A CHOICES Discussion paper

Cost-Effective Strategies to Prevent Obesity and Improve Health Equity

Steven L. Gortmaker, PhD[1], Sara N. Bleich, PhD[2], Erica L Kenney, ScD[1,3], Jessica L Barrett MPH[1], Zachary J. Ward, PhD[4], Michael W. Long, ScD[5], Angie L Cradock, ScD[1].

[1]Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, Boston, MA; [2]Department of Health Policy and Management, Harvard T.H. Chan School of Public Health, Boston, MA. [3]Department of Nutrition, Harvard T.H. Chan School of Public Health, Boston, MA. [4]Center for Health Decision Science, Harvard T.H. Chan School of Public Health, Boston, MA. [5]Department of Prevention and Community Health, Milken Institute School of Public Health, George Washington University, Washington, D.C.

Abstract

We face growing prevalence of children and adults with obesity in the United States, and widening disparities by race, ethnicity, geography, and income. This growth is driven by many forces, including the marketing of foods and beverages that increase obesity risk as well as deeply rooted social and economic determinants and structural racism. This discussion paper is designed to help public health professionals and community members identify feasible and cost-effective intervention strategies that can prevent future obesity cases among children while improving health equity. We provide examples of such strategies in localities throughout the United States. We build on previous findings in CHOICES briefs that describe how Learning Collaborative Partnerships with health departments and their community partners, together with the CHOICES team, have assessed the future impact of a range of strategies on cases of obesity prevented and health equity. In all cases, the strategies have strong evidence for effectiveness and include: sugary drink excise taxes in Denver, Hawaii, California, and West Virginia; a clinical strategy to treat children with obesity in Denver; an intervention to reduce excess TV viewing in Oklahoma. Projections are made using the CHOICES microsimulation model, taking into account effectiveness of the intervention, expected reach in the population, evidence for intervention cost, and other relevant local data. Definitions of groups experiencing disadvantage and inequities were developed with local decision-makers and community members. Projected effectiveness is expressed as cases of obesity prevented, and improvements in health equity as changes in risk relative to a reference population. These examples describe feasible and cost-effective strategies that can prevent future obesity cases and improve health equity.

What is CHOICES?

The Childhood Obesity Intervention Cost-Effectiveness Study (CHOICES) Project identifies which prevention policies and programs will help more kids achieve and maintain a healthy weight and deliver the best results for the dollars invested. CHOICES is a key project of the Prevention Research Center on Nutrition and Physical Activity at the Harvard T.H. Chan School of Public Health (HPRC).

Introduction

When children grow up at a healthy weight, they are less likely to develop chronic diseases such as diabetes, heart disease, and cancer.[1,2,3,4] Both children and adults with obesity experience lower health related quality of life.[5,6] Childhood and adult obesity has increased dramatically in the United States in recent decades, with growing disparities by gender, race, ethnicity, geography, and income.[7,8] This growth in obesity and widening disparities in the United States is driven by many forces. These include changes in the global food system, such as increases in intake of highly processed and marketed foods and beverages,[9] as well as by deeply rooted social and economic determinants and structural racism.[10,11] Communities throughout the United States have experienced these forces, along with the corresponding growth in obesity prevalence with disproportionate impacts among populations experiencing disadvantage. As Shiriki Kumanyika writes: "Obesity levels are disproportionately high in ethnic minority, low-income, and other socially marginalized US population groups…. These disparities are neither surprising nor coincidental. Risks of having obesity and related health problems are conditioned by adverse social circumstances, part of a deeper problem of systemic structural dynamics that curtail opportunities for advancement. Social disadvantage means a greater likelihood of living in poor-quality housing and in neighborhoods with fewer services and limited options for healthy eating and physical activity."[10]

Preventing Obesity, Promoting Healthy Weight, Nutrition & Physical Activity

Because obesity is an important chronic disease (recognized by the National Institutes of Health, the American Medical Association, Medicare, and Medicaid), our research team discusses how cost-effective interventions can prevent cases of obesity, reduce the prevalence of obesity in the population, reduce disparities in obesity, and thus improve health equity. At the same time, we generally do not focus on obesity or excess weight when working with children and adolescents, but rather advocate for language emphasizing healthy eating, improved physical activity, and reduced TV and other obesity risks (see e.g. our Planet Health school-based intervention, and evidence for effectiveness at reducing obesity[69] and reducing disordered weight-control behaviors[70]).

In response to the challenge of growing rates of people with obesity and increasing health disparities, public health leaders and community partners have worked to identify effective strategies that can directly improve population diet and physical activity levels, reduce obesity prevalence, and improve health equity. Achieving health equity in implementing new programs and policies aimed at obesity prevention is challenging. Kumanyika provides a framework for such activities, and notes a key limitation of many strategies: "Current policy, systems, and environmental change interventions target obesity-promoting aspects of physical, economic, social, and information environments but do not necessarily account for inequities in environmental contexts and, therefore, may perpetuate disparities."[10] Williams

and Purdie-Vaughns have highlighted the reality that "interventions that have the potential to improve health at the population level can widen social inequalities in health," and they also point to the Acheson report in the United Kingdom,[12] noting that policies may need to be explicitly formulated to provide greater benefit to the less well-off.[13]

In this brief, we examine three strategies that have strong evidence for effectiveness at preventing obesity at a population level when implemented in the United States. These strategies all focus on proximate determinants of obesity, including improved nutrition and physical activity. We examine the likely impact of these strategies in a variety of settings, and from a number of perspectives, including health disparities and health equity, cost-effectiveness, and population health impact. By documenting the likely impact of these strategies, we hope to begin a focused discussion among state and local health agencies, chronic disease directors, organizations that partner with these agencies, and other nutrition, physical activity, and public health interest groups about how to cost-effectively and equitably prevent obesity.

Methods

We use the definitions of health disparities and health inequities provided by the US Centers for Disease Control and Prevention.[14] The key distinction between these terms is that health inequities are a subset of health inequalities (or health disparities) that are modifiable, associated with social disadvantage, and considered ethically unfair. In contrast, health disparities are differences in health outcomes and their determinants between segments of the population, as defined by social, demographic, environmental, and geographic attributes.[14]

We focus our attention here on intervention strategies that have strong evidence for effectiveness in decreasing obesity risk. Our assumption is that we need effective interventions and successful implementation if we aim to improve population health and improve health equity. The three strategies examined include: 1) sugary drink excise taxes; 2) an obesity treatment program for children – the Study of Technology to Accelerate Research (STAR); and 3) a strategy incorporated into Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) clinic visits that reduces children's TV viewing time. The effectiveness and likely cost-effectiveness of the three strategies reviewed here are documented in peer-reviewed publications. [15,16,17,18,19]

We provide six examples of how our Learning Collaborative Partnership teams in states and cities have worked with the CHOICES team to assess the expected impact of these strategies on future obesity rates

and health equity in their specific locales. As in the peer-reviewed publications estimating potential national impacts on obesity prevalence cited above, we used the CHOICES microsimulation model to project the future course of excess weight gain and obesity in populations over 10 years, this time focusing on specific state and city populations represented by our Learning Collaborative Partners. The CHOICES model has been validated in predictions of future obesity rates.[20] In applying the model, we take into account the known effectiveness of the intervention, as well as likely implementation, including expected reach in the population, evidence for intervention cost, and trends in social, demographic, and other obesity risks, as well as uncertainty in all these estimates. We utilized CDC definitions of groups experiencing disadvantage and disparities and then adapted these with local decision-makers and community members, as well as the manner in which results and disparities are displayed. Local health agencies, for example, often have more detailed population data and may use particular naming conventions for race and ethnicity of the populations they serve, and thus categories may be different from those seen at the national level

Simulation models combine information from different sources to provide a useful tool for examining how the effects of public health policies and risk factors unfold over time in complex systems and impact population health.[21]

In this paper, the first strategy we examine is the projected cost-effectiveness of sugary drink excise taxes and the impact on health equity in a city (Denver), and three states (Hawaii, California, West Virginia). There is strong evidence that sugary drink intake is causally related to increased risk of obesity.[22] Excess consumption of sugary drinks has also been linked to diabetes, cardiovascular disease, cancer, increased risk of death.[23,24,25] and dental decay.[26] Sugary drinks account for 47% of the added sugars in the U.S. diet.[27] Sugary drink excise taxes have been shown to be effective in reducing sales of these beverages in many cities in the U.S.[28,29,30,31]

There are wide differences in sugary drink intake across population groups by age, sex, income, and race/ethnicity, and local variations need to be taken into account as the impact of the tax will depend on the amount consumed. For example, studies have documented higher levels of consumption of sugary drinks in populations with lower income and among Black and Hispanic consumers,[32] potentially driven by targeted marketing of these products.[33] Since existing U.S. sugary drink taxes are based on volume, populations consuming more sugary drinks prior to the tax are expected to change intake the most, as the tax will be higher for those consuming more (of note, this difference by level of intake is not an interaction, it is just a property of a volume-based excise tax). These expected changes in consumption

Sugary drink excise tax: A tax on sugary drinks designed to raise the price and discourage consumption. [35]

have led health economists to conclude that populations with lower income can benefit substantially from sugary drink taxes: they will consume fewer sugary drinks and then experience improved health outcomes.[34] The microsimulation model takes into account these differences in projecting the impact of the tax.

The second strategy examines the projected the impact of a pediatric clinical intervention in the city of Denver, Colorado – the Study of Technology to Accelerate Research (STAR) – shown to be effective in a randomized trial,[16] and also low-cost for a clinical intervention.[17] STAR leverages electronic health record decision support tools for pediatricians, which promote recognition of pediatric obesity and facilitate recommended screening and management during pediatric well-child care visits. The strategy includes direct-to-parent communications via text messages to support behavior change for their children. Families also access local health and wellness web resources. The strategy includes training for primary care physicians at Denver Health clinics, including motivational interviewing techniques to facilitate weight management discussions with patients and families.

The third strategy examined the projected impact of an intervention study with WIC families that incorporated motivational interviewing during WIC clinic visits in Oklahoma. This strategy was based on a prior study showing effectiveness at reducing children's TV viewing time.[36] While screen habits have evolved, TV and videos with advertising content still make up a substantial portion of children's screen time, particularly for children in households with lower income.[37,38] High levels of TV viewing has been linked to increased obesity risk in children and adolescents via the increased consumption of foods and beverages frequently advertised on TV. There is strong evidence that reducing this screen time can reduce obesity risk in children.[39] There is also evidence that strategies to reduce this screen time can confer a substantial benefit to children in households with lower income and Black and Hispanic children,[40] who have higher levels of viewing,[40,41] and who are exposed to more marketing of unhealthy foods and beverages than other children.[41,42]

WIC provides food benefits to children in households with lower income and is required by law to provide nutrition education to participants. In Oklahoma, 27% of 2-4 year olds participate in WIC; in 2016, 13% had obesity.[43] Oklahoma's WIC office participates in the Value Enhanced Nutrition Assessment (VENA), which establishes standards for the assessment process used to determine WIC eligibility, and to personalize nutrition education, referrals, and food package tailoring.[44] The strategy

modeled includes training for WIC staff who provide motivational interviewing and counsel to WIC participants. The training, to be offered by the state Department of Health WIC Services office, would include strategies for providing participants with guidance for reducing children's TV viewing time.

CHOICES Learning Collaborative Partnerships

CHOICES Learning Collaborative Partnerships (LCPs) were established in each of the localities discussed. Each site team consists of members of relevant state or city health agencies, along with community stakeholders. Team members participated in cost-effectiveness trainings with the Harvard CHOICES team and worked to identify community priorities and select effective strategies that could be feasibly implemented. Together with the Harvard CHOICES team, LCP team members developed plans for intervention strategies for each locality that could effectively reduce childhood obesity rates. Local data were gathered and stakeholders were engaged to ensure that strategies and implementation plans were realistic. CHOICES simulation models were then constructed to project the population health impact, impact on health disparities, costs and cost-effectiveness of these strategies in each specific locale if implemented over a 10-year period. While there is a focus on childhood obesity prevention, sugary drinks taxes also reach adults, so both children and adults are included in the discussion. Results and communications plans were developed to ensure that key findings could be used to inform decision-making, strategic planning and implementation by the local team, and were distributed in the form of an online brief. While the LCPs were focused on developing realistic plans, no actual implementation took place under the partnerships. Soon afterward, however, implementation of plans was undertaken in Oklahoma and Denver as described below.

Metrics and Graphics to Describe and Communicate Impact on Population Health and Improvements in Health Equity

One of the insights of prior research concerning disparities is the importance of including metrics that express both **absolute** and **relative** levels of the outcome metric.[45,46] In assessing the impact of an intervention, absolute measures can include differences in rates, or cases of "favorable or adverse events"… "that would be reduced or eliminated by an intervention."[45] Relative levels can be expressed as relative risks with respect to a reference population.

Over the course of the past five years, the Harvard CHOICES team has worked with more than 400 decision-makers and community partners in 21 states and cities. One of our early findings was that

decision-makers and community members found it most useful to talk about the number of cases prevented or averted by implementing a strategy, and not how rates, odds, or risks would change. Few felt comfortable talking about "prevalence," but everyone knew what was meant by a case prevented or averted. Thus, in describing the projected effectiveness of intervention strategies, we typically present results in terms of projected cases of obesity averted (overall for a specific year). An effective strategy is thus one that prevents future cases of obesity, and the projected cases provide a tangible outcome measure. In this way we can document the likely overall effectiveness for the population of interest. We take into account uncertainty by providing 95% uncertainty intervals. A limitation of this approach is that states or cities with larger populations will likely have the potential to prevent more cases compared to states or cities with smaller populations. Thus estimates can also be provided of the projected change in rates taking into account population size (e.g. expressed as a rate of cases of obesity prevented per 100,000 population).

To document the projected impact of a strategy on health equity, we use a ratio or relative difference comparing the change in prevalence expected in a population of interest with respect to change in a reference population. This metric is more complicated than cases prevented, but can be simplified by pointing out that if it is greater than 1.0 for a given group that has historically experienced disadvantage, there is evidence for comparatively larger reductions in obesity prevalence for that group, resulting in reduced disparities and improvement in healthy equity. We also calculate 95% uncertainty intervals for the ratios. We thus express projected effectiveness in terms of cases of obesity prevented, and improvements in health equity as changes relative to changes in a reference population. This metric can be called an "obesity equity indicator."

Reference point: the specific value of a rate, percentage, proportion, mean, or other quantitative measure from which a disparity is measured[51]

Relative difference: a common measure is relative risk[51]

Sugary Drink Excise Taxes to Improve Population Health and Improve Health Equity: Case Studies from Denver, Hawaii, California, and West Virginia

The Harvard CHOICES team worked with health department and community partners in Denver, Hawaii, California, and West Virginia to project the impact of a sugary drink excise tax (called a fee in Hawaii); the results are described in published briefs.[47,48,49,50] The proposed taxes varied across locations, and

some locations examined a few different levels of taxes. Local data concerning sugary drink consumption and rates of obesity among children and youth were assembled, and the CHOICES model used these data to project future health and equity impact. Local population characteristics and implementation plans and costs vary substantially across the states, counties, and cities studied.

In all cases studied, this intervention strategy was projected to be cost-saving – meaning it was projected to save more in future health care costs than it cost to implement (see Table 1). The net savings are higher in the more populous localities – in the case of California, this is an estimated saving of $1.79 billion over 10 years. This can also be expressed as the health care costs saved per $1 invested. In the case of West Virginia, a sugary drink excise tax was already in place: the proposed tax would simply change the tax rate. This led to low costs to implement and very high health care costs saved per $1 invested: $275 saved per $1 invested to implement the strategy. It is worthwhile noting that few public health or medical interventions are expected to be cost-saving.

Note that these calculations of cost savings do not include the revenue from the tax. These revenues are not included in the projected cost-effectiveness of the tax following standard practices used in cost-effectiveness analysis. The substantial tax revenues and their potential uses are discussed later in this paper.

Table 1. Projected Reach, Cost, Cost-Effectiveness, and Population Impact of Sugary Drink Excise Taxes in Denver, Hawaii, California, West Virginia

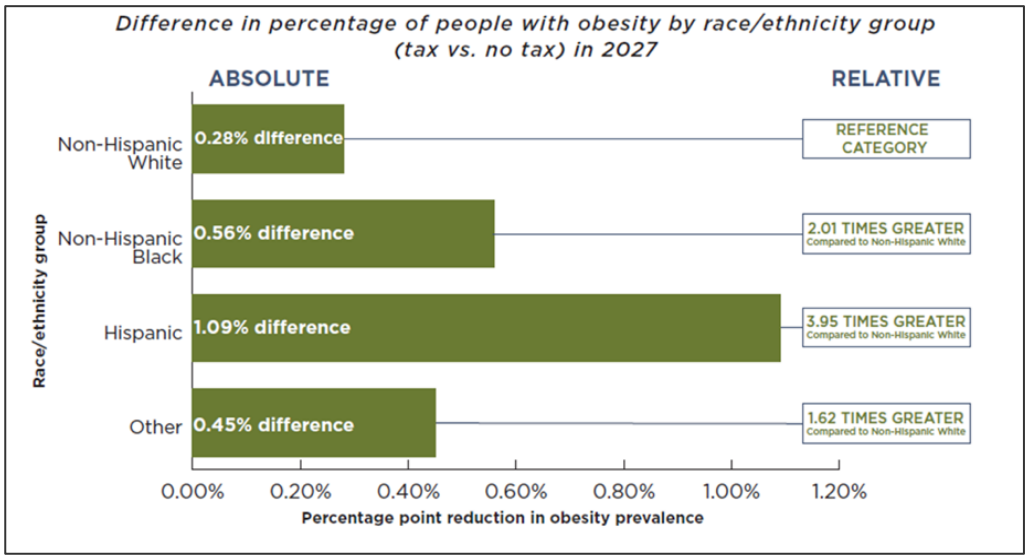
(95% uncertainty intervals in parentheses)

Outcome	**Denver** **$0.02/oz**	**Hawaii** **$0.01/oz**	**California** **$0.02/oz**	**West Virginia** **$0.01/oz**
First Year Reach	733,000	1,440,000	38,000,000	1,840,000
Net Costs Over 10 Years	-$30.8 million (-$87.8;-$7.3) Cost-saving	-$20.3million (-$10.5;-$74.3) Cost-saving	-$1.79 billion -$4.0 b; -$740 m) Cost-saving	-$81.6 million (-$220m; -$24.1m) Cost-saving
Cases of Obesity Prevented the 10th Year	5,575 (1,760; 14,800)	6,040 (2,160; 15,100)	198,000 (96,700; 394,000)	17,700 (5,350; 47,120)
Cases of Childhood Obesity Prevented in the 10th Year	951 (316;2,470)	877 (321;2,280)	33,700 (12,500; 74,800)	3,100 (1,000; 81,00)
Health Care Costs Saved per $1 Invested	$11 ($3.40;$29.50)	$3 ($1.06;$7.51)	$47 ($19.82-$118.76)	$275 ($82; $745)

Both the demographic compositions of the sites and definitions of populations experiencing disadvantage varied. In addition, health department and community participants decided on different ways to illustrate baseline disparities, and the projected impact of the intervention on health equity. We provide examples below.

In Denver, the CHOICES Learning Collaborative Partnership team projected that the implementing a sugary drink excise tax of $0.02/ounce would lead to the prevention of 5,575 cases of obesity overall in the year 2027 (95% uncertainty interval of 1,760; 14;800), and 951 cases among children (95% UI of 316; 2,470). The evidence for expected improvement in health equity can be expressed as a relative change: Hispanic Denver residents are projected to experience nearly a fourfold reduction in obesity prevalence compared to White non-Hispanic Denver residents (3.95: 95% UI 3.38-4.47). Similarly, the reduction in obesity prevalence among Black non-Hispanic Denver residents is projected to be almost twice as high as the reduction among White non-Hispanic Denver residents (2.01: 95% UI 1.72-2.43). These relative reductions – 3.95 times greater, and 2.01 times greater – can be seen as useful indicators of improvements in health equity. On that basis, racial/ethnic disparities in obesity outcomes should decrease following the implementation of the modeled tax, indicating both improved overall population health and improved health equity.[52]

Figure 1: A $0.02/ounce excise tax on sugary drinks is projected to have a greater health impact on Non-Hispanic Black and Hispanic communities



In Hawaii, there were particular concerns for Native Hawaiian and Other Pacific Islander populations, where obesity prevalence was higher than average as was sugary drink consumption. In analyses by racial/ethnic group, CHOICES projected substantial cases of obesity prevented among all race/ethnicity

groups if a sugary drink fee were implemented. These declines were also expressed as relative changes. With a sugary drink fee, Native Hawaiian, other Pacific Islander, and Filipino Hawaii residents would see greater changes in rates of obesity than expected for the average Hawaii resident. In this way the proposed fee should decrease disparities in obesity rates and improve health equity in Hawaii.[53]

In California, analyses projected that non-Latino Black/African American and Latino Californians[51] would experience even greater health benefits than the average resident after the tax is implemented. Under the proposed tax, it is projected that Black/African American Californians would see a 39% greater reduction in obesity prevalence than average, and Latino Californians would see a 33% greater reduction in obesity prevalence than average. The proposed tax should thus improve health equity in California.[55]

In West Virginia, CHOICES worked with partners to project the impact of a $0.02 per ounce sugary drink excise tax. In follow-up analyses using BRFSS data, the team documented that populations with lower income consume more sugary drinks than populations with higher income. As a consequence, a sugary drink excise tax is projected to both reduce the overall prevalence of obesity and to have the greatest effect on populations with lower income: 1.5 times greater compared to populations with higher income (see Figure 2).[52] This change is expected to improve health equity in West Virginia.

Figure 2: Projected reduction in obesity prevalence in 2027 with a $0.02/ounce sugary drink excise tax

One concern in all sites was the potential impact of the tax on households with lower income. CHOICES analyses indicate that households will on average spend less on sugary drinks after the tax goes into effect, providing disposable income for other purchases. This occurs because of the substantial price elasticity of demand, estimated as -1.21.[53] Price elasticity of demand is a measure of of how consumers respond to price increases, and the estimate for sugary drinks means that consumers are very likely to move away from purchasing sugary drinks when prices increase. For example, in West Virginia, this would be an estimated $48 million per year less spent on sugary drinks after a tax was implemented. In Hawaii, these results were presented in terms of how much less individuals would spend on average on sugary drinks after a $0.01 per oz fee was initiated: about $36 less per year per person. While

consumers would pay no fees if they did not purchase sugary drinks, CHOICES analyses also noted that a typical consumer in Hawaii who continued consuming these beverages would be expected to pay fees of about $1.50 per week.[53]

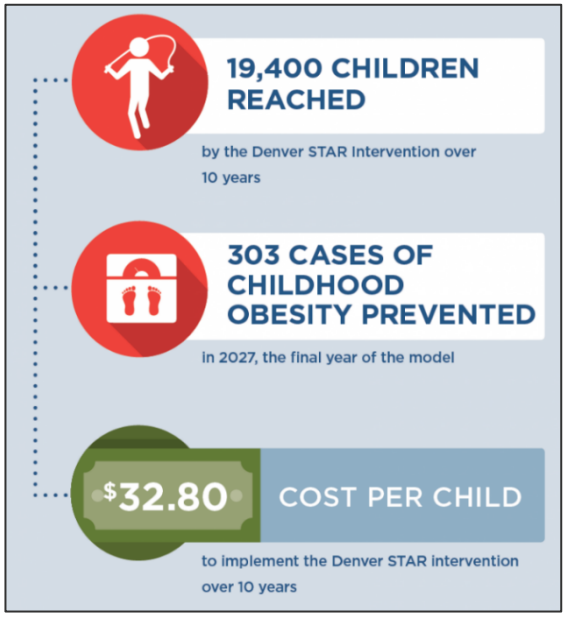
In California, we projected that individuals and households in California will spend less money on sugary drinks after a $0.02 per ounce tax: in this case, about $48 less per year per person, and $142 per year less for an average household. This would free up disposable income for other consumer purchases.[55]

As we have noted above, the revenue that would be collected is substantial and varies based on the size of the tax, consumption levels, and population size. In California, a sugary drink excise tax would generate $1.2 to $1.8 billion per year in revenue. These funds could be reinvested in populations with lower income and in communities experiencing disadvantage to further improve health equity. For instance, in Berkeley, California, revenue from a municipal sugary drink excise tax has been allocated for spending on school and community programs, many serving families with lower income or communities of color. [54] In Seattle, revenue from the tax has been used to provide emergency food vouchers during the COVID-19 pandemic.[55] In Philadelphia, a tax was designed to finance universal prekindergarten and improvements in recreational facilities.[56]

A Clinical Strategy to Treat Children with Too Much Weight for Health[57] in Denver, Colorado

With Denver Public Health officials and community stakeholders, CHOICES also explored the potential impacts of a much more focused intervention in a clinical setting, concentrating on addressing obesity treatment for children with excess weight in the pediatric clinical setting – the STAR intervention.[16] As the health care provider for one-third of Denver's children, Denver Health recognized its potential to reach families experiencing economic disadvantage through Denver Health community health centers, and by undertaking additional actions within its health system.[58]

Figure 3: Implementing STAR in Denver Health pediatric primary care settings is an investment in the future



A CHOICES cost-effectiveness analysis compared the costs and outcomes of the implementation of STAR within pediatric primary care practices in Denver Health, with the costs and outcomes associated with not implementing this program over a 10-year time period (2017-2027). This analysis projected that 19,400 children would be reached by the strategy over 10 years, leading to the prevention of more than 300 cases of childhood obesity in 2027 (95% UI 38-501). This is an inexpensive strategy, with a cost per treated child estimated at $33 (see Figure 3). The strategy is projected to save $0.77 in future health care costs for every $1 spent on implementation (95% UI $0.11- $1.78).[59]

The intervention sites where STAR was planned for implementation serve a higher proportion of Hispanic and Black children than the city average, and the intervention is projected to result in significant health benefits among Hispanic and Black populations in Denver. This strategy is thus projected to both improve overall population health and improve health equity. Because of the relatively small number of cases prevented, there is a good deal of uncertainty in these estimates.

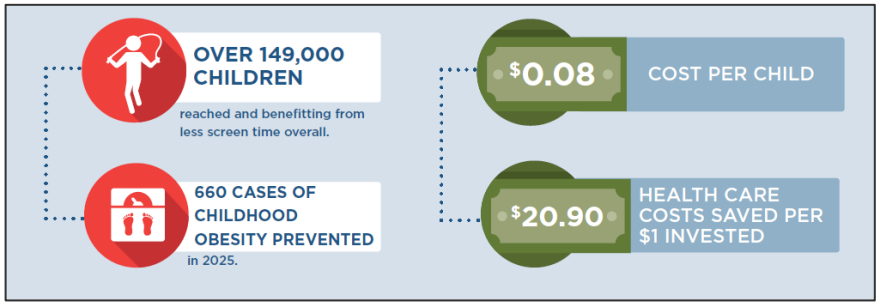
In addition, this Learning Collaborative Partnership gave Denver Health the data they needed to support a grant application for strategy implementation – thereby extending the real-world impact of this work. Denver Health began implementing the intervention in 2019. Since 2019, 11 Denver Health clinics have implemented this strategy, and Denver Health training materials have been created (such as intervention tip sheets, FAQs, and presentations). The intervention has been adapted to make use of local text messaging (versus more expensive mailed materials), using evidence showing effectiveness of this approach in a randomized trial.[60]

A Strategy to Help Families in WIC Reduce TV Time in Oklahoma

The Oklahoma State Department of Health (OSDH) and the Oklahoma Department of Human Services (OKDHS) worked with CHOICES and the Oklahoma WIC service team to develop a strategy to assist families in reducing TV time. A CHOICES cost-effectiveness analysis compared the costs and outcomes of

implementing this strategy in Oklahoma WIC practices over 10 years with costs and outcomes associated with not implementing this initiative. The approach assumes all WIC clinics in Oklahoma would integrate screen time questions into practice and provide counseling to those families who select it.

Figure 4: Implementing screen time counseling in WIC is an investment in the future



CHOICES projected that a state-level initiative to provide screen time counseling to families participating in WIC could prevent 656 (95% UI 266-850) cases of childhood obesity in Oklahoma in 2025 and provide counseling to households representing more than 149,000 children in WIC over 10 years. This is a low-cost strategy (estimated at $0.08 per child). CHOICES projected that implementation of this strategy can save $20.90 (95% UI $8.32-$27.39) in health care costs for every $1 spent on implementation.[61,62]

Children participating in WIC in Oklahoma are in households with lower income and are more likely to be Hispanic or Black than the general population in Oklahoma. Since this strategy is focused on populations with high risk of excess TV viewing, it may help to promote equity. CHOICES projected substantial reductions in cases of obesity among children in households with lower income participating in WIC (in households with income less than 185% of poverty levels) – and no impact of the strategy among households with higher income not participating in WIC. Thus, this strategy will likely improve health equity.

As another example of real-world impact, the Oklahoma team decided to adopt the strategy statewide after reviewing these data and realizing how easy it would be to modify the WIC software. Screen time counseling in the Oklahoma WIC program was rolled out in 2017. Since 2017, nearly 30,000 families have received screen time guidance, and 75% report taking steps to reduce screen time.[63]

Implications and Takeaways for States and Cities and Decision-Makers

Given the substantial health effects,[1-6] and the significant financial costs[64] associated with excess body weight, decision-makers at state and local levels are constantly looking for effective strategies to prevent obesity and promote health equity. The three strategies described in this paper provide

concrete examples of cost-effective approaches to childhood obesity prevention which can likely make a substantial impact on both overall population health and health equity.

Sugary drink excise taxes – which have been implemented in several U.S. localities – are projected to be a cost-saving strategy, to have a substantial impact on future cases of obesity, health care costs, health outcomes, and health equity, as well as raise revenue that can be used to support community activities that can further promote health equity.[65] The health equity implications of this strategy vary substantially across populations, depending upon existing disparities in sugary drink intake, local population characteristics, local history, tax level and implementation.

The interventions in pediatric clinics to treat childhood obesity and to reduce screen time among WIC participants are also expected to improve health equity. Because these strategies focus on children, they will affect fewer members of the population and have more modest overall population impact. Interventions focused solely on children will often have modest short-run health care cost benefits, as most of the serious consequences of excess weight gain occur in middle and later adulthood[66] (e.g., older adults with obesity have the highest health care costs[67]). However, because adult weight gain is so hard to reverse, investments in childhood prevention may be one of the few routes to early prevention of adult obesity, and associated future health burdens and rising inequity.

These three strategies illustrate different paths to improved population health and health equity. In the case of the clinical intervention to treat obesity, and the intervention with WIC families, families experiencing disadvantage are the focus for implementation, so these populations are more likely to receive an effective strategy that populations with more advantage will likely not receive. A sugary drink excise tax has stronger benefits for those who consume the most sugary drinks, and this is projected to be the case with populations experiencing disadvantage in each of the sites studied, with variations by race/ethnicity and income.

THe projected results assume that the interventions can be successfully implemented in these geographic areas. The evidence from evaluations of sugary drink excise taxes in cities across the US and in a range of countries indicates substantial success in implementation.[28-31] Clinical interventions like that modeled with the Denver team have been effectively implemented in a range of populations and settings and shown effectiveness in multiple interventions and randomized trials[60,68,69] Thus all of these strategies are clearly feasible, and the history of multiple successful implementations indicates

promising potential. Clearly ongoing evaluations are needed to further gauge both implementation and success.

Another key insight from our work with a wide range of cities and states has been the importance of understanding how to best communicate results. We have found that everyone – including community partners – find estimates of cases of obesity prevented as quite understandable and meaningful. Relative effects across populations – exemplified by relative risks and differences in obesity prevalence – are more often more difficult to easily understand. Therefore, we recommend use of estimates of cases of obesity prevented along with an obesity equity indicator based on relative reductions in prevalence: if this equity index is greater than one, there is evidence for improved health equity.

We know that the strategies described in this paper cannot eliminate the problem of child obesity and racial/ethnic and economic inequities. Indeed, the strategies reviewed here will need to be implemented more widely and further evaluated to document the accuracy of our projections. The strategies discussed in this paper can be considered to be part of a larger toolkit of cost-effective strategies that are feasible to implement. Because of their consideration of existing disparities in the environments of low income and/or historically marginalized racial/ethnic groups, they offer promising approaches to meaningfully prevent child obesity at a population level while reducing health inequities.

These strategies are only part of the broader solution to widespread inequities in health. To fully address the problem, broader societal changes are required. As Sara Bleich notes in her discussion of policies related to federal nutrition and health insurance safety nets: "Critically, these policies may not address root causes of structural racism. Progress in that area will likely require approaches focused explicitly on ameliorating the very real problems of segregation, wealth gaps, and inequities in access to quality education and health care."[70] The strategies we discuss here are focused on proximate determinants of child obesity. As such, they represent feasible and cost-effective opportunities for action that can both reduce child obesity and improve health equity in the short-term as work to dismantle structural racism, improve economic inequality, and reform an obesogenic food system continues.

Suggested Citation

Gortmaker SL, Bleich SN, Kenney EL, Barrett JL, Ward ZJ, Long MW, Cradock AL. *Cost-Effective Strategies to Prevent Obesity and Improve Health Equity*. Harvard T. H. Chan School of Public Health, 2021. For further information, contact choicesproject@hsph.harvard.edu and visit www.choicesproject.org

Funding

Funded by The JPB Foundation (Grant No. 1085), the National Institutes of Health (Grant No. R01HL146625) and the Centers for Disease Control and Prevention (CDC) (Grant No. U48DP006376). This work is solely the responsibility of the authors and does not represent official views of the CDC, the NIH, or other agencies.

References

[1] Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. International journal of obesity (2005). 2011;35(7):891-8.
[2] The Global Burden of Metabolic Risk Factors for Chronic Diseases Collaboration. Metabolic mediators of the effects of body-mass index,overweight, and obesity on coronary heart disease and stroke: a pooled analysis of 97 prospective cohorts with 1·8 million participants. Lancet. 2014;383(9921):970–83.
[3] Sing G, Danaei G, Farzadfar F, Stevens G, Woodward M, al. e. The Age-Specific Quantitative Effects of Metabolic Risk Factors on Cardiovascular Diseases and Diabetes: A Pooled Analysis. PLoS ONE. 2013;8(7):e65174.
[4] World Cancer Research Fund AIfCR. Food, Nutrition, Physical Activity, and the Prevention of Cancer: A Global Perspective. Washington DC: American Institute for Cancer Research; 2007.
[5] Muennig P, Lubetkin E, Jia H, Franks P. Gender and the burden of disease attributable to obesity. Am J Public Health. 2006 Sep;96(9):1662-8.
[6] Kwon J, Kim SW, Ungar WJ, Tsiplova K, Madan J, Petrou S. A Systematic Review and Meta-analysis of Childhood Health Utilities. Med Decis Making. 2018 Apr;38(3):277-305.
[7] Ward ZJ, Long MW, Resch SC, Giles CM, Cradock AL, Gortmaker SL. Simulation of Growth Trajectories of Childhood Obesity into Adulthood. N Engl J Med. 2017 Nov 30;377(22):2145-2153.
[8] Ward ZJ, Bleich SN, Cradock AL, Barrett JL, Giles CM, Flax C, Long MW, Gortmaker SL. Projected U.S. State-Level Prevalence of Adult Obesity and Severe Obesity. N Engl J Med. 2019 Dec 19;381(25):2440-2450.
[9] Swinburn BA, Sacks G, Hall KD, McPherson K, Finegood DT, Moodie ML, Gortmaker SL. The global obesity pandemic: shaped by global drivers and local environments. Lancet. 2011 Aug 27;378(9793):804-14.
[10] Kumanyika SK. A Framework for Increasing Equity Impact in Obesity Prevention. Am J Public Health. 2019 Oct;109(10):1350-1357.
[11] Bleich SN, Ard JD. COVID-19, Obesity, and Structural Racism: Understanding the Past and Identifying Solutions for the Future. Cell Metab. 2021 Feb 2;33(2):234-241.
[12] Acheson, Donald. 1998. Independent Inquiry into Inequalities in Health Report. London: Stationery Office.
[13] Williams DR, Purdie-Vaughns V. Needed Interventions to Reduce Racial/Ethnic Disparities in Health. J Health Polit Policy Law. 2016 Aug;41(4):627-51.
[14] Centers for Disease Control and Prevention – Division of Community Health. A Practitioner's Guide for Advancing Health Equity: Community Strategies for Preventing Chronic Disease. Atlanta, GA: US Department of Health and Human Services; 2013.
[15] Gortmaker SL, Wang YC, Long MW, Giles CM, Ward ZJ, Barrett JL, Kenney EL, Sonneville KR, Afzal AS, Resch SC, Cradock AL. Three Interventions That Reduce Childhood Obesity Are Projected To Save More Than They Cost To Implement. Health Aff (Millwood). 2015 Nov;34(11):1932-9.
[16] Taveras E., Marshall R., Kleinman KP et al. Comparative Effectiveness of Childhood Obesity Interventions in Pediatric Primary Care: A Cluster-Randomized Clinical Trial. JAMA Pediatrics 2015:169(6):535-542.
[17] Sharifi M, Franz C, Horan CM, Giles CM, Long MW, Ward ZJ, Resch SC, Marshall R, Gortmaker SL, Taveras EM. Cost-Effectiveness of a Clinical Childhood Obesity Intervention. Pediatrics. 2017 Nov;140(5):e20162998. doi: 10.1542/peds.2016-2998.
[18] Whaley SE, McGregor S, Jiang L, Gomez J, Harrison G, Jenks E. A WIC-based intervention to prevent early childhood overweight. J Nutr Educ Behav. 2010;42(3 Suppl):S47-51.

[19] Kenney EL, Mozaffarian RS, Long MW, Barrett JL, Cradock AL, Giles CM, Ward ZJ, Gortmaker SL. Limiting television to reduce childhood obesity: cost-effectiveness of five population strategies. Child Obes. 2021 May 10. Epub ahead of print. PMID: 33970695.
[20] Ward ZJ, Long MW, Resch SC, Giles CM, Cradock AL, Gortmaker SL. Simulation of Growth Trajectories of Childhood Obesity into Adulthood. N Engl J Med. 2017 Nov 30;377(22):2145-2153.
[21] Levy DT, Mabry PL, Wang YC, Gortmaker S, Huang TT, Marsh T, Moodie M, Swinburn B. Simulation models of obesity: a review of the literature and implications for research and policy. Obes Rev. 2011 May;12(5):378-94.
[22] Hu FB. Resolved: there is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases. Obes Rev. 2013 Aug;14(8):606-19.
[23] Malik VS, Pan A, Willett WC, Hu FB. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. American Journal of Clinical Nutrition. 2013;98(4):1084-1102.
[24] Malik VS, Popkin BM, Bray GA, Despres JP, Hu FB. Sugar- sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. Circulation. 2010;121(11):1356-64.
[25] Malik VS, Li Y, Pan A, et al. Long-Term Consumption of Sugar-Sweetened and Artificially Sweetened Beverages and Risk of Mortality in US Adults. Circulation. 2019;139(18):2113-2125.
[26] Bernabe E, Vehkalahti MM, Sheiham A, Lundqvist A, Suominen AL. The Shape of the Dose-Response Relationship between Sugars and Caries in Adults. Journal of Dental Research. 2016;95(2):167-172.
[27]U.S. Dept of Health and Human Services & U.S. Dept of Agriculture, 2015-2020 Dietary Guidelines for Americans, 8th Edition, 2015.
[28] Silver LD, Ng SW, Ryan-Ibarra S, Taillie LS, Induni M, Miles DR, Poti JM, Popkin BM. Changes in prices, sales, consumer spending, and beverage consumption one year after a tax on sugar-sweetened beverages in Berkeley, California, US: A before-and-after study. PLoS Med. 2017 Apr 18;14(4):e1002283.
[29] Powell LM, Leider J. The impact of Seattle's Sweetened Beverage Tax on beverage prices and volume sold. Econ Hum Biol. 2020 May;37:100856.
[30] Powell LM, Leider J. Evaluation of Changes in Beverage Prices and Volume Sold Following the Implementation and Repeal of a Sweetened Beverage Tax in Cook County, Illinois. JAMA Netw Open. 2020 Dec 1;3(12):e2031083.
[31] Roberto CA, Lawman HG, LeVasseur MT, Mitra N, Peterhans A, Herring B, Bleich SN. Association of a Beverage Tax on Sugar-Sweetened and Artificially Sweetened Beverages With Changes in Beverage Prices and Sales at Chain Retailers in a Large Urban Setting. JAMA. 2019 May 14;321(18):1799-1810.
[32] Bleich SN, Vercammen KA. The Associations Between Sugar-Sweetened Beverage Consumption and Children's Health: An Updated Review of the Literature. Durham, NC: Healthy Eating Research; 2018. Available at: http://healthyeatingresearch.org.
[33] Harris JL, Frazier W, Kumanyika S, Ramirez AG. Increasing Disparities in Unhealthy Food Advertising Targeted to Black and Hispanic Youth, Rudd Report. January 2019. http://uconnruddcenter.org/files/Pdfs/TargetedMarketingReport2019.pdf
[34] Allcott H, Lockwood BB, Taubinsky D. Should We Tax Sugar-Sweetened Beverages? An Overview of Theory and Evidence. Journal of Economic Perspectives. 2019; 33 no 3: 202–27.
[35] Chaloupka FJ, Powell LM, Warner KE. The Use of Excise Taxes to Reduce Tobacco, Alcohol, and Sugary Beverage Consumption. Annu Rev Public Health. 2019 Apr 1;40:187-201.
[36] Whaley SE, McGregor S, Jiang L, Gomez J, Harrison G, Jenks, E. A WIC-Based Intervention to Prevent Early Childhood Overweight. J Nutr Educ Behav. 2010;42(3 Suppl):S47-51.
[37] Rideout V. The Common Sense Census: Media Use by Kids Age Zero to Eight. San Francisco, CA; 2020.
[38] Rideout V. The Common Sense Census: Media Use by Tweens and Teens. San Francisco, CA: Common Sense Media; 2019.
[39] Buchanan, L. R. et al. (2016). Reducing Recreational Sedentary Screen Time: A Community Guide Systematic Review. Am J Prev Med, 50(3), 402-415. https://www.thecommunityguide.org/sites/default/files/publications/obesity-AJPM-evrev-behavioral_0.pdf
[40] Sonneville KR, Long MW, Ward ZJ, et al. BMI and Healthcare Cost Impact of Eliminating Tax Subsidy for Advertising Unhealthy Food to Youth. Am J Prev Med. 2015;49(1):124-134.
[41] Fleming-Milici F, Harris JL (2018). Television food advertising viewed by preschoolers, children and adolescents: contributors to differences in exposure for black and white youth in the United States. Pediatric Obesity, 13, 103-110.

[42] Grier S, Kumanyika S (2010). Targeted marketing and public health. Annual Review of Public Health. 31 (1):349-369.
[43] Pan L, Blanck HM, Park S, et al. State-Specific Prevalence of Obesity Among Children Aged 2-4 Years Enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children - United States, 2010-2016. MMWR Morb Mortal Wkly Rep. 2019;68(46):1057-1061.
[44] https://wicworks.fns.usda.gov/resources/value-enhanced-nutrition-assessment-vena-guidance. Accessed 6/22/2021.
[45] Keppel K, Pamuk E, Lynch J, et al. Methodological issues in measuring health disparities. Vital and health statistics Series 2, Data evaluation and methods research. 2005(141):1-16.
[46] Harper S, Lynch J. Methods for Measuring Cancer Disparities: Using Data Relevant to Healthy People 2010 Cancer-Related Objectives. NCI Cancer Surveillance Monograph Series, Number 6. Bethesda, MD: National Cancer Institute, 2005. NIH Publication No. 05-5777.
[47] Moreland J, Kraus (McCormick) E, Long MW, Ward ZJ, Giles CM, Barrett JL, Cradock AL, Resch SC, Greatsinger A, Tao H, Flax CN, and Gortmaker SL. Sugary Drink Excise Tax in Denver. Boston MA, 2018. Harvard T. H. Chan School of Public Health.
[48] Irvin L, Inoue K, Bowie A, Ching L, Starr R, Ryan J, White BS, La Chica T, Gortmaker SL, Long MW, Ward ZJ, Giles CM, Barrett JL, Resch SC, Greatsinger A, Tao H, Flax CN, Cradock AL. Hawaii: Sugary Drink Fee [Report]. Hawaii Department of Health, Hawaii Public Health Institute, Honolulu, HI, and the CHOICES Learning Collaborative Partnership at the Harvard T.H. Chan School of Public Health, Boston, MA; January 2021.
[49] Gortmaker SL, Long MW, Ward ZJ, Giles CM, Barrett JL, Resch SC, Cradock AL. Sugary Drink Excise Tax in West Virginia. Boston MA, 2017. Harvard T. H. Chan School of Public Health.
[50] Gouck J, Whetstone L, Walter C, Pugliese J, Kurtz C, Seavey-Hultquist J, Barrett J, McCulloch S, Garrone M, Cradock A, Gortmaker, S. California: A Sugary Drink Excise Tax. California Department of Public Health, Sacramento, CA, the County of Santa Clara Public Health Department, San Jose, CA, and the CHOICES Learning Collaborative Partnership at the Harvard T.H. Chan School of Public Health, Boston, MA; March 2021.
[51] The sites used different terms for racial/ethnic populations. For example, the Denver team used the term "Black non-Hispanic" and the California team used "non-Latino Black/African American."
[52] Giles, C.M, Jeffrey, J., Case, S. "Improving Population Health and Reducing Disparities in Obesity: Cost-Effective Strategies to Promote Health Equity." Southern Obesity Summit: Charleston, WV. October 2018. http://www.southernobesitysummit.org/uploads/1/4/5/7/14570646/choices_keynote_panel_2018_10_22.pdf
[53] Powell LM, Chriqui JF, Khan T, Wada R, Chaloupka FJ. Assessing the Potential Effectiveness of Food and Beverage Taxes and Subsidies for Improving Public Health: A Systematic Review of Prices, Demand and Body Weight Outcomes. Obesity Reviews. 2013;14(2):110-128.
[54] Bennet S, Draper N, Farnsworth I, McBride F. 2019. The Bay Area sugar-sweetened beverage taxes: an evaluation of community investments. Rep., Praxis Proj., Berkeley Food Inst., Berkeley, CA. https://food.berkeley.edu/wp-content/uploads/2019/05/GSPP-Soda-Tax-Evaluation-Final-Draft_ withdate.pdf
[55] Scruggs G. 2020. Seattle turns soda tax revenue into emergency grocery vouchers during pandemic. Next City, March 30. https://nextcity.org/daily/entry/seattle-turns-soda-tax-revenue-into-emergency-grocery-vouchers-pandemic.
[56] Purtle J, Langellier B, Lê-Scherban F. A Case Study of the Philadelphia Sugar-Sweetened Beverage Tax Policymaking Process: Implications for Policy Development and Advocacy. J Public Health Manag Pract. 2018 Jan/Feb;24(1):4-8.
[57] Clinical strategies often describe interventions to treat children with overweight or obesity. The Denver team uses a different term: children with too much weight for health.
[58] CHOICES Stories from the Field: Denver Takes Action to Promote Healthy Child Weight. Denver Public Health, a Department of Denver Health, Denver, CO, and the CHOICES Project Team at the Harvard T.H. Chan School of Public Health, Boston, MA; October 2020.
[59] Moreland J, Rosen J, Kraus E, Reiner J, Gortmaker S, Giles C, Ward Z. *Denver: Study of Technology to Accelerate Research (STAR)* [Issue Brief]. Denver Public Health and Denver Health, Denver, CO, and the CHOICES Learning Collaborative Partnership at the Harvard T.H. Chan School of Public Health, Boston, MA; July 2018. . https://choicesproject.org/publications/brief-star-denver

[60] Taveras EM, Marshall R, Sharifi M, Avalon E, Fiechtner L, Horan C, Gerber MW, Orav EJ, Price SN, Sequist T, Slater D. Comparative Effectiveness of Clinical-Community Childhood Obesity Interventions: A Randomized Clinical Trial. JAMA Pediatr. 2017 Aug 7;171(8):e171325.
[61] Bryce T, Kenney E, Giles C, Flax C, Gortmaker S, Ward Z, Cradock A. *Oklahoma: Incorporating Screen Time into the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) Modified Value, Enhanced, Nutrition Assessment (VENA)* [Issue Brief]. Oklahoma State Department of Health, Oklahoma City, OK, and the CHOICES Learning Collaborative Partnership at the Harvard T.H. Chan School of Public Health, Boston, MA; August 2017. https://choicesproject.org/publications/brief-wic-screen-time-oklahoma
[62] CHOICES Stories from the Field: *Oklahoma Takes Action to Improve Child Health.* Oklahoma State Department of Health & Oklahoma Department of Human Services, Oklahoma City, OK, and the CHOICES Project Team at the Harvard T.H. Chan School of Public Health, Boston, MA; May 2020. https://choicesproject.org/publications/sftf-oklahoma-takes-action-to-improve-child-health
[63] CHOICES Stories from the Field: Oklahoma Takes Action to Improve Child Health. Oklahoma State Department of Health & Oklahoma Department of Human Services, Oklahoma City, OK, and the CHOICES Project Team at the Harvard T.H. Chan School of Public Health, Boston, MA; May 2020.
[64] Ward ZJ, Bleich SN, Long MW, Gortmaker SL. Association of body mass index with health care expenditures in the United States by age and sex. PLoS One. 2021 Mar 24;16(3):e0247307.
[65] Krieger J, Bleich SN, Scarmo S, Ng SW. Sugar-Sweetened Beverage Reduction Policies: Progress and Promise. Annu Rev Public Health. 2021 Apr 1;42:439-461.
[66] Gortmaker SL, Wang YC, Long MW, Giles CM, Ward ZJ, Barrett JL, Kenney EL, Sonneville KR, Afzal AS, Resch SC, Cradock AL. Three Interventions That Reduce Childhood Obesity Are Projected To Save More Than They Cost To Implement. Health Aff (Millwood). 2015 Nov;34(11):1932-9.
[67] Ward ZJ, Bleich SN, Long MW, Gortmaker SL. Association of body mass index with health care expenditures in the United States by age and sex. PLoS One. 2021 Mar 24;16(3):e0247307.
[68] Taveras EM, Marshall R, Kleinman KP, et al. Comparative effectiveness of childhood obesity interventions in pediatric primary care: a cluster-randomized clinical trial. JAMA Pediatr. 2015;169(6):535–542
[69] Fiechtner L, Perkins M, Biggs V, Langhans N, Sharifi M, Price S, Luo M, Locascio JJ, Hohman KH, Hodge H, Gortmaker S, Torres S, Taveras EM. Comparative Effectiveness of Clinical and Community-Based Approaches to Healthy Weight. Pediatrics. 2021 Oct;148(4):e2021050405.
[70] Bleich SN, Ard JD. COVID-19, Obesity, and Structural Racism: Understanding the Past and Identifying Solutions for the Future. Cell Metab. 2021 Feb 2;33(2):234-241.
[69] Gortmaker SL, Peterson K, Wiecha J, Sobol AM, Dixit S, Fox MK, Laird N. Reducing obesity via a school-based interdisciplinary intervention among youth: Planet Health. Arch Pediatr Adolesc Med. 1999 Apr;153(4):409-18.
[70] Austin SB, Field AE, Wiecha J, Peterson KE, Gortmaker SL. The impact of a school-based obesity prevention trial on disordered weight-control behaviors in early adolescent girls. Arch Pediatr Adolesc Med. 2005 Mar;159(3):225-30.