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HEALTH RISKS ASSOCIATED WITH HIGH SUGAR SWEETENED BEVERAGE  
CONSUMPTION AND WAYS TO REDUCE INGESTION

By

Tyler Austin Pahl

A Thesis Submitted in Partial Fulfillment  
Of the Requirements for the  
University Honors Program

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Department of Biology  
The University of South Dakota  
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The members of the Honors Thesis Committee appointed  
to examine the thesis of Tyler A. Pahl  
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## ABSTRACT

### HEALTH RISKS ASSOCIATED WITH HIGH SUGAR SWEETENED BEVERAGE CONSUMPTION AND WAYS TO REDUCE INGESTION

Tyler Austin Pahl

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This literature review analyzes the many health implications of high sugar-sweetened beverage (SSB) consumption. Some of these health implications include (but are not limited to) obesity, diabetes, cardiovascular disease, and higher blood pressure. SSB consumption has increased 500% in the past fifty years and is the largest source of calorie intake among children. Obesity rates have increased to epidemic proportions in the United States and many countries around the world. According to the World Health Organization (WHO) more than 1 billion adults throughout the world are overweight, with a body mass index (BMI) of over 25. In the United States, an estimated 129.6 million people (64% of the population between the ages of 20-75) are overweight, and out of those 129.6 million 30% of people can be considered obese. Several methods have been proposed to lower the intake of SSB, thus improving public health. These methods include: mass media campaigns, regulations, taxation, SSB bans, and replacing SSBs with other beverages.

**Keywords:** Sugar-Sweetened Beverage (SSBs), Obesity, Health Issues, Regulations, Taxation

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## CHAPTER ONE

### Introduction

Sugar-sweetened beverages (SSBs) are the largest source of sugar consumption and contribute a large number of calories to U.S. diets. SSBs also typically contain little to none of the nutrients the body needs. (“Intake of Sugar-sweetened Beverages” Malik, et al. 274). The 2010 Dietary Guidelines for Americans define SSBs as “liquids that are sweetened with various forms of sugars that add calories.” These include pops/sodas, juices, energy drinks, teas, sport drinks, and any other beverages to which sugar (usually high fructose corn syrup or sucrose) has been added. It is important to note that this definition excludes diet sodas or other beverages that use artificial, non-caloric sweeteners.

The American Heart Association has found that SSB consumption has increased 500% in the past fifty years and is the largest source of calorie intake among children. Before 1950, the standard bottle size of SSBs were 6.5 ounces. However, in 1950 soft-drink companies began introducing larger bottle sizes such as the 12 ounce can. These companies continued to increase sizes and in the early 1990s, 20-ounce bottles had taken over the market. Today, even larger sizes are available. For example, fountain-pop cups can range anywhere from 32 ounces to 64 ounces. This is alarming when considering that 20-ounce sodas can contain anywhere from 15 to 18 teaspoons of sugar and around 240 calories. A 64-ounce SSB could have close to 700 calories. The recommended daily calorie intake varies from person to person, but the US Department of Health estimates

that the average daily calorie intake is 1940 calories for women and 2550 for men. Eighty percent of children and 63% of adults in the United States consume a SSB everyday. In 1965, per capita consumption of SSBs was 2.5% of total calorie intake (50 kcal/day) among adults in the United States. Today, SSB consumption is approximately at 11% of total calories (224 kcal/day) among children and 9% of total calories (203 kcal/day) among adults. Adolescents aged 12 to 19 years consume the most SSBs at 13% of their total calories.

High levels of SSB consumption has been linked with obesity. Several studies (Zimmernan, Malik, et al., World Health Organization) show a correlation between SSB consumption and increased levels of body fat. Systematic reviews show that higher SSB consumption leads to “small but significant” weight gain (“Intake of Sugar-sweetened Beverages” Malik, et al. 274). Obesity is not the only adverse side effect of increased SSB consumption. These other side affects include (but are not limited to) diabetes, cardiovascular disease, and higher blood pressure. High levels of SSB consumption can also lead to low nutrient dense diets by replacing nutrient dense foods, like milk, with poor nutrient SSBs. State, city, and county governments need to make efforts to regulate and control the amount of sugar-sweetened beverages that are being consumed by regulating the amount of sugar that can be placed in a drink, increasing taxes on SSBs, properly educating individuals, and/or by banning SSBs in certain facilities.

## **CHAPTER TWO**

### **Background**

Carbonated beverages can be traced to the 1760s when carbonation techniques were developed to reproduce naturally occurring carbonated mineral waters that people initially believed to be healthy. However, these carbonated beverages did not add sugar. Almost 100 years later, a groundbreaking event in soft drink history happened when Atlanta pharmacist J.S. Pemberton combined coca (a stimulant leaf from South America) with kola (a caffeinated nut from Africa) and thus created Coca-Cola. The creation of Coca-Cola paved the way for other production of soft drinks in the 1800s. Around 1904, Asa Candler purchased legal rights to the Coca-Cola formula and developed the first mass producing factory. During World War II, Coca-Cola worked closely with the US Department of War to provide free sodas to soldiers. Because of this, Candler was allowed to break sugar ration rules and was able to build new factories in Europe with the support of their government. This practice soon spread to a global scale (“Intake of Sugar-sweetened Beverages” Malik et al. 274).

In 1974, Earl Butz, the Secretary of Agriculture, and President Richard Nixon completely revised United States agricultural policy. From the 1930’s to 1973, agriculture policies subsidized farmers by restraining production and therefore keeping crop prices high. However, Butz and Nixon thought this policy did not make much sense.

So they shifted subsidizing policies that favor large scale productions to keep crop prices low. Butz encouraged farmers to plant as much as they could. So farmers did just that, especially with corn. The higher volume of corn being produced led to lower and lower corn prices, which also meant lower and lower high fructose corn syrup prices, the main sweetener used in almost all sugar-sweetened beverages. “The cheapness of high fructose corn syrup makes soft drinks among the most profitable commodities produced by the capitalist industry” (Albritton, 334) This abundance helps explain why SSBs have been so cheap. In fact, after adjusting for inflation, SSBs are no more expensive than they were in 1974 (Solkoff 13). These types of markets are very effective and when a product is cheap, consumers tend to purchase it frequently. According to the American Heart Association, the average American consumes close to 50 gallons of sugar-sweetened beverages every year.

### **Chapter Three**

#### **Health Issues Associated with Sugar-Sweetened Beverage Consumption**

Over the past 20 years, obesity rates have increased to epidemic proportions in the United States and many countries around the world. According to the World Health Organization (WHO) more than 1 billion adults throughout the world are overweight, with a body mass index (BMI) of over 25. About 300 million out of this 1 billion are considered obese with a BMI over 30. In the United States, an estimated 129.6 million people (64% of the population between the ages of 20-75) are overweight, and out of those 129.6 million 30% of people can be considered obese (“Sugar-sweetened

beverages” Malik et al. 274). Similar trends can be seen in children and young-adults, which can lead to serious health complications in adulthood, such as hypertension, heart disease, diabetes and even depression (Allison DB 1530). Being overweight or obese leads to decreases in productivity and quality of life which leads to higher medical, psychological, and social costs (Sugar-sweetened beverages” Malik et al. 274).

The National Health Service (NHS) states that obesity results from consuming high amounts of calories in your diet, particularly from fat and sugars. The problem occurs when an individual eats these high amounts of calories but does not engage in enough exercise or physical activity to burn off those calories as energy. When one does not burn off those calories as energy, the body takes that surplus of calories and stores it as fat. In general, obesity “reflects complex interactions of genetic, metabolic, cultural, environmental, socioeconomic, and behavioral factors” (Sugar-sweetened beverages” Malik et al. 274). According to national survey data done by the USDA center for Nutrition and Policy and Promotion in the United States, carbohydrate consumption (largely in the form of added sugars) has increased in parallel with increases in obesity rates over the past 20 years. Between 1977 and 1996, the proportion of calories from the consumption of SSBs rose from 13.1% to 16.0%, and in 1995 more than 30% of carbohydrates consumed in the United States came from SSBs (USDA Center for Nutrition Policy and Promotion). As a result, the 2000 and 2005 *Dietary Guidelines for Americans* advised the public to avoid food and drinks that contain high amounts of added sugar and the World Health Organization has suggested that added sugars should provide no more than 10% of dietary energy.

Currently, the average intake of added sugar in the United States accounts for 15.8% of total energy. The largest source of these added sugars come from SSBs, which account for 47% of total sugar consumption in the diet (“Sugar-sweetened beverages” Malik et al. 274). SSB consumption increased by 135% between 1977 and 2001 (Sugar-sweetened beverages” Malik et al. 274). During this time, it is also estimated that consumption of daily caloric sweetener consumption in the United States increased by 83 calories per person. Nearly 65% of that 83 calorie increase came from soda consumption. In the US, an average 12-ounce soda (1 can) can contain 150 calories and 40–50 g sugar (or 10 teaspoons of table sugar). Adding these calories to a typical US diet without decreasing calorie intake from other sources means that one soda a day can lead to a weight increase of 15 pounds in one year (Sugar-sweetened beverages” Malik et al. 274). In addition to the increase of soda consumption, increase of fruit drink consumption has also been on the rise. These fruit drinks are similarly sweetened with large amounts of added sugar. These fruit drinks are often consumed by toddlers and children. Of the total 83 calorie/person increase in SSB consumption, 16% is estimated to have come from fruit drinks (Sugar-sweetened beverages” Malik et al. 276). This increase in fruit drink and soda consumption accounts for nearly 81% of caloric sweetener intake across the last two decades in the United States (Sugar-sweetened beverages” Malik et al. 277). The increased consumption of fruit drinks and sodas in the United States has been found to increase at the same time obesity rates have increased. The intake of sugar-sweetened beverages promotes weight gain and obesity by increasing overall calorie intake.

It has long been a concern that SSB consumption has contributed to the growing obesity epidemic. However, only recently have large epidemiological studies been able to

form a connection between SSB consumption and long-term weight gain, type 2 diabetes mellitus, and cardiovascular risk. These health risks may be because of the fact that SSBs contain high amounts of “rapidly absorbable carbohydrates” (Malik et al. 277) such as different forms of sugar and high-fructose corn syrup (HFCS). SSBs may increase type 2 diabetes mellitus and cardiovascular diseases independently from obesity by contributing a high dietary glycemic load (GL). This high GL can lead to inflamed, insulin-resistant, and impaired  $\beta$ -cell function (Sugar-sweetened beverages” Malik et al.). Additional metabolic effects of these beverages may also lead to hypertension and promote accumulation of visceral adipose tissue and of ectopic fat due to elevated hepatic de novo lipogenesis. This results in the development of high triglycerides and low HDL cholesterol and small, dense LDL, although the specific metabolic effects of fructose versus glucose need to be examined further.

## **CHAPTER FOUR**

### **Possible Solutions**

Reducing SSB consumption will help reduce obesity levels and may also have positive effects on type 2 diabetes mellitus and cardiovascular risk by lowering blood pressure, cell inflammation, and lowering insulin sensitivity. Lowering SSB consumption in children and young adults is important because overweight and obesity rates have reached epidemic proportions in the United States. Properly educating parents and

children about the health risks associated with SSB's consumption is a possible solution that would be fairly easy to implement. This would include implementing programs within schools and adding material to classes children are already involved in or using mass media campaigns. Regulating SSB consumption has also proven effective. This includes regulating drink sizes and even regulating labels these companies must include. Increasing taxes on these beverages and even banning them in certain places are other possible solutions that can provide hope for the fight against SSB's and the health risks associated with them.

### **Education via Mass Media Campaigns**

Many American's overall health is often affected by a few lifestyle choices such as smoking, physical activity, and dietary choices. Individualized approaches to behavior changes are often impractical as these behavior changes often need to reach millions of people in order to raise public awareness and improve overall public health. Mass media campaigns have been used in the past to alter public behaviors and stigmas. However, these mass media campaigns have been used for some behaviors far more than others. There is strong evidence of mass media campaigns working to reduce smoking; however, campaigns of the same magnitude targeted towards dietary changes have not been found to be as effective ("Mass Media Campaign to Reduce Consumption of Sugar-Sweetened Beverages in a Rural Area of the United States." Farley, Thomas A., et al.). This may be due to the fact that diets consist of many choices and products and is far more complex than smoking. In order for dietary campaigns to be more successful, these campaigns

must focus on a single dietary issue. Focusing on one dietary issue that leads to more complex health issues would prove to be more successful. Recently, sugar-sweetened beverages have become a higher concern to public health as recent evidence links high sugar-sweetened beverage consumption to obesity, type 2 diabetes, and cardiovascular disease (Farley, Thomas A., et al.).

Thomas A. Farley and colleagues conducted a study evaluating mass media campaign's effectiveness on reducing sugar-sweetened consumption. Farley and colleagues sent out messages emphasizing the health risks associated with high SSB consumption via television and local organizations. Their audience for the campaign was adults aged 18 to 45 years of aged with a focus on 18 to 29 year olds (group with the highest rate of SSB consumption). Focus groups suggest that adults in the region were aware of the health implications of SSBs but felt that these risks did not apply to them (Farley, Thomas A., et al.). This messages were sent out over a fifteen-week time period during 2016. The messages were sent out to the "Tri-City" region of northeast Tennessee, Southwest Virginia, and southeast Kentucky. After this time period, they then evaluated the effectiveness of their media campaign with pre and post digital surveys. Participants in these surveys ranged from the ages of 18 to 45. The results are as follows

'Before the campaign, we completed 1031 mobile phone surveys, and afterward we completed 1000 surveys of adults aged 18 to 45 years in the intervention region. The survey samples before and after the campaign were similar in distribution by age (44% vs 40% younger than 30 years) and gender (55% men vs 54% women). Fifty-one percent of respondents after the campaign (vs 6% before;  $P < .001$ ) recalled seeing an advertisement that compared cigarettes to soda, and 54% recalled seeing the specific advertisement shown by the campaign when it was described to them. Among the 536 who recalled the specific advertisement, 63% considered the advertisement "believable," 62% considered it "important," and 28% spoke to someone about it. Twenty-seven percent claimed that they had already reduced their consumption of SSBs and 64% claimed that they would do so in the future. The surveys showed significant differences in beliefs about SSBs

from before to after the campaign, with a higher proportion of respondents afterward who agreed that SSBs were a “big cause of weight gain” (from 70% to 82%;  $P < .001$ ) and a “big cause of diabetes” (from 60% to 75%;  $P < .001$ ). In the postcampaign surveys, 53% of respondents agreed that SSBs increased the risk of heart disease, 29% agreed that they increased the risk of cancer, and 72% agreed that they increased the risk of losing teeth— questions that were not asked in the precampaign survey. After the campaign, those who recalled seeing advertisements were more likely than were those who did not recall seeing them to recognize most of these risks.’ (Farley, Thomas A., et al.).

These low-income, rural areas had high rates of obesity and high rates of SSB consumption. These multichannel media campaigns led to changes in beliefs about SSBs and even reduced sales of SSBs in the area (Farley, Thomas A., et al.). This suggests that the study had the intended effect of reducing population level consumption of SSBs.

Advertising to influence dietary changes and lifestyle changes to population levels is not a new concept. According to data provided by Advertising Age, PepsiCo, Coca-Cola, and Dr. Pepper and Snapple spent \$2.2 billion on advertising in the United States in 2013 (Farley, Thomas A., et al.). These companies put a lot of faith into these advertising campaigns. They are confident that these campaigns will increase the sale and consumption of their own products. It is easy to accept that companies of this magnitude effectively advertise to increase SSB consumption. Therefore, public health advocates must consider if it is just as practical to advertise against the consumption of SSBs by advertising the adverse effects of high consumption. It is difficult to compete against these multi-billion dollar companies, but we have seen success in anti-smoking campaigns so it would not be difficult for anti-SSB campaigns to be effective if done properly (Farley, Thomas A., et al.). Farley’s study suggest that this can be an effective solution to reducing SSB consumption.

## **Regulations**

During the past 50 years, SSB portion sizes have increased dramatically, and children and adults are consuming more SSBs than ever before. SSBs used to be consumed as an occasional treat, but now these beverages have become a part of daily life (Zimmerman). These consumption levels have risen in parallel with obesity rates and a number of local governments and health- organizations have attempted to solve this issue by regulation of SSBs. Attempts to regulate SSBs in order to decrease SSB consumption began once the harmful effects associated with excessive SSB consumption became apparent.

In the US, the attempted regulations have taken different forms including warning labels, zoning restrictions, and portion control (Zimmerman 295). At the forefront of this effort has been former New York City Mayor, Michael Bloomberg, an aggressive advocate of public health initiatives (Zimmerman 292). High obesity rates in New York City led Bloomberg to propose a Portion Cap rule in 2012 that would limit the sizes of SSBs that could be purchased in New York. This regulation would prohibit the sale of SSBs in containers the exceed 16 ounces in the city's "food service establishments" (Roberto et al. 2183) These establishments included restaurants, food trucks, stadiums, movie theaters, and delis. The city's ordinance defined SSBs as any nonalcoholic beverage that contained added sugar or another form of caloric sweetener (such as

glucose, fructose, or high fructose corn syrup) that also have more than 25 calories per 8 fluid ounces. Artificially sweetened drinks that are sweetened with non-caloric sweeteners like stevia, or aspartame (such as diet beverages), fruit juices without added sugar, unsweetened coffees, and milk were not implemented in this policy. Although this policy was an attempt to lower obesity rates in New York and was a proactive attempt, it failed to pass due to legal concerns. New York's State Court of Appeals' Judge Eugene F. Pigott Jr felt that the city's Board of Health exceeded their scope of regulatory authority. However, advocates for SSB regulations continue to view this attempt and others like it as a solution that will help decrease the obesity rates in children, adolescents, and adults.

Several other forms of regulatory policies have been directed at reducing SSB consumption and therefore obesity. For example, the Los Angeles City Council unanimously passed an interim control ordinance (ICO) in July of 2008 as a means to indirectly control SSB consumption. This ICO "prevents fast-food chains from opening in low-income sections of the city that had higher levels of obesity than other parts of the surrounding area." (Zimmerman 299). The City Council wanted to attract dining establishments or grocery stores instead of fast-food options. They thought these forms of obtaining food would help improve the quality of life in these areas. A survey of 300 South Los Angeles residents affected by this ICO reported that 44% were aware of the ban, and of these 44%, 67% supported it (Zimmerman 308). Even though there were oppositions from fast-food industries, the ICO has generally been viewed as a successful regulation policy that helps reduce SSB consumption and obesity rates.

It is difficult to decide how to effectively pass regulation policy. Nationwide bans are almost impossible to obtain, although the case in Mexico was successful. (see below) Therefore, in order to effectively regulate SSBs, local governments must first focus on small-scale solutions.

### **Taxation**

Another proposed solution to decrease SSB consumption is implementing taxes on these beverages. The general idea of this solution is that an increase in price of these beverages will lead to less people purchasing them. With less people purchasing these beverages, obesity rates will lower. Taxation is a common way to decrease consumption of unhealthy products. A good example of this working is the increased taxes on cigarettes and tobacco. For example, a price increase of about 10% on a pack of cigarettes can reduce cigarette use by about 4%, on average, in high income countries (Bader et al. 4119). When looking at taxes as a means to reduce consumption, the type of tax and how high of a tax is important. A typical type of tax for SSBs is an excise tax. This type of tax would raise the price of SSBs by approximately 20% and result in approximately \$13-billion in new revenue in one year alone (Zimmerman 298). Currently, 33 US states implement on average a 5.2% sales tax on soft drinks. However, this average sales tax rate is too low to affect consumption rates. Sales taxes can also lead consumers to choose cheaper alternatives or purchase them in larger sizes which typically

are cheaper (Zimmerman 298). Another issue with sales taxes are that some states exempt SSBs from their sales taxes because they consider SSBs as food even though they contain little to no nutritional value. Because of this, people who are in favor for the taxation of SSBs advocate for an excise tax instead of a sales tax. First, an excise tax is levied against the “manufacture, sale or consumption of commodities.” (Zimmerman 300). This type of tax targets the producers of SSBs. If production prices increase, the manufacturers will certainly pass this cost onto the consumer. Excise taxes also promote increased revenue coming into the state which can be used to promote even more public awareness of the risks of SSB consumption.

Recent research suggests that large taxes (up to 20%) on SSBs would reduce their consumption and obesity rates. Most US states already have some form of tax on SSBs, but these taxes are small in comparison to the price of these products. (Niederdeppe et al.) A couple of states (Pennsylvania, Mississippi) are considering a larger tax on SSBs but currently these efforts to increase SSB taxes have not been very successful. However, the city of Berkley, California proposed legislation that increased taxes on SSBs in 2014. This legislation was designed to incorporate a sales tax on all beverages sweetened with sugar at \$0.12 per twelve-ounce can of soda or 1 cent per-ounce. This legislation passed with overwhelming support with 29,540 in favor, compared to the 9,243 people who opposed it. The effects of this 1 cent per ounce tax were almost seen immediately. Instead of absorbing the loss in profits, large production companies passed their increase of production costs onto the consumer, thus raising the retail price of these SSBs. The increase in these retail prices can be seen anywhere from chain supermarkets, such as Safeway, to family-owned gas stations. This price increase is a step in the right direction

in hopes to reduce consumption rates and lower obesity rates. Not only has this tax increased retail prices of SSBs, it is also helping Berkeley raise money for city programs that help promote public health and nutrition. Within the first 6 months of this tax, nearly \$700,000 have been raised. This figure surpasses early predictions of the tax that were projected to only raise \$1.2 million in the first year.

Other countries have had success in implementing taxes as well. For example, 32% of the population in Mexico is obese. This alarming rate of obesity led the country to pass public health legislation that implemented a 10% tax on sugar-sweetened beverages (Cabrera Escobar, et al.). This legislation went into effect in January 2014. Even though there was initial opposition against the tax and critics argued that such a tax would be detrimental to sugar-cane farmers, the results so far have been largely beneficial. Sugar-sweetened beverages sales fell 6% in 2014, and 12% in the last half of the year. Low-income households showed even higher success rates with sales falling 9 percent in 2014 and 17 percent in the later half of the year (Cabrera Escobar, et al.). Mexico's example shows that taxes are an effective way to reduce SSB consumption.

Basu and colleagues examine how taxes would affect SSB consumption and obesity rates. They do this by modeling a 20% SSB excise tax increase in India. In order to do this, they first calculated how changes in SSB price change SSB consumption per capita. They then incorporated "SSB sales trends, body mass index (BMI), and diabetes incidence data stratified by age, sex, income, and urban/rural residence into a validated microsimulation of caloric consumption, glycemic load, overweight/obesity prevalence, and type 2 diabetes incidence" (Basu et al. 265) among populations that face this 20% excise tax. If SSB consumption continues to increase, Basu and colleagues estimate that a

20% SSB tax may prevent up to 4.2% of obesity, and reduce diabetes by 2.5% between the years 2014 to 2023. Given that about 25% of India's population is obese, this 4.2% reduction in obesity results in to lowering their obesity rates from 1 in 4 people to 1 and 5 people.

Econometric research generally finds that a 1% increase in SSB price should decrease consumption by about 1% (Blakely et al.). However, in real-life settings (like many states in the US) taxes on SSBs are usually too small to observe any measurable impact. The taxing solution is simple. These taxes work to improve public health by increasing prices, therefore decreasing consumption and lowering obesity rates, diabetes and other negative health consequences. For example, Basu and his colleagues also estimated that “a one percentage point increase in soft drink taxes decreases adult BMI by 0.003”.

### **Taxation Efficiency**

Policymakers have strong incentives to tax SSBs based on lessons learned from long-standing efforts concerning tobacco products. The World Health Organization (WHO) cites excise taxation (i.e., taxes paid at purchase) as the single most effective tool in reducing the demand for tobacco use, particularly among children and adolescents.<sup>16</sup> The Centers for Disease Control and Prevention (CDC) reports that tobacco taxes have led to a 9.4% decrease in smoking among U.S. high school students between 1991 and 2011. Like tobacco use, habitual SSB consumption starts early in life for many, is greater among low-income populations, and imposes significant health care costs. In 2009, Dr.

Kelly Brownell and colleagues proposed implementation of excise taxes to curb SSB consumption and raise significant revenue. Based on the price elasticity of soft drinks, they recommended an SSB excise tax of 1-cent-per-ounce, or about 15-20% of the purchase price. Such a price increase could yield a 12-20% reduction in SSB purchases, and a minimum of 10% overall caloric reduction (accounting for expected caloric substitutions from other sources). Enhanced taxation of SSBs at the point of purchase is proliferating internationally (e.g. France, Belgium, Barbados) as a strategy to reduce SSB consumption and yield long-term public health benefits.<sup>20</sup> In 2014, Mexico implemented a national 1-peso-per-liter (about 6 cents) SSB excise tax to help combat its 32.8% obesity rate (Blakely et al.). Even though Mexico's tax rate was about half the rate that Brownell and colleagues recommended to significantly reduce consumption, researchers have already observed a 6% decline in SSB sales in 2014 directly related to the price increase. Declines in SSB sales spanned all income groups, but were most pronounced (9%) in low-income households which tend to drink more soda and have higher obesity rates (Blakely et al.). Mexican parents are serving fewer sugary drinks to their young, and schools are encouraging distribution of plain, unflavored water. To the extent excise taxes actually increase SSB prices (and are not absorbed by retailers to sustain sales), these results suggest they can substantially reduce SSB consumption (Blakely et al.).

Overconsumption of SSBs places children at high risk for immediate and long-term health problems. Among many positive interventions to protect children from known public health harms, excise taxation of SSBs can effectuate behavioral change among kids and their caregivers. Initial data from reviews of SSB taxes in Mexico and Berkeley provide promising evidence of the viability of SSB excise taxes to lower consumption and improve child health. Future tax proposals built on broader definitions of SSBs, content-based tax rates, and responsible revenue allocation may overcome political and legal challenges and combat childhood obesity in America.

## **Bans**

State policy makers in the U.S. have aggressively targeted adolescents since they consume the most SSBs. The most common way these policy makers target adolescents is often by banning SSB sales in schools. Banning SSB sales in school is thought to decrease consumption rates by limiting students' access to these beverages. In 2006, the amount of students that could purchase SSBs in the US was around 53.6%. However, in 2011 that percent was nearly cut in half and reduced to 25.3% (Eneli et al. 1822). This can be attributed to the increasing number of states banning SSB sales in school.

In 2010 the Ohio legislature passed the Healthy Choices for Healthy Children Act as a means to reduce their high obesity rates. Banning the sales of SSBs in schools was a part of this act. In hopes to raise awareness and stress the importance of this act, Nationwide Children's Hospital (NCH) teamed up with community leaders to gain bipartisan support for this legislation. In order to further show its support of this new

statewide act, NCH decided to lead by example by also implementing the ban of SSB sales in their food establishments and catering services. The hope was to “improve the nutritional offerings for patients and employees” (Eneli et al. 1822). Such a ban would not only impact the food environment for children but also their families as well as hospital staff. During this implementation, NCH documented the steps they took, the SSB consumption rates before and after the ban, obesity rates, and sales revenue before and after the ban.

The hospital’s plan was to improve the food options available so between 2009 and 2010 they began replacing their current food with healthier choices. Portion sizes were reduced and they even replaced all their fryers with conventional ovens. As part of this effort, nutrition advocates and doctors proposed banning SSBs in the hospital as well. After working with other hospitals and public health officers, the hospital came up with their plan to implement this ban. This included weekly employee meetings and extensive advertising that include flyers, posters and local news stories with patients who had successfully eliminated SSBs from their diet. Then, hospital vendors signed a contract that excluded SSB sales in 2011. These vendors were very supportive of the hospital’s initiative and they were not a problem while implementing this plan. These soda vendors also allowed the hospital to return any unopened cases of soda. Diet sodas were the only type of carbonated beverage allowed in the hospital. Other beverages allowed included 100% fruit juices, Gatorade, Vitamin Water and milk. In addition to this, 20oz coffees were removed and their price of bottled water was lowered by 10 cents. Sales revenue were recorded “from January 1, 2010, to December 31, 2010 (before the ban), and from January 1, 2011, to December 31, 2011 (after the ban).” (Eneli, Ihuoma U., et al. 1824).

From 2010 to 2011 beverage sales from the hospitals cafeteria, food court, and gift shops increased by 2.7 percent from \$798,752 to \$867,853. Revenue for all types of milk increased by 19%, fruit juices increased by 22%, 13% for coffee, and 7% for water. At the same time, sales revenue for carbonated beverages fell by 17%. The hospital only received 11 complaints from employees and patients that found it too inconvenient to obtain a SSB or large coffees from outside the hospital. These complaints were resolved individually and was only a minor obstacle.

This ban of SSBs at NCH altered beverage sales within the first year without showing a loss of revenue from their food locations. Consumption rates of carbonated beverages decreased while consumption rates of healthier beverages such as milk, juice, and water increased. The hospital believed that implementing a SSB ban is not an overwhelming task if it is part of a wider overall health initiative that includes overall better food options and strong employee support.

### **Replacing SSBs with other beverages**

When replacing SSBs with other beverages, it is important to choose beverages that are healthy and do not increase weight gain. An average person needs at least 1 mL fluid for every calorie burned, which comes out to approximately eight 8-oz glasses of water a day for someone who consumes a 2000 calorie diet (“Intake of Sugar-sweetened Beverages” Malik et al.). This level of hydration is important in order to maintaining one’s blood volume, and kidney function (“Intake of Sugar-sweetened Beverages” Malik et al.). Water contains zero calories and no additives, like sugar. Water is one of the best

alternatives because of its high availability and low cost. Findings from epidemiological studies (“Intake of Sugar-sweetened Beverages” Malik et al.) show that calorie intake is 9% lower (200 calories) in people who drink large amounts of water compared to those who do not. This data is supported by a controlled trial in German elementary schools. The study found that you can reduce your risk of being overweight by 31% from consuming a year’s worth of water (“Intake of Sugar-sweetened Beverages” Malik et al.). A secondary analysis of a clinical weight loss trial showed that an individual will have a lower total calorie intake by replacing SSBs with water (“Intake of Sugar-sweetened Beverages” Malik, et al.). There is also some evidence that suggests consuming water before or with a meal reduces feelings of hunger, thus reducing calorie intake. However, consuming SSBs before or during a meal has the opposite effect. SSBs can stimulate appetite with their intense sweet flavor. (“Intake of Sugar-sweetened Beverages” Malik et al.). Tea or coffee can also act as a safer alternative to SSBs, assuming added sweeteners are used sparingly. Over the past few decades, milk consumption has decreased in the United States. The replacement of SSBs for milk is concerning in children because lower milk intake also means lower intake of protein, calcium and other important vitamins found in milk that are important to growth and development. A decrease of these levels can lead to higher risk of osteoporosis and bone fractures.

## CHAPTER FIVE

### Conclusion

Consumption of SSBs is on the rise in the US. This rise in SSB consumption is linked to a rise in health issues such as obesity, diabetes, and cardiovascular disease. In order to improve public health, the US must find a way to lower consumption of SSBs, thus also lowering the health issues associated with their consumption. Success has been seen in mass media campaigns, taxation, banning and simply replacing SSBs with other beverages. Mass media education and taxation have seen the most success as ways to reduce consumption. Success has been seen from implementing taxes and bans on SSBs in California and in Mexico. These bans, taxes, and regulations will result in consumers instead choosing different beverages. Consumption of different beverages instead of SSBs will increase public health because different beverages have the opportunity to have more nutritional value, fewer calories, and lead to overall less calorie intake than SSBs. Because regulating, taxing, and banning SSBs can have such positive results, state, city, and federal governments need to implement legislation that will do so.

In order to reduce consumption of SSBs, public health officials and city officials must first focus on educating the general public of the dangers of high SSB consumption. The public needs to be aware of the adverse health effects that high SSB consumption is responsible for. Without the proper knowledge, the public is often unconcerned about certain issues as they are unaware on how it can affect them personally. Mass media campaigns have seen success in educating the public of the dangers of high SSB

consumption. These campaigns are traditionally done via television advertisements; however, there are a variety of mass media outlets that one can use to spread awareness. In today's world there are various online media sources that can often target a large audience. These outlets include sites such as Facebook, Twitter, Instagram, and even mobile applications such as Snapchat. Studies need to be done to measure the effectiveness of these media outlets, but they provide an easy way to contact a large audience cheaply and effectively. After properly educating the public on the dangers of high SSB consumption, officials must then make steps towards taxing or banning these beverages. The most effective way this can be accomplished is encouraging local facilities to ban these beverages within their own building. The Nationwide Children's Hospital is an excellent example on how effective banning SSBs within one's own facility is. Facilities may be concerned about losing profits and receiving complaints when implementing such a ban. The Nationwide Children's Hospital actually saw an increase in sales of other beverages and only received a handful of complaints that were all individually handled with little to no further conflict. Once success is seen in banning SSBs in local facilities, city officials must then focus on implementing larger scale bans or regulations. It has been proven difficult to pass large scale regulations and bans as seen in the case with the mayor of New York; however, with local facilities already implementing their own policies, city officials will have more support passing regulations on a larger scale. SSB consumption is a growing health concern and it is up to public health officials to properly educate the public about the dangers associated with high levels of SSB consumption. Only then will public officials understand the severity of the situation and begin passing legislation that can begin to tackle this epidemic.

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