lusk J, Tyner W	J Health Econ. 2008;27(1): 45-68	Adults	10% tax on soft drinks (seems to only be soda, not a full range of SSBs)	Weight loss, change in BMI A 10% tax on regular soft drinks leads to a loss of 0.189 lbs for an average man, and a loss of 0.201 lbs for an average woman	Works within a utility maximization framework, uses a simple 3-good model (a high calorie food tax, a low calorie food subsidy, and exercise). The approach is extended, first theoretically and then empirically, to analyze the weight impacts for the N-good case.
Smith TA, Lin BH, Lee JY	(2010). USDA Economic Research Report. 100, 1 - 23.	U.S. children and adults	20% price increase on calorically sweetened beverages that consumers are aware of	Beverage consumption, calories, weight loss, BMI, prevalence of overweight/obesity Adults: avg reduction of 37 calories per day, 3.8 lbs per year. Children: avg reduction of 43 calories per day, 4.5 lbs per year. Estimated to reduce prevalence of adult overweight to 62.4%, adult obesity to 30.4%, childhood overweight to 27% and childhood obesity to 13.7%	Secondary analysis using 1999-2004 NHANES data and Nielsen Homescan Panels from 1998-2007. Uses static weight loss rule that 1 lb of body fat has 3500 calories (overestimates weight loss).
Sturm R, Powell LM, Chiqui JF, Chaloupka FJ	Health Affairs. 2010;29(5): 1052-1058	Students who were involved in the Early Childhood Longitudinal Study - Kindergarten (ECLS-K) cohort study	Existing state-level sales tax rates for soda purchased at grocery stores. Those taxes did not necessarily apply to other SSBs.	Association between soda tax and BMI, drinks consumed per week and drinks bought at school Extrapolating effects to an 18% differential soda tax would correspond to a -0.23 BMI units, or a 20% reduction of the excess BMI gained.	Secondary analysis combining data from ECLS-K with state-level grocery store tax rates to determine whether there is an association between BMI and SSB tax.
Taber, DR, Chiqui, JF, Powell LM, Chaloupka FJ	Arch Pediatr Adolesc Med. 2012;166, 256 - 262.	Schools in the United States	State policies that ban all SSBs or ban only soda from schools	In-school SSB access, weekly purchasing, daily purchasing, and overall SSB consumption (weekly and daily)	Cross-sectional

Author(s)	Journal Info	Population or Setting	Intervention or Policy	Outcome Measures and Results	Study Design & Analysis
Wang YC, Ludwig DS, Sonneville K, Gortmaker SL	Arch Pediatr Adolesc Med. 2009;163(4):336-343	U.S. children and adolescents 2-19 years	Replacing beverages with other beverages, particularly replacing SSBs with water. Also whether children and youth compensate for liquid calories consumed. Study aims to shed light on concerns about substitution effects when people switch from SSBs to other caloric drinks (mostly juice and milk).	Association between consumption of SSBs and other beverages and changes in total energy intake. Replacing all SSBs with water would result in an avg net reduction of 235 kcal/day for all children aged 2-19, and a reduction of 302 kcal/day for children aged 12-19.	Fixed effect regression analysis to test the potential effects on total energy intake of replacing one beverage for another (looked at replacing SSBs, juice, and water with other beverages). Used NHANES 2003-2004 survey data (the 24 hour dietary recall interview).
Yen S, Lin B, Smallwood D	Agri-business. 2004;20:309-321	Low-income households in the United States	N/A	Different elasticities for categories of beverages	Estimated a Translog demand system using a nonlinear extension to the linear Tobit system of Amemiya. Used data from the National Food Stamp Program Survey (908 households).
Zhen C, Wohlgemut MK, Kays S, Kaufman P	Amer J Agr Econ. 2010;93(1):175-193	U.S. households	A one-half cent per ounce excise tax on SSBs purchased in grocery stores. Testing whether habit formation impacts demand for SSBs.	Reduced demand for SSBs (measured in 12-ounce cans) Low-income households: reduced SSB demand is 118-135 12-ounce cans/year High-income households: reduced SSB demand is 110-128 12-ounce cans/year	Used a dynamic extension of the almost ideal demand system (AIDS) and incorporated habit formation into the model. The demand system was separately estimated for low- and high-income households. Data came from Nielsen Homescan panel 2004-2006.

Appendix Table 7

Development of composite SSB serving

Beverage	Calories	Sugars (g)	Ounces
Coke	140	42	12
Sprite	140	42	12
Snapple	150	46	12
Juicy Juice	100	25	8
Hi-C	110	25	6
Capri Sun	90	25	6
Country Time Lemonade	90	16	8
Powerade	130	40	12
Gatorade	90	20	12
Sunny D	90	21	6
Composite Sugar Sweetened Beverage	101	26.3	8

Appendix Table 8

Development of composite fast food meal

Surveyed Restaurants	Calories	Fat (g)	Cholesterol (mg)	Sodium (mg)	Carbo-hydrates (g)	Dietary Fiber (g)	Sugar (g)	Protein (g)
Arby's	479.6	11.6	27.9	984.4	78.2	2.5	45.2	15.8
Burger King	714.6	26.2	45.8	1183.8	103.8	4.5	40.3	20.1
Carl's Jr	483.1	23.9	40.9	994.4	53.6	2.0	25.1	14.4
Cici's Pizza	588.9	20.2	54.2	1131.0	84.8	0.3	44.1	18.9
Chick-fil-A	395.0	12.3	51.7	721.7	44.7	1.8	27.0	23.8
Chipotle	210.9	9.3	10.7	259.9	26.0	3.2	1.4	6.6
Domino's Pizza	1104.1	53.8	969.9	2016.3	104.6	6.6	50.0	32.8
Dairy Queen	923.3	33.8	67.1	1445.1	137.0	5.7	75.5	21.3
Hardee's	766.1	34.9	1531.8	93.4	5.4	28.6	19.6	0.0
In-N-Out Burger	1058.3	50.5	78.4	1309.6	122.7	5.0	44.8	33.9
Jack in the Box	587.8	21.7	34.7	1146.9	517.1	79.1	3.3	31.2
KFC	1050.0	36.5	87.4	1484.4	163.1	3.6	121.2	24.9
Krystal	711.0	22.2	55.6	947.4	109.0	5.0	54.8	22.3
Little Caesars Pizza	641.5	33.4	51.4	1240.3	69.0	2.3	33.0	20.4
McDonald's	652.9	22.9	40.6	958.3	88.6	4.5	36.7	17.9
Papa John's Pizza	1239.3	36.9	66.5	2026.2	201.5	4.3	101.9	30.7
Pizza Hut	917.4	30.4	66.6	1730.0	141.7	3.6	88.5	25.3
Popeyes	672.8	24.3	61.7	1514.9	90.4	3.7	52.6	25.0
Sonic	1152.3	47.4	93.6	1468.2	164.8	4.0	106.9	21.0
Subway	465.8	8.4	37.9	620.8	74.1	5.3	45.8	24.0
Taco Bell	613.0	16.8	18.8	814.6	100.7	3.5	64.5	11.0

Surveyed Restaurants	Calories	Fat (g)	Cholesterol (mg)	Sodium (mg)	Carbo-hydrates (g)	Dietary Fiber (g)	Sugar (g)	Protein (g)
Wendy's	575.7	20.4	39.6	925.6	81.0	3.9	33.7	17.3
White Castle	1105.3	59.9	83.3	1326.1	119.9	7.2	65.8	22.7
<i>Composite Meal</i>	<i>743.9</i>	<i>28.6</i>	<i>157.2</i>	<i>1145.4</i>	<i>116.6</i>	<i>8.3</i>	<i>51.4</i>	<i>20.9</i>
National School Lunch Guideline	550	10	130	710	90	15.5	25	45
<i>Net Change per Meal</i>	<i>-193.9</i>	<i>-18.6</i>	<i>-27.2</i>	<i>-435.4</i>	<i>-26.6</i>	<i>7.2</i>	<i>-26.4</i>	<i>24.1</i>

Appendix Table 9

Sensitivity analysis

Model and Policy Assumptions	Model Parameters		Change in Obesity Rate Under Different Assumptions	
	Baseline Value	Range (+/-) for Sensitivity Analysis	+ Sensitivity Value	- Sensitivity Value
<i>Afterschool Physical Activity</i>				
Physical activity level (METs)	1902.7	471.9	-1.3%	-2.7%
Percentage change in METs/week (Policy effect size)	22.6%	5.8%	-2.8%	-1.5%
Adherence	52.5 %	2.3%	-2.1%	-1.4%
<i>\$.01/Ounce Excise Tax on SSBs</i>				
Baseline diet				
Daily calories	2027.0	723.3	-0.8%	-2.7%
Daily grams of sugar	131.2	59.3	-1.4%	-2.5%
Composition of average SSB (Per 8ounce serving)				
Calories	101.9	16.6	-2.2%	-1.7%
Grams of carbohydrates	26.3	5.4	-2.4%	-1.9%
Current daily 8ounce servings	2.2	1.4	-2.8%	-1.4%
Percent change in consumption (Policy effect size)				
Children (6-12 yrs)	25%	12.5%	-2.9%	-1.1%
Adolescents (13-18 yrs)	35%	17.5%		
<i>Ban on Fast Food Advertising Targeting Children</i>				
Baseline diet				
Daily calories	2027.0	723.3	-1.2%	-0.5%
Daily grams of sugar	131.2	59.3	-1.1%	-0.7%
Daily grams of fat	75.3	31.9	-0.9%	-0.8%
Average composition of fast food meal				
Calories	744.0	46.6	-1.9%	-0.5%
Grams of sugar	52.0	10.1	0.8%	-0.7%

Model and Policy Assumptions	Model Parameters		Change in Obesity Rate Under Different Assumptions	
	Baseline Value	Range (+/-) for Sensitivity Analysis	+ Sensitivity Value	- Sensitivity Value
Grams of fat	29.0	3.0	0.7%	-0.8%
Current weekly servings	2.5	2.8	-2.0%	-0.2%
Reduced servings of fast food ^a				
(Policy effect size)				
Children (6-12 yrs)	2.5	1.25	-1.5%	-0.1%
Adolescents (13-18 yrs)	4	2		

^a = Those averaging fewer fast food meals per week than the modeled effect size experienced a complete elimination of fast food consumption.

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Summary of U.S. federal policies to reduce childhood obesity

Table 1

Afterschool Physical Activity		\$0.01/ounce Excise Tax on SSBs	Ban on Fast Food Television Advertising Targeting Children
Policy Description	Programs that incorporate 60-90 minutes of moderate-to-vigorous physical activity 3-5 days per week and are delivered after school.	A 1-cent-per-ounce excise tax placed on beverages containing added caloric sweeteners.	A ban on fast food television advertising that targets children aged 12 and under.
Targeted Population(s)	Children and adolescents ages 6-18	Children and adolescents ages 6-18	Children ages 6-12
Summary Impact	The policy results in a potential average increase in moderate-to-vigorous physical activity of 22.6% across both age groups. The potential impact is smaller among children ages 6-12 (15.3%) than adolescents ages 13-18 (25.3%) due to differences in baseline activity levels.	There are two potential impacts: For children (ages 6-12), whose parents purchase most SSBs, the tax results in a 25% average decrease in SSB consumption. For adolescents (ages 13-18), who can independently purchase SSBs, the tax results in a 35% average decrease in SSB consumption.	There are two potential impacts: For children (ages 6-12), whose parents purchase most fast food, the advertising ban results in 2-3 fewer fast food meals consumed per week. For adolescents (ages 13-18), who have their own purchasing power, the advertising ban results in 3-5 fewer fast food meals consumed per week.

Table 2

Microsimulation model parameters

Model Inputs	Baseline Value	Range (+/-) for Sensitivity Analysis	Data Source
<i>Demographics, BMI and Health Behaviors</i>			
Age	US population distribution	NA	2010 US Census
Race and ethnicity			
BMI ^a	21.4	5.8	2001-2010 Continuous NHANES
Physical activity level (METs) ^{ac}	1902.7	471.9	
Diet ^a			
Daily calories	2027.0	723.3	
Daily grams of sugar	131.2	59.3	2001-2010 Continuous NHANES
Daily grams of fat	75.3	31.9	
Daily grams of carbohydrates	269.4	99.7	
<i>Afterschool Physical Activity</i>			
Percentage change in METs/wk (Policy effect size) ^b	22.6%	5.8%	Abstracted articles
Program adherence ^b	52.5%	2.3%	
<i>\$.01/ounce Excise Tax on SSBs</i>			
Composite SSB (per 8 ounce serving)			Abstracted from beverage labels ^d
Calories	101.9	16.6	
Grams of sugar	26.3	5.4	
Current daily 8 ounce servings ^a	2.2	1.4	2001-2010 Continuous NHANES; YRBS
Percent change in consumption (Policy effect size)			
Children (6-12 yrs)	25%	(12.5%, 37.5%)	SSB literature
Adolescents (13-18 yrs)	35%	(17.5%, 52.5%)	
<i>Ban on Fast Food Television Advertising Targeting Children</i>			
Composite fast food meal			
Calories	744.0	46.6	Abstracted from menus ^e
Grams of sugar	52.0	10.1	
Grams of fat	29.0	3.0	
Current weekly servings ^f	2.5	2.8	2003-2010 Continuous NHANES
Reduced servings of fast food (Policy effect size) ^g			Marketing literature
Children (6-12 yrs)	2.5	(1.25, 3.75)	
Adolescents (13-18 yrs)	4	(2, 6)	
Substituted healthy meal			
Calories	600	NA	National School Lunch Program

Model Inputs	Baseline Value	Range (+/-) for Sensitivity Analysis	Data Source
Grams of sugar	25	NA	
Grams of fat	10	NA	

^aListed value is the average across the entire simulated population. Unique values for each simulated individual are drawn from age-, gender-, and ethnicity-specific distributions fit to the 2001-2010 continuous NHANES data.

^bAdjusted by age and grade in school according to abstracted literature.

^cExpressed in metabolic equivalents (METs) derived from CDC tables and assuming a sedentary floor of 1200 (8 sleeping hours and 16 inactive hours).

^dAbstracted beverages were: Coke, Sprite, Snapple, Juicy Juice, Hi-C, Capri Sun, Country Time Lemonade, Powerade, Gatorade, and Sunny D.

^eAbstracted restaurants were: Arby's, Burger King, McDonald's, Wendy's, Taco Bell, Dairy Queen, Subway, Hardee's, Carl's Jr., In-N-Out Burger, Jack in the Box, White Castle, Krystal, Popeyes, Chick-fil-A, KFC, Chipotle, Sonic, Domino's Pizza, Pizza Hut, Little Caesars Pizza, Papa John's Pizza, and CiCi's Pizza.

^fThe average for the entire modeled population where almost 2/3 (64.6%-Table 3) consumed fewer than 2 fast food meals/week.

^gThose averaging fewer fast food meals per week than the modeled effect size experienced a complete elimination of fast food consumption.

Table 3

Baseline weight and behavior distributions of simulated population

Age	Race/ Ethnicity ^a	Normal Weight (<85%ile of BMI distribution)	Overweight (85-<95%ile of BMI distribution)	Obese (95%ile of BMI distribution)	Meets Physical Activity Recommendation ^b	Consumes 2+ SSBs/Day ^c	Consumes 2+ Fast Food Meals/Week ^c
All	All	64.3%	15.9%	19.8%	24.3%	32.3%	35.4%
	All	65.6%	15.5%	19.0%	26.8%	30.5%	37.9%
6-12	White	68.3%	15.4%	16.3%	24.4%	29.3%	36.8%
	Black	61.8%	15.6%	22.7%	31.5%	30.1%	37.7%
	Hispanic	57.5%	17.5%	25.1%	24.1%	30.0%	41.5%
13-18	All	63.0%	16.3%	20.7%	21.5%	34.2%	32.7%
	White	67.9%	15.0%	17.1%	19.7%	35.8%	37.2%
	Black	59.6%	15.6%	24.8%	17.0%	28.2%	21.3%
	Hispanic	56.0%	18.6%	25.4%	19.0%	29.6%	32.3%

^a Other was removed from Race/Ethnicity^b At least one hour of daily physical activity (CDC's recommendation for children aged 6-17 years)^c Extrapolated from the NHANES 2-day food frequency questionnaire

Table 4

Change in childhood obesity-related behaviors in 2032

Ages	Race/ Ethnicity ^a	Change in Youth Meeting Physical Activity Recommendation	Change in Youth Consuming 2+ SSBs/Day	Change in Youth Consuming 2+ Fast Food Meals/Week
All	All	7.5%	-13.9%	-18.8%
	All	7.7%	-11.4%	-19.6%
	White	7.1%	-10.6%	-18.0%
6-12	Black	8.7%	-11.2%	-18.5%
	Hispanic	7.0%	-11.3%	-22.4%
	All	7.4%	-16.6%	-18.0%
13-18	White	6.9%	-15.9%	-16.2%
	Black	6.7%	-14.5%	-12.1%
	Hispanic	6.6%	-14.5%	-21.3%

^a Other was removed from Race/Ethnicity

Table 5

Change in childhood weight distributions in 2032

Age	Race/ Ethnicity ^a	Afterschool Physical Activity			\$0.01/ounce Excise Tax on SSBs			Ban on Fast Food Television Advertising Targeting Children		
		Change in Normal Weight	Change in Over- weight	Change in Obesity	Change in Normal Weight	Change in Over- weight	Change in Obesity	Change in Normal Weight	Change in Over- weight	Change in Obesity
6-12	All	1.7%	0.2%	-1.9%	1.7%	0.2%	-1.9%	0.6%	0.2%	-0.9%
	All	1.6%	0.2%	-1.8%	1.2%	0.3%	-1.6%	0.7%	0.2%	-0.9%
	White	1.6%	0.1%	-1.6%	1.1%	0.2%	-1.3%	0.7%	0.0%	-0.7%
	Black	1.7%	0.5%	-2.2%	1.4%	0.5%	-1.9%	0.7%	0.3%	-1.0%
	Hispanic	1.9%	0.4%	-2.3%	1.5%	0.5%	-2.0%	0.8%	0.4%	-1.2%
13-18	All	1.8%	0.1%	-1.9%	2.3%	0.1%	-2.4%	0.6%	0.3%	-0.8%
	White	1.8%	-0.2%	-1.6%	2.2%	-0.2%	-2.0%	0.6%	0.1%	-0.7%
	Black	1.8%	0.6%	-2.3%	2.5%	0.6%	-3.0%	0.5%	0.5%	-1.0%
	Hispanic	2.0%	0.4%	-2.4%	2.7%	0.2%	-2.9%	0.6%	0.5%	-1.1%

^a Other was removed from Race/Ethnicity