Drink Different

Feasible Strategies to Reduce Obesity

January 2015

Anusuya Chatterjee and Sindhu Kubendran

MILKEN INSTITUTE

Acknowledgments

This project involved numerous discussions with stakeholders, foundations, members of the health policy community, and our research colleagues about effective policy to combat obesity. The views expressed, and any errors or omissions, are those of the authors and the Milken Institute. We thank our research colleagues Ross DeVol and Perry Wong for their support and Jaque King for her research contributions. We also thank our communications colleagues Skip Rimer, Cecilia Arradaza, Conrad Kiechel, Jeff Monford, and Melody Yuan for their valuable assistance. Lastly, we owe a debt of gratitude to our editors, Rosemary Perkins and Edward Silver, who greatly improved the quality and clarity of this report.

About the Milken Institute

The Milken Institute is a nonprofit, nonpartisan think tank determined to increase global prosperity by advancing collaborative solutions that widen access to capital, create jobs and improve health. We do this through independent, data-driven research, action-oriented meetings and meaningful policy initiatives.

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Executive Summary

If trends continue toward unhealthy lifestyle choices and more sedentary work and leisure activities, obesity will become more prevalent in the United States. According to the Centers for Disease Control and Prevention (CDC), overweight tips into obesity at a body mass index (BMI) of 30, which corresponds to a weight of about 203 pounds on a person 5 feet 9 inches tall. The added sugars and unhealthy fats common in the American diet pile on empty calories, often displacing more nutritious foods. These empty-calorie foods and drinks fail to provide satiety, or a sense of fullness, despite their caloric load. In addition, people who consume large amounts of low-satiety foods are often insufficiently active to burn off the surplus calories. The result: excess calories are stored in the form of fat. We examined a leading contributor to the empty-calorie syndrome, sugar-sweetened beverages, and explored its effects.

Why this study is needed

Numerous studies have confirmed the cause-and-effect relationship between sugar-sweetened beverages and obesity, but most have been conducted at the national or state level. A "micro-level" analysis, taking into account geographical diversity, public policy differences, local demographics and infrastructure, as well as other contributing factors, will enable more people to appreciate the seriousness of the issue.

Skeptics dismiss a link between sugar-sweetened beverages and obesity, claiming that while consumption of sugary drinks has fallen in recent years, the obesity rate has not, although its growth may have slowed. There are several ways to explain this apparent paradox. Consumers may replace sugar-sweetened beverages with other, equally unhealthy foods and drinks. A person who doesn't feel satisfied after consuming empty calories may compensate by eating even more. The adverse effects of physical inactivity and sedentary work may outweigh efforts to improve diet. In addition, excess calorie intake over the long term disrupts the process by which insulin regulates carbohydrate and fat metabolism. Finally, a combination of factors could be at play, leading to the adverse end result: weight gain.

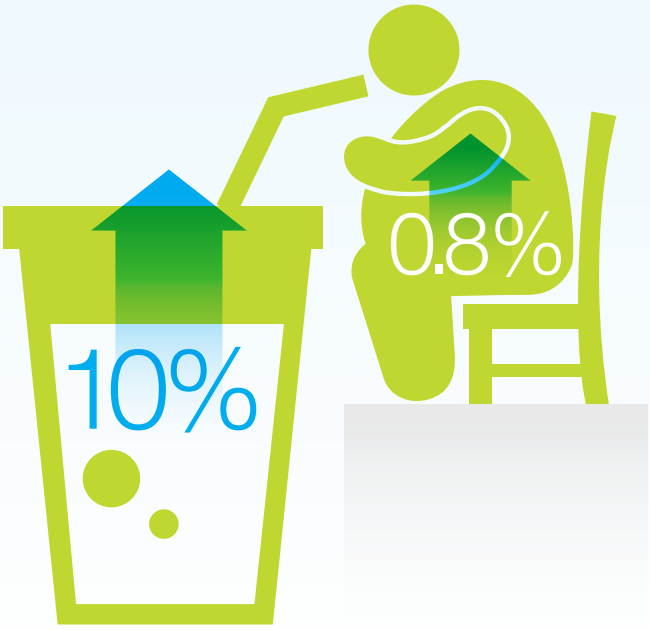
Data-driven evidence will help policymakers, consumers, business leaders, and other stakeholders devise ways to improve dietary habits and rein in obesity. Sturdy estimates of how future consumption patterns will influence obesity rates and affect the health-care system could facilitate the development of an effective long-term policy. Our study offers a dual-value proposition:

a) Our methodology incorporated micro-level geographic variations to establish the strength of the link between sugar-sweetened beverages and obesity, taking into account behavioral and neighborhood-specific factors.

b) We charted a baseline scenario—the expected pattern of consumption if the status quo was maintained—and an optimistic scenario to map how changes in sugary drink consumption could influence obesity rates and the burden they impose on health-care resources.

A HEAVY IMPACT

Increasing sugar-sweetened drink intake is linked to rising obesity



Data included in this study

More than 52 percent of sugar-sweetened beverages are consumed outside of restaurants and other public eating places, yet many of the attempts to curb their consumption have targeted only those establishments. To tackle the obesity issue effectively, health policy must take a comprehensive approach to include behaviors at home as well.

We studied home consumption of sugar-sweetened beverages in 26 market groups defined by the Nielsen Homescan™ research organization, which represent 76.5 percent of the U.S. population. We defined sugar-sweetened beverages as non-alcoholic carbonated beverages and non-carbonated caloric beverages consumed at home. In American homes, these drinks include sodas, fruit drinks of less than 100 percent juice, and sports drinks. Our sample does not represent the entire U.S., but accounts for almost 80 percent of the sugar-sweetened beverages that Americans consumed in 2010. Based on recent historical data, the differences in obesity rates in our sample and in the nation as a whole were within 1 percentage point.

Main findings

After controlling for behavioral risks, work-life environment, and neighborhood factors, we found that:

- For every 10 percent increase in the consumption of sugar-sweetened beverages, the obesity rate increases by 0.8 percent.

Obesity and excess caloric intake are risk factors for the development of diabetes and heart disease, the leading killers both in the U.S. and worldwide. Unhealthy diets, with too much fat and sugar, undermine the nation's economic health. Our results indicate that effective policies are needed to curb unhealthy behaviors and encourage healthy ones. Even moderate behavior changes can have a substantial impact not only on individual health but on the health-care system.

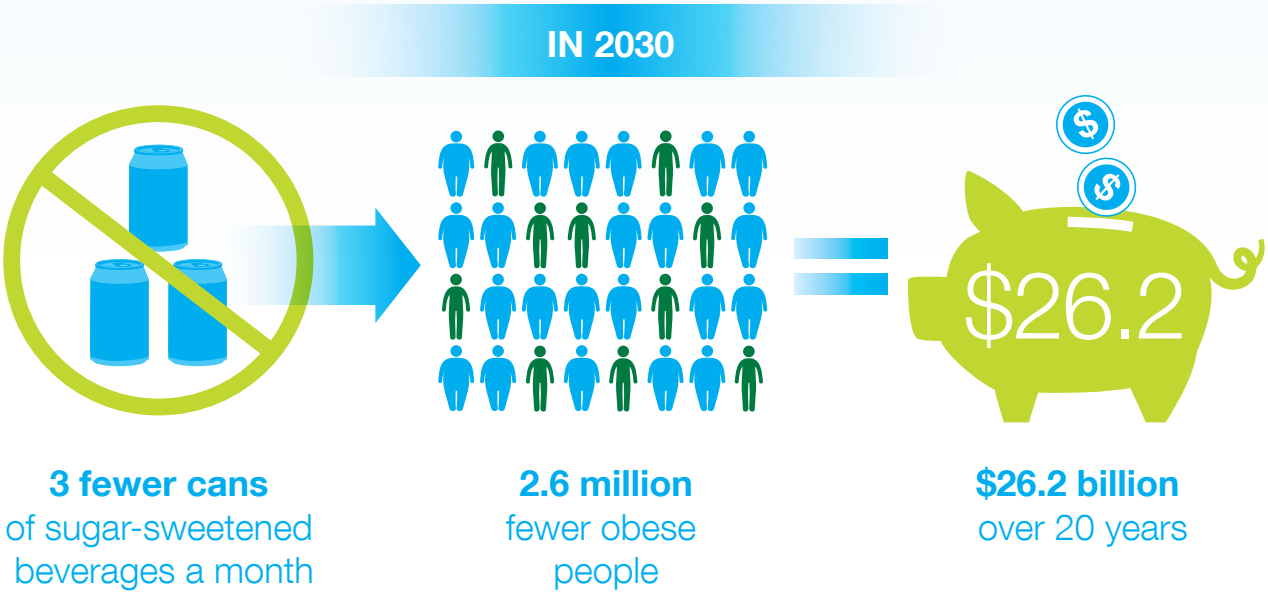
Using alternative scenarios of sugar-sweetened beverage consumption, we developed statistical simulations of two possible paths from 2010 to 2030. The baseline scenario projected sugary drink consumption assuming that behavior and policy stayed the same. The optimistic

scenario modeled the path of sugary drink consumption as modified by effective policies and other efforts to reduce the intake of empty calories. In other words, the optimistic scenario assumed a faster decline in sugary drink consumption compared with the baseline scenario and resulted in fewer people with obesity over time. The optimistic scenario indicated that even a moderate reduction in consumption could bring dramatic benefits to the health-care system over a 20-year period.

- If we accelerate the reduction in sugary drink consumption so that in 2030 Americans consume three fewer 12-ounce beverages per month compared with the baseline rate, the number of obese Americans would be reduced by 2.6 million.
- The process of reaching this goal by 2030 would produce cumulative savings of $40.7 billion ($26.2 billion in 2010 dollars) for the U.S. health-care system.

FOSTERING PHYSICAL AND ECONOMIC HEALTH

We project that lower sugary drink consumption would reduce obesity in America and generate economic dividends



Takeaways

Our findings point to a strong financial and moral incentive to develop and implement public policy promoting healthier beverage choices. Existing policies have been only partly successful. Many policies that included taxing sugary drinks have failed, mainly because the prices of healthy alternatives were still much higher. Policies aimed at decreasing portion size also failed in many cases, as consumers compensated by buying the smaller portions in larger quantities.

To come to terms with this serious issue, policymakers, consumers, business leaders, nonprofit organizations, and other stakeholders should reach beyond their silos. A multisector, multistrategy approach is crucial to engage Americans in long-lasting, healthful decision-making.

PRICING

The prices of sugar-sweetened beverages should be substantially higher than those of healthy alternatives to discourage the purchase of unhealthy drinks.

PROMOTING ALTERNATIVES

Making healthy drinks, including water, an attractive option could curb sugary drink consumption. For example, improving the taste of tap water in communities where it is substandard, or increasing the affordability of bottled water, might spur demand.

HEALTH EDUCATION AND AWARENESS

Many consumers remain oblivious to the health consequences of their behavior. Creating awareness and a culture of health could bring long-term benefits.

INFRASTRUCTURE FOR HEALTHY FOOD AND BEVERAGE OPTIONS

City leaders, community organizers, and business executives can play major roles in shaping the health of the nation. Expanding access to healthier foods by encouraging retailers to offer such options is key.

PHYSICAL ACTIVITY

If long-term weight management is to succeed, nutritious food and drink consumption must be complemented by an active lifestyle. Policymakers need to encourage a supportive environment, and businesses and communities need to develop an infrastructure that will raise consumers' awareness of the importance of physical activity.

SOCIAL RESPONSIBILITY

Businesses, city leaders, and communities must work together to increase awareness by pledging support for healthy lifestyles. Business leaders increasingly recognize the value of investing in healthier choices. In 2014, for example, the three leading global soda companies pledged to support a 20 percent reduction in Americans' consumption of calories from sugary drinks by 2025.

Introduction

Obesity is the fifth-leading global risk factor for death and is a trigger for many chronic diseases.[1] In the U.S., obesity-related medical costs account for a significant portion of national health-care expenditures. Lowering this rate is key to controlling rising health-care costs and improving quality of life. Because a healthier individual is a more productive one, improving health will also result in longer careers, increased output, and a stronger economy.

The primary drivers of obesity are poor diet, sedentary lifestyle, and a desk-bound work environment. People gain weight when they consume more calories than they burn. Many items in the typical American diet are considered "empty calories" because they have little nutritional value, and are found mainly in solid fats—such as butter, margarine, and shortening—and added sugars. Fats, sugars, and syrups are added by food companies as well as in home preparation.

Our report focuses on the empty calories in sugar-sweetened beverages. We also project future obesity rates under alternative scenarios for the consumption of such beverages.

Sugar-sweetened beverages include sodas, sweetened teas, sports and energy drinks, sweetened water and juices, and blended coffee drinks. They contain, on average, 10 teaspoons of sugar per 12-ounce container.[2] Too often, sugary beverages displace healthy foods and drinks. Medical researchers have established a causal relationship between the excess calories in these drinks and a rise in blood sugar level—also known as glycemic load—triggering an elevated insulin response, which may eventually lead to insulin resistance and metabolic syndrome. This condition, whose symptoms include high blood pressure, high blood sugar, abnormal cholesterol levels, and an expanding waistline, is often a precursor to diabetes and heart disease.[3]

In conveying the seriousness of the issue, a geographically diverse data analysis that controls for the major factors influencing obesity is indispensable. This report provides data-driven evidence to support feasible strategies for reducing the prevalence of obesity. Estimates of the future cost of obesity, and the savings that could be generated if healthier lifestyles were adopted, support their implementation.

Recognizing the importance of including geographic variations at micro-levels, we used Nielsen Homescan™ data that defined 26 metropolitan ("metro") market groups in the 48 contiguous states. The groups represent 76.5 percent of Americans, who drank 80 percent of the sugar-sweetened beverages consumed in the U.S. in 2010.

To estimate the health and economic impacts of sugar-sweetened beverages, we used data from 1999 to 2010, reporting factors affecting obesity for each market group. The main historical finding was that for every 10 percent increase in consumption, the obesity rate increased 0.8 percent. In other words, if every American doubled his or her consumption of sugary drinks, the obesity rate would increase 8 percent, from 35.7 percent to 38.6 percent of the population.

We also looked at two possible scenarios of sugar-sweetened beverage consumption to note the effects on obesity: baseline (a continuation of the status quo) and optimistic (integrating policy improvements and health-conscious attitudes over time). Our optimistic alternative scenario indicates that even a moderate reduction in consumption could have dramatic benefits for the health-care system. If we reduce consumption more rapidly than the baseline rate, with Americans each drinking three fewer cans of soda a month by 2030, then 2.6 million fewer Americans would be obese by that year. The savings to the health-care system would add up to $40.7 billion ($26.2 billion in 2010 dollars) over two decades.

1. World Health Organization, "Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks," 2009.
2. A. Pan et al., "Changes in Water and Beverage Intake and Long-Term Weight Changes: Results From Three Prospective Cohort Studies," *International Journal of Obesity*, Vol. 37, No. 10 (2013) pp. 1378-85.
3. Frank B. Hu, "Sugar-Sweetened Soft Drink Consumption and Risk of Type 2 Diabetes and Cardiovascular Risk," *Official Journal of the International Chair on Cardiometabolic Risk*, Vol. 2, No. 2 (2009) pp. 15-18.

Background

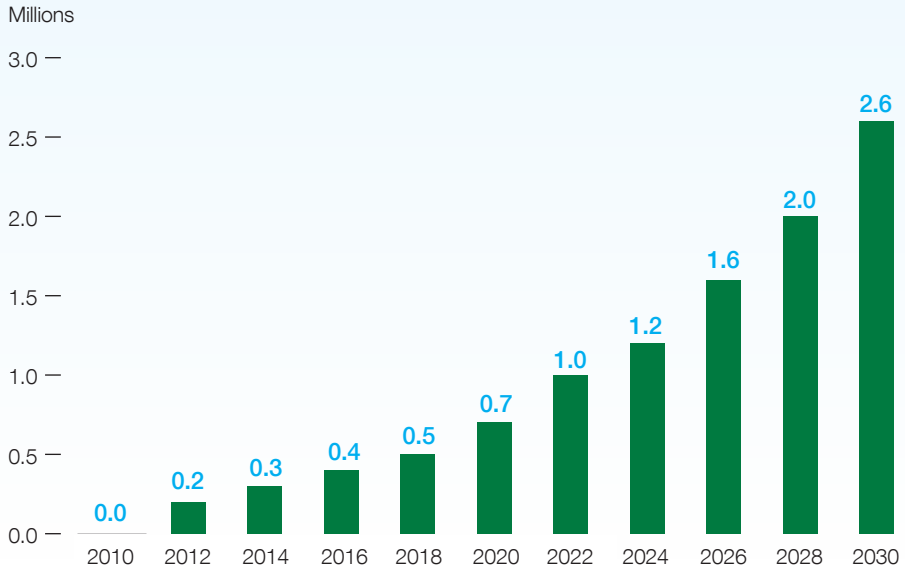
In 2010, the self-reported obesity rate in the 26 Nielsen markets was 27.3 percent, very close to the national self-reported rate of 27.5 percent. After controlling for underreporting of data, we found that the obesity rate in the market groups was actually 35.7 percent. Although the market groups are not representative of the entire nation, they are where most sugar-sweetened beverages are consumed.

Numerous factors contribute to obesity. Diet, smoking habits, and a sedentary lifestyle and work environment are important. So are social demographics, family structure, and regional infrastructure. Additionally, variations in obesity across metro areas are subject to less tangible influences, such as government policy, social attitudes, and cultural differences. We developed a fixed-effects statistical model to estimate the influence of sugary drink consumption on obesity after controlling for relevant factors. Using coefficients from the historical data together with projected variables (see Methodology, Page 8), we charted future rates of obesity.

To pinpoint the value of acting now to prevent disease later, we simulated two paths for obesity rates: the baseline and the optimistic. We projected alternative scenarios to chart how consumption of sugar-sweetened beverages would influence obesity. The baseline scenario assumed that Americans would continue along their current path, whereas the optimistic scenario indicated what could happen with the inception of effective policy changes, heightened education and awareness, and corporate social responsibility.

In the baseline scenario, we projected an obesity rate of 45.5 percent by 2030. A moderate reduction in sugar-sweetened beverage consumption could reduce the rate to 44.3 percent. Note that percentages can be deceptive: Although the size of the decrease may appear small, it actually represents 2.6 million fewer obese Americans in 2030.

Figure 1 **Projected reduction in obesity if Americans drink fewer sugar-sweetened beverages**



Methodology

A closer look at four groups of variables that influence obesity rates:

- Nutrition and risk behavior
- Lifestyle and workplace activities
- Demographics and family structure
- Geographic variations

Nutrition and risk behavior

Nutrition and risk behavior encompass individual choices that affect obesity, including those that are unhealthy (sugar-sweetened beverages) and those that are nutritious (whole fruits and vegetables). We obtained consumption patterns for both choices from the USDA Quarterly Food-at-Home Price Database. Data for two additional risk factors, excessive alcohol consumption and smoking, were obtained from the CDC self-reported Behavioral Risk Factor Surveillance System (BRFSS) database.

SUGAR-SWEETENED BEVERAGES contain levels of sugar higher than those found in foods with naturally occurring sugars, such as milk and fruits, and exceed CDC-recommended levels of sugar intake.[4] Our study included non-alcoholic carbonated and non-carbonated caloric beverages. We also included diet sodas because, although they contain non-caloric artificial sweeteners, they have been linked to weight gain and obesity.[5]

The American Heart Association (AHA) recommends limiting sugary drink consumption to three 12-ounce cans per week. According to current purchasing and consumption patterns seen in USDA data, this corresponds to approximately 10 gallons a year per person at home.

In fact, according to the USDA, the average American consumed 235 cans, or about 22 gallons, of sugar-sweetened beverages in 1999, well above the AHA recommendation. Annual home consumption of sugary drinks subsequently declined to an average of 171 cans, or 16 gallons per person, in 2010. This represents a 27.3 percent reduction over the decade.

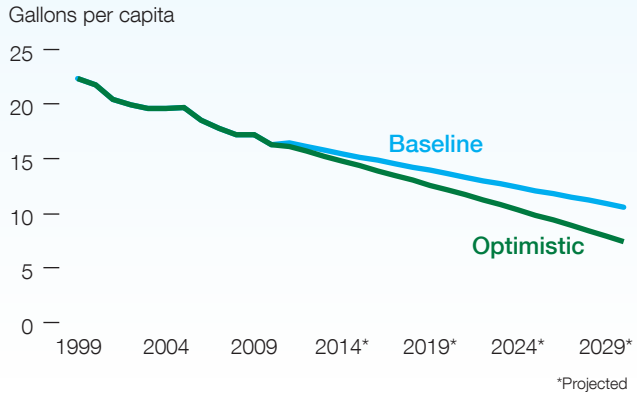
When we projected sugar-sweetened beverage intake in the baseline scenario, the market groups with the lowest consumption were assumed to reach the AHA goal of no more than three cans per week within 10 years; the quartile with the next level of consumption reached the

4. Centers for Disease Control and Prevention, "The CDC Guide to Strategies for Reducing Consumption of Sugar-Sweetened Beverages," March 2010, at: http://www.cdph.ca.gov/SiteCollectionDocuments/StratstoReduce_Sugar_Sweetened_Bevs.pdf. Accessed Nov. 11, 2014.
5. Sara N. Bleich et al., "Diet-Beverage Consumption and Caloric Intake Among U.S. Adults, Overall and by Body Weight," *American Journal of Public Health* (2014) pp. e1-7.

goal in 15 years; and a total of three-fourths of market groups reached the AHA goal by the end of 20 years. In the optimistic scenario, the lowest-consuming market groups reached the AHA goal in five years; the next quartile in 10 years; a further quartile in 15 years; and all four market groups were projected to reach the AHA goal by the end of 20 years.

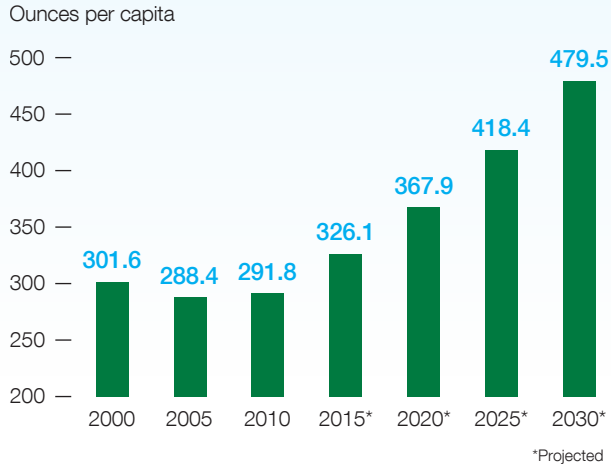
In the projected baseline scenario, aggregate home consumption of sugar-sweetened beverages fell short of the AHA-recommended goal, leveling at 113 cans, or 10.6 gallons, per person per year. But in our optimistic scenario, we assumed that as health education expanded and public policies were implemented to curb unhealthy habits and promote nutrition, sugary drink consumption would fall drastically, to fewer than three 12-ounce cans per week, or 7.4 gallons per person per year by 2030. This would mean that Americans were close to meeting the AHA recommendations for limiting sugar-sweetened beverage consumption by 2025.

Figure 2 **Consumption of sugar-sweetened beverages**



FRUITS AND VEGETABLES help people maintain a healthy weight while also offering protection against risk factors for chronic disease, such as high cholesterol and high blood pressure.[6] The AHA recommends that adults consuming 2,000 calories daily include at least 4.5 cups of fruits and vegetables as part of that. Of course, daily calorie intake varies from one person to another depending in part on height, weight, and activity level. In our analysis, we used consumption of fruits and vegetables as a proxy for eating habits that can help maintain healthy weight. In 2010, Americans ate 291.8 ounces of fruits and vegetables per person. Consumption was projected to rise to 479.5 ounces by 2030.

Figure 3 **Consumption of fruits and vegetables**

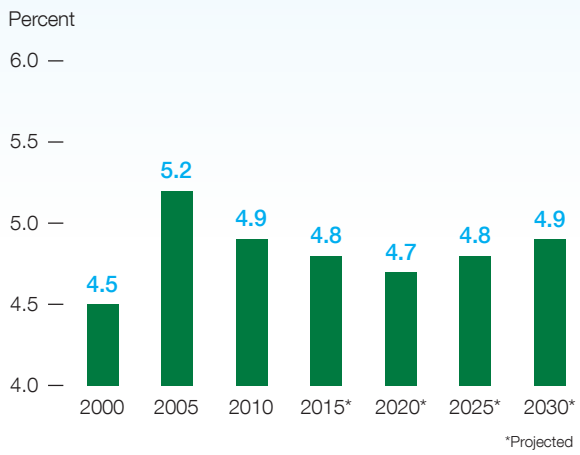


Estimates based on our historical model confirm that for every 10 percent increase in the consumption of fruits and vegetables, the rate of obesity falls by 0.8 percent.

6. American Heart Assn., "About Fruits and Vegetables," http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyEating/About-Fruits-and-Vegetables_UCM_302057_Article.jsp (accessed November 2014).

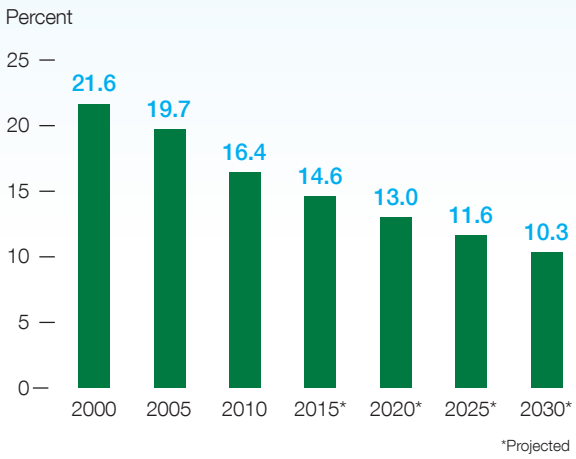
ALCOHOL, like sugar-sweetened beverages, adds empty calories to the diet and inches to the waistline. As part of our study, we examined the percentage of adults who regularly consume 60 or more alcoholic drinks a month. In our regression, we found that chronic drinking was associated with an increased rate of obesity, although this relationship was not statistically significant. When we used a three-year growth rate to predict the prevalence of chronic drinking, we found that it introduced very little change to the values over the 20-year projection period. Similarly, other researchers have predicted a relatively constant rate of alcohol consumption to 2030.[7]

Figure 4 | **Regular alcohol drinkers**



SMOKING is indisputably unhealthy. However, some people may see it as beneficial in helping them lose weight. When we examined the percentage of adult current smokers, we found a significant relationship with obesity. Our model indicates that for every 10 percent increase in the number of adult smokers, obesity in the population fell by 1.4 percent. When we assumed a 10-year growth rate to project future smoking prevalence, the percentage of smokers declined from 16.4 in 2010 to 10.3 by 2030. The decline was similar to the range projected by other public health studies.[8]

Figure 5 | **Current adult smokers**



Lifestyle and workplace activities

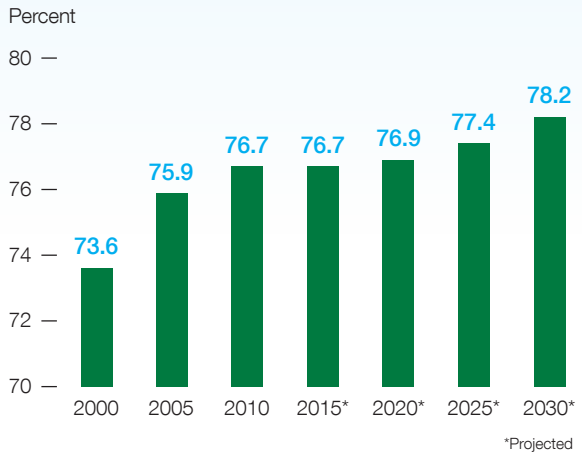
Physical inactivity inside and outside the workplace has been cited as a fundamental contributor to the obesity crisis in the U.S.[9] We examined two indicators, physical activity outside work and relative size, in terms of job numbers, of the office-based service sector compared with the manufacturing sector.

7. Ross DeVol and Armen Bedroussian, "An Unhealthy America: The Economic Burden of Chronic Disease," Milken Institute, 2007.
8. Kenneth E. Warner, "Update on Tobacco Epidemiology & Policy," National Health Policy Forum, Washington, D.C. (2011).
9. Mark Stephen Tremblay et al., "Physiological and Health Implications of a Sedentary Lifestyle," *Applied Physiology, Nutrition, and Metabolism*, Vol. 35, No. 6 (2010) pp. 725-740.

PHYSICAL ACTIVITY OUTSIDE OF WORK is recommended for adults by the CDC, which advocates moderate physical activity for a minimum of 2 hours and 30 minutes a week, or vigorous physical activity for a minimum of 1 hour and 15 minutes a week, in addition to muscle-strengthening activities on two or more days a week.[10] Physical activity boosts metabolism and helps stave off weight gain and metabolic diseases such as diabetes. Because we lacked consistent data for each market group, we examined the percentage of adults who took part in physical activity outside work as a proxy for recommended levels of physical activity.

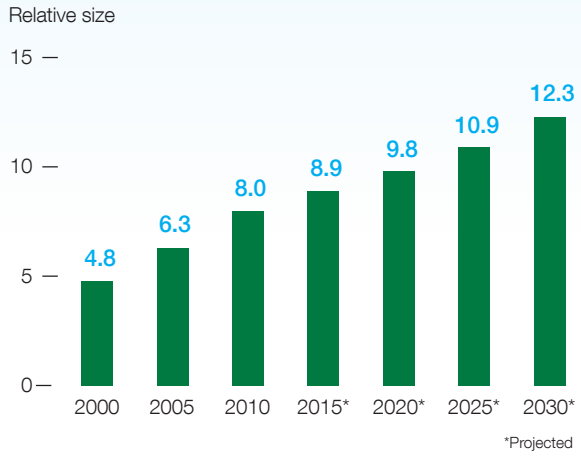
About 74 percent of adults who responded to the BRFSS survey said they were physically active outside work. Anticipating increased marketing efforts and an expanded infrastructure to promote an active lifestyle, we projected physical activity using a three-year growth rate. Our assumption that 78.2 percent of adults would be physically active by 2030 was within 1 percentage point of physical activity projections by other researchers.[11]

Figure 6 | **Physically active adults**



THE SERVICE-TO-MANUFACTURING RATIO also plays a role in obesity rates because many jobs, particularly in the service sector, keep people tied to a desk for at least eight hours a day. As the economy becomes increasingly service-oriented, many workers run an ever-higher risk of expending less energy than they consume. In the market locations we examined, the number of office-based, service-sector jobs compared with manufacturing jobs is a gauge of the likelihood that people are engaged in physically non-strenuous activities at work. Estimates from our historical model indicated that obesity increases significantly as desk jobs proliferate: by 0.4 percent for every 1.0 percent increase in the relative size of the service sector. Current trends imply that the size of the service sector will continue to grow. In 2000 there were about five service sector jobs, on average, for every manufacturing job. This ratio is projected to more than double, to 12.3 service sector jobs for every manufacturing job, by 2030.

Figure 7 | **Size of service sector relative to manufacturing**



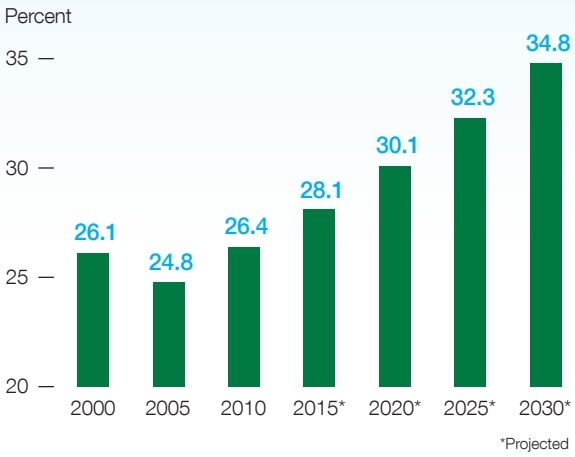
10. Centers for Disease Control and Prevention, "Physical Activity," March 3, 2014, http://www.cdc.gov/physicalactivity/everyone/guidelines/adults.html (accessed October 2014).
11. Ross DeVol and Armen Bedroussian, "An Unhealthy America: The Economic Burden of Chronic Disease," Milken Institute, 2007.

Demographics and family structure

Demographics and family structure influence obesity. Changing family structures and the aging of the population can pose challenges to staying healthy.

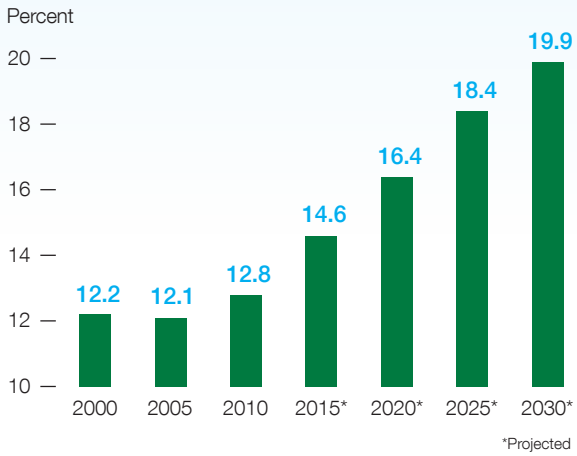
DUAL-EARNER FAMILIES are a reflection of the changing structure of the American household, and today both spouses are more likely to be working full time. About 26 percent of American families were supported by full-time dual earners in 2000, a figure that is expected to grow to 34.8 percent in 2030. This change has been associated with a decrease in healthy nutrition and an increase in obesity.[12] As Americans spend more time outside the home, they are more likely to eat fast, processed, and not optimally healthy foods instead of preparing nutritious meals.

Figure 8 | **Dual-earner families**



THE POPULATION IS AGING in the U.S. as in most developed countries. By 2030, according to the U.S. Census, one in five Americans in the market groups we studied will be 65 or older. As people age, their metabolisms slow and their general health declines. Controlling for the effect of age was an important factor in our analysis.

Figure 9 | **People aged 65+**



Geographic or regional variations and infrastructure

Regional variations, including cultural differences, public policies, and the availability of health-related infrastructure, play important roles in health and obesity. Our historical market group fixed-effects model took into account both observable and unobservable variations. We also included access to facilities and infrastructures that influence health outcomes. Lack of access to food stores has been identified as a barrier to purchasing nutritious foods—although buyers can also find unhealthy foods and drinks at the same locations. However, the availability of limited-service restaurants, including

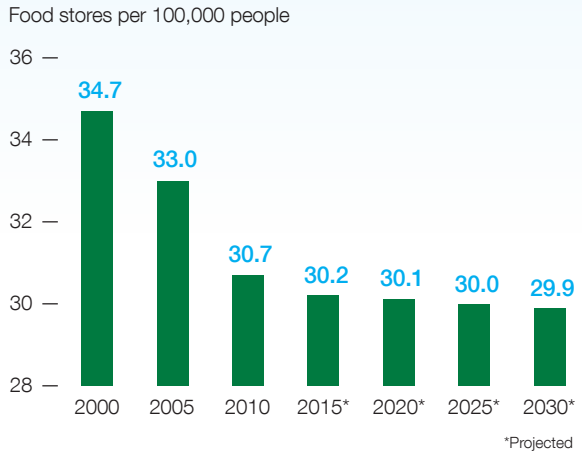
12. Amit Kramer and WonJoon Chung, "The Relationship Between Work Demands, Family Demands, and BMI in Dual-Earner Families: A 16-Year Longitudinal Study," http://www.ler.illinois.edu/faculty/papers/The%20Relationship%20Between%20Work%20Demands,%20Family%20Demands,%20and%20BMI%20in%20Dual-Earners%20Families_A%2016-Year%20Longitudinal%20Study.pdf, (accessed October 2014).

fast-food outlets, can foster unhealthy habits and must be considered.

FOOD STORES strongly influence purchasing habits. We defined food stores as establishments engaged in retailing food products, encompassing supermarkets and convenience stores.

People who live in "food deserts," where the quality of the available food is poor, or in areas that lack convenient access to food stores, are more likely to make poor dietary choices. Still, food stores offer a variety of options, healthy and otherwise. The vast majority of sugary drinks consumed at home—92 percent—are purchased in stores.[13]

Figure 10 | **Number of food stores**

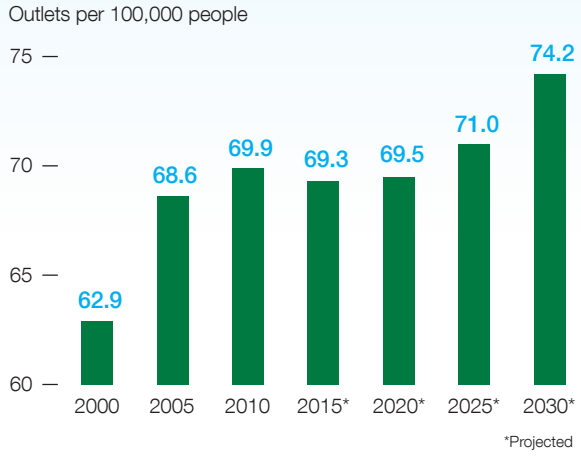


People with better access to food stores are less likely to be obese. In fact, for every 10 percent increase in food stores per 1,000 residents, our model shows a 2.8 percent decrease in the obesity rate. This further confirms the importance of the commercial environment in influencing health decisions.

LIMITED-SERVICE RESTAURANTS have taken on a bigger role in the lives of American families as more homes depend on two full-time earners and schedules become tighter. Healthy food options can be expensive and hard to find. Limited-service restaurants, offering counter service and some self-service, offer inexpensive and quick options to harried working people. Many offerings at these restaurants tend to be calorie-dense, however, and easy access to such outlets may boost caloric intake and increase the risk of obesity.

Often, such restaurants are located in low-income neighborhoods, to such a great extent that they serve as an indicator that a community is poor. When these restaurants open for business, public health monitors tend to consider it bad news.

Figure 11 | **Limited-service restaurants**



When we looked at the number of limited-service restaurants per 1,000 people, we found that a 10 percent increase corresponded to a 2.2 percent rise in the rate of obesity. The relationship was not statistically significant, but it could have a substantial impact on the health of long-term residents.

13. Cynthia L. Ogden et al., "Consumption of Sugar Drinks in the United States, 2005-2008," National Center for Health Statistics Data Brief, No. 71, National Center for Health Statistics, Hyattsville, MD (2011).

Conclusion

Sugar-sweetened drinks have been the target of public policy and health campaigns since researchers established their connection with weight gain, obesity, and other adverse effects. But it's difficult to fully appreciate the seriousness of the issue without data-driven evidence. Our study bridged gaps in what is known about sugary drinks and obesity by examining geographic variations in consumption. We also controlled for numerous other factors that influence obesity and are not likely to offset one another.

Our results provide evidence that sugar-sweetened beverages significantly influence obesity rates. Moreover, the research suggests strategies that could curb consumption, restrain obesity rates, and ease the burden on health-care resources. Making one change toward a healthier lifestyle could get the ball rolling on more. But our analysis also emphasizes that sugary drinks should not be the sole focus of obesity-prevention efforts. Other factors, such as consumption of whole fruits and vegetables, the ratio of service to manufacturing jobs, and access to food stores, are also significant. These all contribute to the epidemic, and public health professionals, governments, and businesses can join forces to address them.

Our results provide hard data that link the likely future scale of sugary drink consumption to effects on the health-care system. A modestly accelerated reduction in that consumption could save the system billions of dollars over 20 years. Our estimate did not address quality of life or broader economic effects resulting from labor market outcomes. Nevertheless, we believe that such effects would be positive and large.

Quantifying the potential monetary savings from efforts to control obesity provides an incentive for decision-makers to take action. As our analysis suggests, a multilevel, collaborative approach is likely to prove the most effective in achieving positive health outcomes. More grocery stores should be opened in food deserts. Businesses can offer wellness programs or restructure their work processes to change the sedentary nature of office jobs. Educational campaigns must ensure that people understand how to prevent obesity and the risks associated with its onset. Lastly, healthy beverages should cost less than sugary drinks—and should be just as aggressively marketed to consumers.

Motivating healthy behavior, including implementing policy and evaluating its effectiveness, has proved an arduous process. Still, the results of our analysis show that it is a worthwhile task. Reducing the consumption of sugar-sweetened beverages is an excellent place to start.

Appendix

Historical data and the econometric model

The historical model is estimated by using a market group fixed-effects unbalanced panel data model:

$$Y_{it} = X_{it}\beta + U_{it},\ i=1, \ldots N,\ t=1, \ldots., T_i\ (1).$$

In this model, i represents market groups and t specifies the time period. In our framework, Yit is the obesity rate in the ith market group in the tth year. Xit are all independent variables and Uit is the disturbance term. This model is unbalanced in the sense that there are N market groups observed over varying time periods.

An ordinary least-squares regression (OLS) for the above model could produce biased results, as unobserved regional differences could affect obesity, such as public policy, culture, and so on. The disturbance could be described as such:

$$U_{it} = \mu_i + \varepsilon_{it.}$$

In this equation, μi expresses the market group-specific factors not accounted for by the independent variables in the model. A fixed-effect model is used for this unbalanced panel. Because a Hausman test yielded a significant result, a more efficient random-effects model could not be used. Refer to the following table for estimated coefficients for the above econometric model.

Table A1 | **Fixed-effects regression estimates**
Dependent variable: log (adult obesity rate)

VARIABLE	FIXED-EFFECTS COEFFICIENT (STANDARD ERROR)#
Log (Sugary drink consumption), gallons per capita	0.08 (0.03)*
Log (% physically active adults)	-0.14 (0.12)
Log (% adults who are chronic alcohol drinkers)	0.01 (0.03)
Log (% adults who are current smokers)	-0.14 (0.07)**
Log (Food stores per 1,000 people)	-0.28 (0.08)*
Log (Limited-service restaurants per 1,000 people)	0.22 (0.17)
Log (Fruits and vegetable consumption), ounces per capita	-0.08 (0.04) **
Log (% dual-earner families)	0.02 (0.07)
Log (Ratio of service to manufacturing jobs)	0.44 (0.08) *
Log (% population 65+)	0.20 (0.36)
Constant	-2.05 (1.03) **
Total observations	280
Number of market groups	26
R^2	.03
F-statistic	102.76
Probability>F	0.0000

*Significant at 5% level. **Significant at 10% level. # Corrected for heteroscedasticity.

Market groups

Nielsen constructs market groups from both metropolitan (metro) and non-metropolitan (non-metro) areas. Non-metropolitan areas lack consistent data across all years; hence, this study includes only 26 metropolitan market groups as defined by Nielsen. Each market group can be identified as the aggregate of multiple U.S. Census-defined counties.

Data from the USDA Quarterly Food-at-Home Database

Historical data at the market group level on consumption of sugary drinks and of fruits and vegetables were obtained from the USDA Quarterly Food-at-Home Price Index. There are two versions of this index: The first collected data from 1999 to 2006 and the second from 2004 to 2010. The second version represents a larger sample and includes more detailed food categories. For example, the second version separates diet carbonated beverages, whereas the first version does not. Our study includes diet beverages, as researchers have found that they are associated with increased BMI.[14]

We recalculated the 1999–2003 data to match the 2004–2010 version because of a difference in sample size. This was accomplished by applying the 1999–2003 annual growth rates to the 2004–2010 data.

Data from the Behavioral Risk Factor Surveillance System

Obesity, physical activity, alcohol, and smoking data were taken from the CDC BRFSS survey, which is nationally representative for the U.S. adult, non-institutionalized civilian population. These data were obtained at the county level and aggregated to the market group level by using county-level population data from the U.S. Census.

U.S. Census data

Percentage of the population aged 65+ and distribution of food stores and limited-service restaurants were obtained from the U.S. Census at the county level and aggregated to the market group level. Data on dual earners were obtained from the U.S. Census at the state level and applied to each county in a state. Data were then aggregated to market groups by population-weighted means. By a similar method, data on the ratio of service to manufacturing jobs were aggregated from the metro to the market group level. Data for all variables were smoothed as necessary.

Multicollinearity and heteroscedasticity

The potential for collinearity exists between variables such as sugar-sweetened beverage consumption and food stores per 1,000 residents, or fruit and vegetable consumption and food stores per 1,000 residents. Increased access to food stores could facilitate increased purchases of either item. To ensure that collinearity did not affect the regression analysis, a correlation coefficient was calculated for both fruit and vegetable consumption and food stores per 1,000 residents, and sugar-sweetened beverage consumption and food stores per 1,000 residents. As both displayed a weak, non-significant correlation, we concluded that it would be appropriate to include variables in the model.

Heteroscedasticity was accounted for by use of the Huber-White-Sandwich estimators.

Model validation

In addition to examining models with lags for relevant variables, we looked at other demographic and environmental drivers of obesity including gender, education level, overall employment, and increased taxes on soda compared with other food items. However, these variables did not significantly contribute to our model.

We considered including grocery stores instead of all food stores, because groceries tend to offer a wider selection of produce. However, food stores had a stronger negative relationship, and we ultimately included them to account for the increasing number of convenience stores that offer healthy options.

14. Sharon P. Fowler et al., "Fueling the Obesity Epidemic? Artificially Sweetened Beverage Use and Long-Term Weight Gain," Obesity, Vol. 16, No. 8(2008) pp. 1894-1900.

Projections

We projected out each independent variable from 2011 to 2030, using the regression coefficients to estimate the prevalence of obesity.

Sugar-sweetened beverages

Our sugar-sweetened beverage projections were based on the AHA recommendation to limit consumption to three 12-ounce cans per week. As 92 percent of sugary drinks consumed at home are purchased in stores, and 43 percent of sugary drinks consumed away from home are purchased in stores, this goal translates to 10 gallons per person annually for our data on beverages purchased at stores. To project the data, we split the market groups into quartiles of consumption and assumed that each quartile met the recommendation at a different time.

In the baseline scenario, the lowest quartile of sugary drink consumption was assumed to meet the AHA recommendation in 10 years. The second-lowest quartile was assumed to reach the first-quartile maximum consumption level in 10 years and the AHA recommendation in 15 years. The third quartile was assumed to meet the second-quartile maximum in 10 years, the first-quartile maximum in 15 years, and the AHA recommendation in 20 years. The highest quartile was assumed not to meet the AHA goal during the 20-year projection.

In the optimistic scenario, consumption was assumed to decrease faster as more aggressive policy affected consumer behavior. The lowest quartile was assumed to reach the AHA-recommended level of consumption in five years, the second quartile in 10 years, the third in 15 years, and the fourth in 20 years.

For each market group, either an exponential or a polynomial function was fitted by using the aforementioned specifications alongside the historical data based on the most realistic results. The output of this function was used to predict sugary drink consumption and, as such, the data do not necessarily match the specifications.

The optimistic scenario represents what could happen with more attentive policy toward sugar-sweetened beverage consumption. By subtracting the number of obese people in the optimistic scenario from the number of obese people in the baseline scenario, we can assess the number of obesity cases that would be prevented over 20 years.

The other independent variables in the model were held constant in both the baseline and optimistic scenarios. We obtained age projections from Moody's Analytics based on U.S. Census data and obtained the relative size of the service sector to manufacturing data projections from the Bureau of Labor Statistics through Moody's Analytics. All other variables were projected based on historical data.

To assess our model's sensitivity to changes in the independent variable projections, we looked at one-year, three-year, five-year, and 10-year growth rates, as well as projections using a linear time trend. We compared these variables with similar projections from the literature. For every variable except smoking and food stores per 1,000 residents, the three-year growth rate made the most sense.

For smoking, the three-year average was too steep for many market groups. However, the 10-year average gave a more reasonable estimate, aligning with estimates in the literature. Density of food stores is currently in flux. While the 10-year growth rate for this variable is generally negative for each market group, the three- and one-year growth rates trend positive. Because of the volatile nature of this variable, a three-year average taken from 2008 to 2010 was held constant for the entirety of the projection.

Obesity rate projections

Obesity rates from market group projections were aggregated separately for the baseline and optimistic scenarios. Using population projections from the U.S. Census through Moody's Analytics and our projected obesity rates, we calculated the number of obese people in each market group. These numbers were aggregated

Table A2 | Variables in the econometric model and projections

VARIABLE	HISTORICAL DEFINITION	PROJECTION METHOD
Obesity	Percent of adults with a BMI greater than or equal to 30 Source: Centers for Disease Control and Prevention	Dependent variable
Sugary drink consumption	Gallons of sugary drink per capita, including sodas, diet sodas, sugar-sweetened fruit drinks, and powerades Source: USDA	Stepwise projection
Alcohol	Percent of adults who are heavy drinkers, defined as two or more drinks per day on average for men and one or more drinks on average for women Source: Centers for Disease Control and Prevention	3-year growth rate
Dual earners	Percent of married households in which both spouses work full time Source: U.S. Census	3-year growth rate
Food stores	Food stores per 1,000 people, including grocery and convenience stores. NAICS code: 4451 Source: U.S. Census	3-year average held constant
Fruits and vegetables	Ounces of healthy fruits and vegetables per capita. Those measured include fresh or frozen whole fruits, fresh or frozen dark green or orange vegetables, and other fresh or frozen vegetables that were nutrient-dense or mostly water Source: USDA	3-year growth rate
Limited-service restaurants	Limited service/fast-food restaurants per 1,000 people NAICS code: 722211 Source: U.S. Census	3-year growth rate
Physical activity	Percent of adults who participate in physical activity outside of work Source: Centers for Disease Control and Prevention	3-year growth rate
Population 65+	Percent of population age 65+ Sources: U.S. Census, Moody's Analytics	Moody's Analytics estimate
Ratio of service to manufacturing jobs	Service jobs/manufacturing jobs. Service jobs NAICS codes: 51-56, 61-62, 71-72, 81. Manufacturing jobs NAICS codes: 31-33 Sources: U.S. Bureau of Economic Analysis, Moody's Analytics	Moody's Analytics estimate
Smoking	Percent of adults who have smoked more than 100 cigarettes over their lifetime and still smoke Source: Centers for Disease Control and Prevention	10-year growth rate

to calculate the total number of obese people in the entire sample. The difference between the number of obese people in the baseline and optimistic scenarios was the population that would not be obese if influenced by strategic efforts to reduce sugar-sweetened beverage consumption.

Adjustment for underreporting

Historical obesity data were obtained from the CDC's self-reported BRFSS survey, in which obesity tends to be underreported. The CDC also conducts the periodic National Health and Nutrition Examination Survey (NHANES), which gathers data on obesity through actual measurement. NHANES is considered a more accurate portrayal of actual obesity rates in the nation, and its numbers tend to be higher. In 2009-2010, for example, the BRFSS found that 27.2 percent of Americans were obese, whereas NHANES showed a rate of 35.7 percent. We adjusted BRFSS data to better align with NHANES, using a multiple of 1.31 to adjust for underreporting.

Projections of obesity-related health-care costs

After projecting obesity for the baseline and optimistic scenarios, we calculated the cost of obesity. According to an earlier study,[15] obesity-related extra medical costs per obese person in 2008 amounted to $1,429. We adjusted this amount for future inflation by using the urban consumer price index (CPI-U) projected by the Centers for Medicare and Medicaid Services (CMS). This yielded an annual incremental cost of $1,449 per obese person in 2010. As the CMS projects only to 2023, we applied the 2022–2023 growth rate to the CPI for the following years. The number of people saved from obesity was multiplied by the incremental cost of obesity each year to obtain the savings to the health-care system.

Table A3 | Savings to the health-care system ($ millions)

YEAR	SAVINGS
2010	—
2030	6,172.5
Cumulative	40,660.2
Net present value (2010 dollars)	26,183.6

Sensitivity analysis

We compared our estimated projection with public data and published studies to validate the model. In the historical data, obesity prevalence in the metropolitan market groups stays within a 3.5 percent range of the national obesity prevalence reported by BRFSS. As our projections begin in 2011, we can compare the following three data points with the actual values calculated by BRFSS. Our 2011–2013 projections also stay within the 3.5 percent range, and we can compare our projections with other published studies of national obesity prevalence after adjustment for data underreporting. One group of investigators projected national obesity prevalence in 2018 to 42.8 percent, which is close to our 39.5 percent baseline estimate.[16] Another group projected a rate of 51.1 percent in 2030, which is within 6 percentage points of our 45.5 percent baseline estimate.[17]

15. Eric A. Finkelstein et al., "Annual Medical Spending Attributable to Obesity: Payer and Service-Specific Estimates," *Health Affairs*, Vol. 28, No. 5 (2009) pp. 822-831.
16. Kenneth E. Thorpe, "The Future Costs of Obesity: National and State Estimates of the Impact of Obesity on Direct Health-Care Expenses," 2009, http://www.nccor.org/downloads/CostofObesityReport-FINAL.pdf (accessed October 2014).
17. Youfa Wang, "Will All Americans Become Overweight or Obese? Estimating the Progression and Cost of the US. Obesity Epidemic." Obesity, Vol. 16, No. 10 (2008) pp. 2323-30.

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