SUGAR-SWEETENED BEVERAGES: CLOSING THE NUTRITION KNOWLEDGE GAP WITH INNOVATIVE FRONT-OF-PACKAGE LABELING AND STRATEGICALLY PLACED EDUCATIONAL SIGNAGE

A Thesis

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by

Jack Aaron Reeves

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by

Jack Aaron Reeves

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Department of Public Policy and Administration

Abstract

of

SUGAR-SWEETENED BEVERAGES: CLOSING THE NUTRITION KNOWLEDGE GAP WITH INNOVATIVE FRONT-OF-PACKAGE LABELING AND STRATEGICALLY PLACED EDUCATIONAL SIGNAGE

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There is a growing body of evidence that front-of-package (FOP) labeling on pre-packaged foods and sugar-sweetened beverages may be an effective method of helping consumers make healthier dietary choices. On the other hand, there is also growing evidence that the current industry standard Facts-Up-Front FOP label design by the Grocery Manufacturers Association (GMA) is not effective. For my thesis, I wanted to address this disparity by creating a set of visual label guidelines to assist future policymakers in their efforts to stem the increasing tide of obesity. To accomplish this, I used a mixed methods approach. First, I completed a regression analysis using the California Health Interview Survey dataset to understand the relationship between an

individual's level of nutritional knowledge and his or her consumption of sugar-sweetened beverages. By using education level as a stand-in for nutritional knowledge, I find that the more nutritional knowledge an individual has, the fewer SSBs he or she will consume. Considering this relationship between knowledge, consumption, and the potential effectiveness of FOPs, I next develop a framework from which to analyze the current industry standard FOP label. From this framework, and an analysis of current literature, I find that the industry standard is not effective at influencing consumers' consumption patterns of SSBs because it lacks four visual characteristics; clarity, color, context, and novelty. Finally, I will present a set of policy recommendations for both the Food and Drug Administration and the State of California.

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TABLE OF CONTENTS

LIST OF TABLES

Tables Page

LIST OF FIGURES

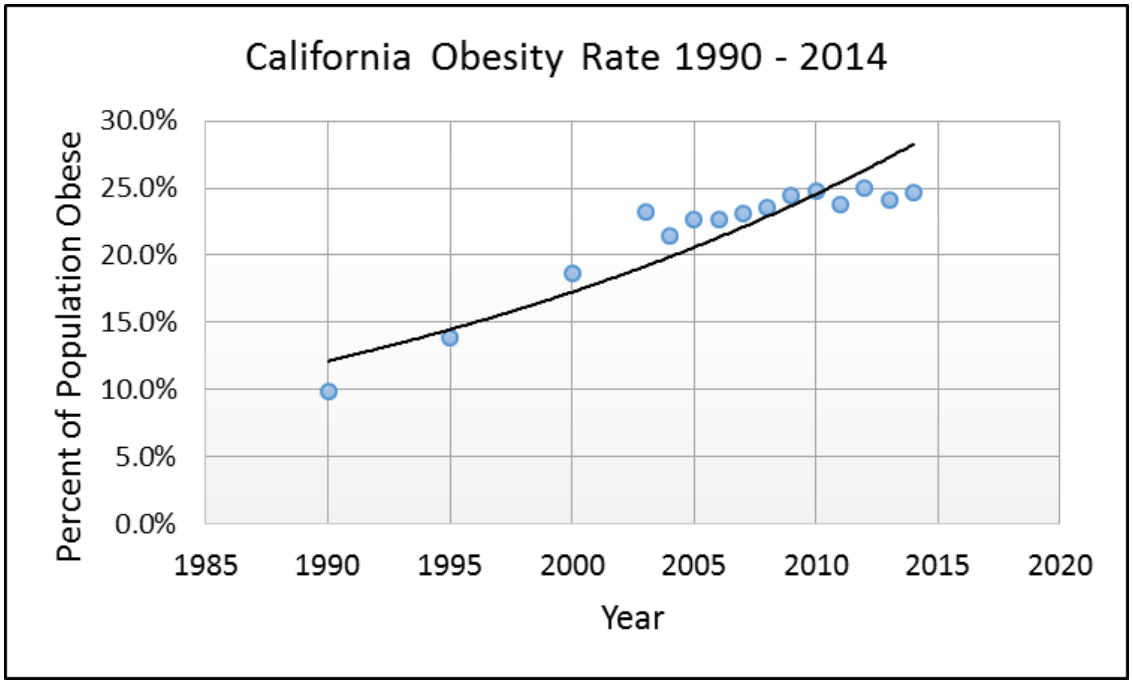
Figures Page

Chapter 1

INTRODUCTION

The state of California is in the middle of an obesity epidemic. A recent report from the California Department of Public Health (CDPH) states that the "prevalence of obesity among California adults" has increased from 20% in 2000 to 25% in 2012 (*Obesity in California: The Weight of the State, 2000-2012*, 2014.) Compared to the rest of the nation though, the state is ranked 47th for having a relatively low rate of obesity but the pace at which this statistic is growing mirrors the country as a whole ("Adult Obesity in the United States," 2015.) This ranking is a mean of the entire state and does not account for substantial obesity rate variation in ethnic, racial, and other demographic groups.

Figure 1.1: California Mean Obesity Rate, 1990-2014



Source: CDPH, 2015

If California continues on this path, the average obesity rate could be as high as 46% by the year 2030. In addition, many comorbidities of obesity such as Type 2 Diabetes, heart disease, and hypertension place a heavy economic burden on the state. The estimated total economic cost to the state is $41 billion a year and the burden will increase substantially if the epidemic continues on its current trajectory (*F as in Fat: How Obesity Threatens America's Future*, 2012.)

A difficulty in addressing this epidemic is that there is no single causal factor. Health conditions such as metabolic disorders, genetic predispositions, and medication side effects can all promote weight gain in an individual (*Obesity in California: The Weight of the State, 2000-2012*, 2014.). In addition, California's 25% obesity rate does not take into account variances among different demographics and risk factors within the state. Research has shown though that the major drivers of obesity in society relate to individual lifestyle choices such as a lack of physical activity and the consumption of sugar-sweetened beverages, and that increasing consumer nutrition knowledge through informative package labeling on SSBs may be a viable method of changing consumption patterns in high-risk populations (Wang & Beydoun, 2007).

For labeling to be effective at reducing consumption of SSBs, it must take into account the nutritional knowledge of its target audience. If a low level of educational attainment is a strong positive determinant of risk of obesity as research suggests, then designing front-of-package labels tailored to this demographic is advisable. By analyzing the effectiveness of front-of-package labeling conventions in the United States at informing consumers and reducing

consumption, I hope to be able to provide actionable guidance for future policy consideration.

For my thesis, I will be asking two questions with the ultimate goal of providing state and federal policy guidance for future front-of-package label designs on sugar-sweetened beverages. They are as follows:

1. Is a low level of educational attainment a positive determinant of risk for high levels of sugar-sweetened beverage consumption?

By answering this question, I will be able to test the validity of the assertion that nutritional knowledge positively correlates to educational attainment. If my regression analysis reaffirms this assertion, then it should bolster the claim that bridging the knowledge gap between producer and consumer via front-of-package nutrition labels is an effective means of reducing overall sugar-sweetened beverage consumption. After answering question 1, I will then be able to move on to the second question of my thesis which includes an analysis of the effectiveness of front-of-package in the United States.

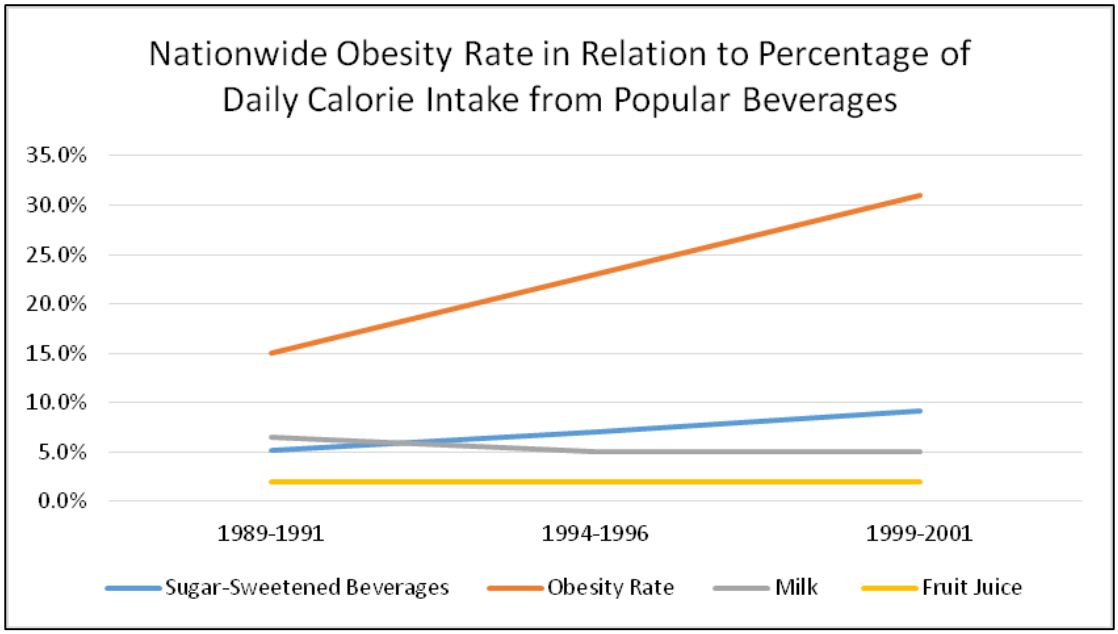
2. Are current American industry standard "Facts up Front" front-of-package labels effective at informing low educational attainment consumers about healthier beverage options and reducing SSB consumption among this demographic?

The remainder of this first chapter of my thesis will proceed as follows.

Energy Consumption and Obesity

Sugar-sweetened beverages (SSBs) make up a large portion of the average American diet and the increase in the consumption of SSBs closely correlates to the increase in obesity over the past few decades. Unlike fruit juice and other naturally sweetened beverages, an SSB is a drink with caloric sweeteners such as sugar or high-fructose corn syrup added during production. In 1977, the American average total daily energy intake from all sources was 1790 kilocalories with 2.8% consisting of sweetened soft drinks such as Pepsi or Coca-Cola. As of 2001, total average daily energy intake increased to 2068 kilocalories and 7%, respectively. This represents a three-fold increase in kilocalories consumed via just one type of SSB (Nielsen & Popkin, 2004).

Figure 1. 2: Obesity Rate in Relation to Beverage Consumption



The energy present in sugar-sweetened beverages is not harmful in of itself because the human body requires the consumption of energy, measured in kilocalories, to maintain its basic functioning (such as pumping blood and regulating body temperature)

and to perform various physical activities. At rest, the human body burns a minimum number ranging on average from 50 to 100 per hour. The name for this minimum number of kilocalories is the basal metabolic rate (BMR.) Each person's BMR is different and can vary from day to day. This number coupled with the kilocalories burned through physical activity is how much total energy a person requires in a day to maintain his weight. If a person consumes more in kilocalories than he burns, the excess energy will be stored in fat, and over time will lead to weight gain. If a person burns 2000 kilocalories in a day, but consumes 2,500 kilocalories, he could gain upwards of 1 pound per week (SIU School of Medicine, 2015).

The problem is that SSBs are so energy dense that a person does not need to consume much to push their daily caloric intake over the amount required to maintain his weight. If a person replaces 20 ounces of water during a meal with 20 ounces of a regular, non-diet soft drink, he will have added about 250 kilocalories to his lunch. Given that high SSB consumption is a large part of the average American diet, and high kilocalorie consumption contributes to obesity, reducing the consumption of SSBs by choosing more healthful beverage choices should help prevent or reduce the prevalence of the condition.

The generally accepted and commonly used method is via the body-mass index (BMI.) The BMI test consists of a simple formula that takes into account a person's height and weight. Plugging these two measurements into the formula shown below produces a number that tells the person whether they are underweight (BMI<18.5), normal weight (BMI=18.5-24.9), overweight (BMI=25-29.9), or obese (BMI=30 or

higher.) For the purposes of this thesis, I will be focusing on the California population who are considered obese with a BMI score of greater than or equal to 30 (Wells & Fewtrell, 2006).

Figure 1.3: Body Mass Index Formula

$$BMI = \frac{weight(lb) \times 703}{(height(in))^2}$$

Source: Central Washington University, 2015

Approaches to Reducing SSB Consumption through Policy

Government intervention in the food and beverage industry is a common occurrence with a long-standing precedent. Historically in America, the industry came from a position of little regulation. Consumers' purchasing decisions were made based on scant information about the contents of the products or potential health issues in consuming them. Since industry fails to address this problem of information asymmetry between producer and consumer on its own in response to public demand, policy based interventions were required.

While the predecessor to the Food and Drug Administration came into existence under the direction of President Abraham Lincoln in 1862, the United States did not create its first major food safety regulations until 1906 in response to public pressure following the release of Upton Sinclair's 1906 novel, "The Jungle." The people's knowledge of meat products was limited to information they received when they went to make their purchases and had no idea about potential problems of food safety. Sinclair's

novel brought the industry's unsanitary practices to the people's attention and their response ushered in a new era of government intervention in the food and beverage market. Since the 1960s, the federal government has repeatedly crafted legislation that mandates package labeling that is easy to understand by the consumer, the products be unadulterated, accurately branded, and that producers be truthful in its health claims (Weingarten, 2008; and Moore, 2001).

Considering the effectiveness of past regulation and labeling mandates in improving food quality and informing consumers of a product's contents and healthfulness, it is understandable why both the United States and California are moving towards the implementation of mandating front-of-package nutrition and warning labels to reduce consumption of SSBs. While other methods of reducing consumption such as taxation are in use, for the purposes of this thesis I will be focusing on the effectiveness of front-of-package (FOP) calorie content and nutrition labeling.

United States:

There currently is no federal or state requirement for any front-of-package labeling on SSBs to supplement mandated labels on the backs of packaged foods. Back of package labeling contains basic nutritional information such as calories, fats, and carbohydrates, but is limited in their ability to provide context to the consumer which would help bridge the information asymmetry gap. In response to persuasion by the FDA and First Lady Michelle Obama, a voluntary front-of-package labeling initiative has been markedly successful in adoption by industry. The industry-designed program known as "Facts Up Front" standardizes a voluntary front-of-package nutrition label with the intent

that it is easier to read and understand by the consumer ("Facts Up Front, " 2015). Unlike a warning label, these labels present nutrition information that is also available on the FDA mandated back-of-package nutrition panel. This program is purely voluntary and

Figure 1.4: Example of "Facts up Front" FOP Label

Source: Grocery Manufacturers Association,

the federal government only requires that the labels meet certain minimal guidelines for honesty and has been adopted by many major brands such as the Campbell Soup Company, Kraft, and PepsiCo Inc. While this is not a policy intervention by the government, it is a response by industry to the threat of such policies.

California:

To compensate for labeling deficiencies on SSBs, some states are actively reviewing potential methods of reducing consumption at the subnational level. For example, policymakers in the California state legislature are pursuing two methods of promoting reduction. The first method is taxation. California does not currently tax sugar-sweetened beverages, and attempts by the legislature have repeatedly failed. The most recent attempt by California Assemblymember Richard Bloom (D-Santa Monica) to impose a two-cent per-ounce tax on SSBs failed in the Assembly Health Committee due to pressure from the food and beverage industry (Walters, 2015.) The only California

local government to pass a per-ounce tax is the city of Berkeley in 2014 (Lochner, 2015.) As of 2009, 33 states have successfully implemented sales taxes on SSB at an average of 5.6%, but according to one study, they have not been successful at reducing the consumption of SSBs because the tax rates may be too low to affect consumption (Brownell *et al*., 2009).

The second method in consideration in California is to dissuade consumers from purchasing sugar-sweetened beverages via a highly visible warning label, similar to what is on individual packs of cigarettes today. Although, as with the state legislature's attempts to pass taxes, attempts to pass warning label legislation have failed as well. The most recent attempt by California Senator Bill Monning would have required a label stating "STATE OF CALIFORNIA SAFETY WARNING: Drinking beverages with added sugar(s) contributes to obesity, diabetes, and tooth decay." On April 29th of 2015, Senator Monning's bill died in committee with support from four senators, one "no" vote, and four abstaining (Tejas, 2015).

Thesis Roadmap

In the following chapter, I will summarize the literature regarding consumption patterns of sugar-sweetened beverages. I will discuss how an individual's level of educational attainment positively correlates with the level of nutritional knowledge and how this demographic is a high determinant of risk for consumption of SSBs.

Next, in chapter 3, I will outline my methodology and data source for my study. I will then explain my rationale for going with a negative binomial regression study, rather than another regression form. I will next define my dependent variable and then discuss

the broad causal demographic and socioeconomic factors. I will then provide a discussion of the different underlying causal factors within each broad grouping. The results of my regression studies will appear in chapter 4.

Chapter 5 will house my second literature review. I will first discuss how my previous regression study relates to current field of knowledge regarding the subject. I will next review current literature and then craft a framework from which I can analyze the effectiveness of the Facts up Front FOP label design. I will conclude this chapter with a discussion about the basic elements of effective front-of-package label designs.

Next in Chapter 6, I will apply my framework in an analysis of the industry derived "Facts up Front" label. I will then compare this label design to other front-of-package label designs from Europe through the lens of the same framework.

Finally, in chapter 7, I will summarize my findings from my regression study and analysis of front-of-package labeling in the United States. From my findings, I will offer guidance on future FOP label designs that both the State of California and Food and Drug Administration. In addition, I will also offer guidance for California policymakers on a potential alternative to SSB labeling to reduce consumption.

Chapter 2

QUANTITATIVE LITERATURE REVIEW

This chapter focuses on exploring the connection between an individual's level of educational attainment and his or her level of nutritional knowledge, which is the basis of my first question. If a person's education level equates to nutritional knowledge as Parmenter, Waller, & Wardle (2000) observe in a study regarding this very issue, and positively correlates to SSB consumption and the rate of obesity, then addressing this nutritional knowledge deficit by educating people on better dietary choices via front-of-package nutrition labels may be effective and produce positive results. After completion of my quantitative analysis in Chapters 3 and 4, I will then move into the qualitative portion of this thesis in my analysis of front-of-package nutrition labels in use in the United States.

While a review of current literature does provide some support for my hypothesis, not all of it includes an individual's education level as a variable. In addition, most of the studies that include education are not focusing on it, and only include education to account for omitted variable bias.

For the rest of this chapter, I will examine multiple peer reviewed articles relating to SSB consumption and obesity so that I may develop my dependent and independent variables in my regression study in Chapter 4. From the literature, I will focus on three themes. The first is understanding which populations are most likely to consume SSBs and which are most affected by the obesity epidemic. The second theme is understanding the socioeconomic factors that moderate consumption within these groups. Finally, for

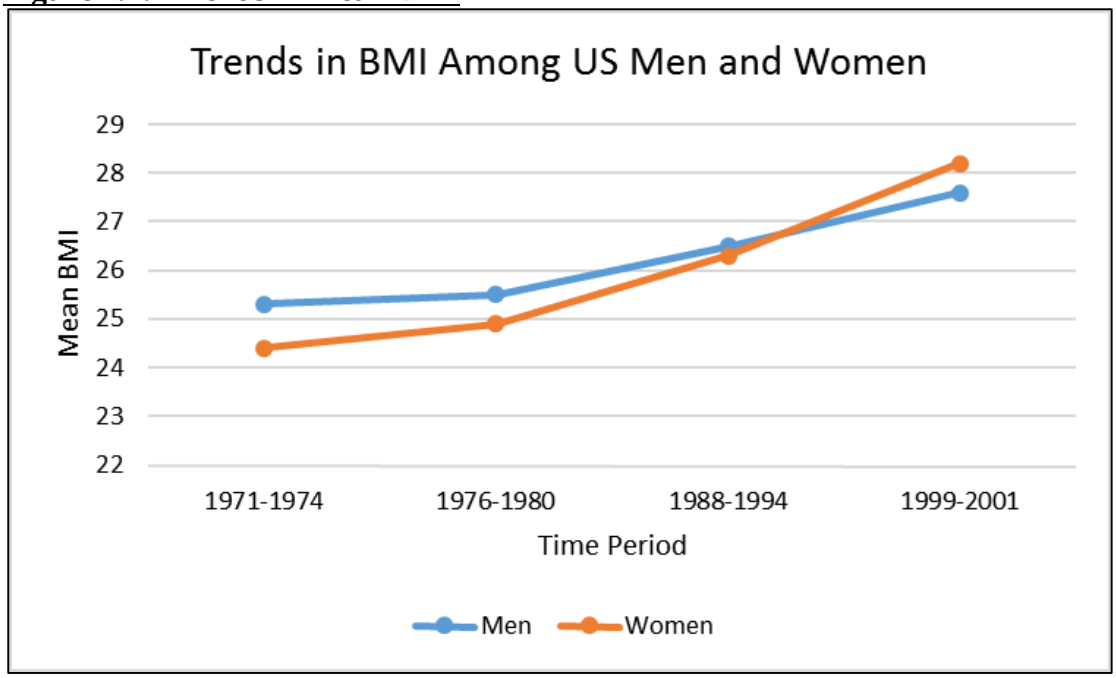
the third theme, I will examine how education associates sugar-sweetened beverage consumption and obesity. I will also identify gaps within the available literature and extrapolate from this how I should formulate my own regression study.

Demographics

Gender

Examining the relationship between men, women, and SSB consumption, Park, Blanck, Sherry, Brener, & O'toole (2012) find that male adolescents are 66% more likely than female adolescents to consume 1 or more SSBs per day. Although upon further examination, the author notes that this disparity is not uniform among all different types of SSBs consumed. For example, while men are 57% more likely than women to consume regular soda, the odds of them consuming sports and energy increase significantly (99% and 117% respectively). This difference in consumption patterns also appears in a study by Kristal, Blank, Wylie-Rosett, & Selwyn (2014) with adult women being 12% less likely than adult men to consume 1 or more SSBs per day. Even though the two studies rely on two distinctly different age groups, one being high school students and the other being low-income adults who use public health services, the pattern of male consumption being higher than female consumption remains constant.

Figure 2.1: Trends in Mean BMI



Source: Wang & Beydoun, 2007

It is interesting to note though that this relationship between men and women regarding SSB consumption is not mirrored when examining rates of obesity. Per Wang & Beydoun (2007), adult men have a mean BMI higher than women, but after 1994, this relationship reversed as the rate of obesity in the adult American female population outpaced their male counterparts. Using a linear regression model, Wang & Beydoun project that for every year, adult men's BMIs will increase by .7 points and adult women's by .8. For example, if a man has a BMI of 30, by the next year it will be 30.7 points. If a woman has the same BMI of 30, her BMI would be 30.8. Both numbers rank them as being obese, it is just that women's average body mass is increasing at a faster rate. Wang & Beydoun's projection also goes along with another longitudinal study of residents throughout New York City. In a stratified random sample of 48,506 New York

City residents, Black & Macinko (2010) find that women are more likely than men to be obese, and the disparity between the genders is growing. For each year in the study, there is a statistically significant increase in obesity for women of 3.4%, while there is no statistically significant increase for men. In Wang & Beydoun's study, the increase in obesity in women is what mostly accounts for the overall obesity trend of the city (actual results not given).

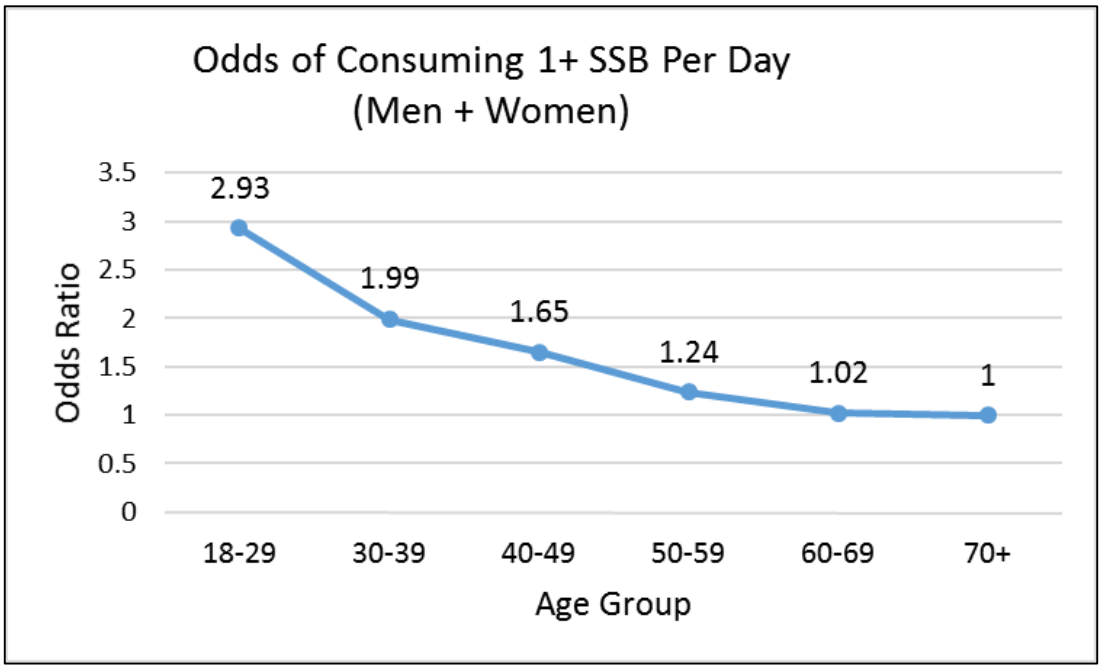
Race and Ethnicity

The consumption pattern of SSBs and prevalence of obesity between men and women can be further broken down into racial and ethnic groups. Using a logistic regression, Han & Powell (2014) examine this relationship and find that in a longitudinal study of American adults that African Americans are more 89% likely than whites to consume SSBs. In addition, Hispanics adults are also 25% more likely than whites but less than African Americans to consume SSBs. While Han & Powell (2014) do not break down the study groups into male and female categories, the higher consumption patterns of African American and Hispanics do coincide with the higher prevalence of obesity in those populations per a report published by the state of California in 2014 (*p. 15*).

Unlike Han & Powell, Black & Macinko (2010) do include variables based on both gender, racial, and ethnic groupings in a study regarding obesity. Using the reference of white and female, Black & Macinko find that in all races and ethnicities that women of those groups have a higher prevalence of obesity than their male counterparts. African Americans are 10% more likely than whites to be obese, but when examining only the African American population, black females have a 67% greater chance of being

obese than their male counterparts. What these studies mean is that when not controlling for gender, variations in SSB consumption positively correlates to the prevalence of obesity in racial and ethnic groups, but this positive correlation dissipates when comparing men and women of their respective demographics.

Figure 2.2: SSB Consumption Trend by Age



Source: Kristal, Blank, Wylie-Rosett, & Selwyn 2008

Age

The consensus among all literature reviewed for this thesis is that age negatively correlates to SSB consumption. In one longitudinal study of children and adults in America from 1999 to 2010, Kit, Fakhouri, Park, Nielsen, & Ogden (2013) found that consumption of SSBs declines with age for all demographics including race, income, and gender. The authors posit that this decline in consumption may be a result of recent government campaigns to reduce consumption of SSBs. If this is indeed the case, then it

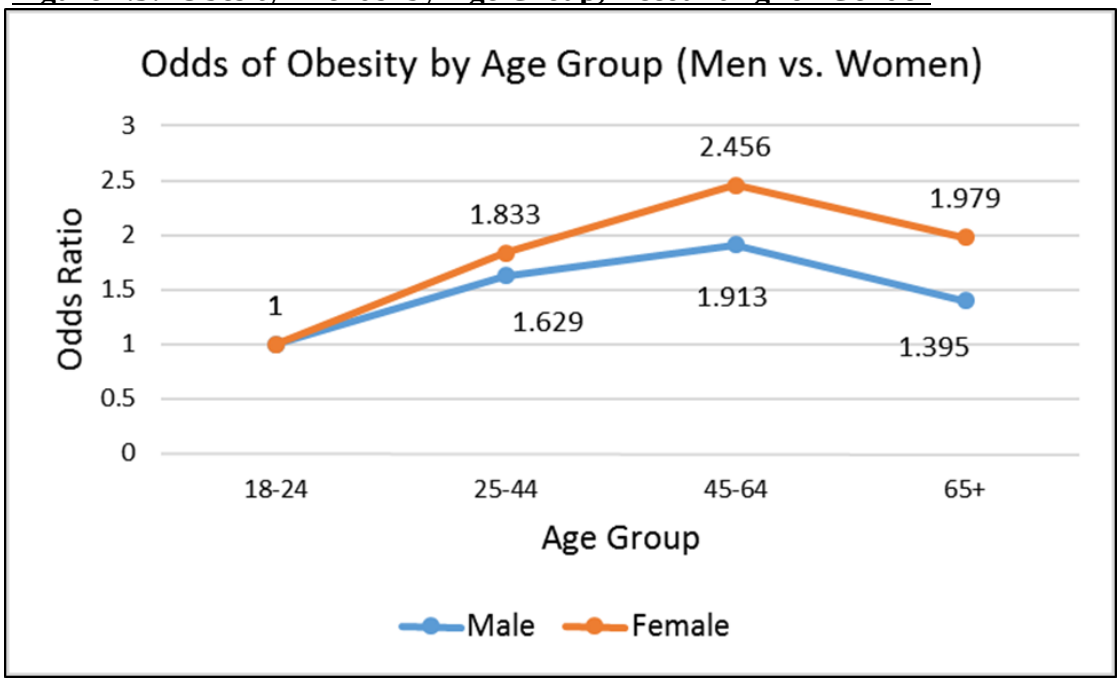
may be evidence of the effectiveness of consumer education as a viable method of reducing consumption and promoting healthier dietary choices.

Exploring the variations in consumption patterns for SSBs, Kristal, Blank, Wylie-Rosett, & Selwyn (2014) find that the younger age groups tend to be heavier consumers. For example, relative to those 70 years old and up, people between 30 and 39 are 99% more likely to consume 1 or more servings per day of any type of SSB. People between the ages of 18 to 29 are 193% more likely to consume one or more servings per day. The pattern of decreasing consumption is consistent with every successive age group moving up from the 18-29 demographic. Rehm, Matte, Wye, Young, & Frieden (2008), duplicates Kristal, Blank, Wylie-Rosett, & Selwyn's results in an earlier study asking similar questions regarding adults in New York City. In this report, Rehm, Matte, Wye, Young, & Frieden also find that 18 to 24 year olds are 140% more likely than those 25 to 44 to consume more than 12 ounces of SSB per day.

The trend of lower consumption for higher age groups runs contrast to the trend of increasing obesity. In analyzing the determinants of obesity in the City of New York between 2003 to 2007, Black & Macinko (2008) find that obesity rates increase up to a point, but then decrease again in the 65 and older age group. In addition to this phenomenon, when comparing consumption patterns from Kristal, Blank, Wylie-Rosett, & Selwyn's 2004 study in which men consume more SSBs than women, women have a higher propensity than men for having a BMI of greater than 30. Women consume fewer SSBs, but have greater odds of becoming obese.

Neither report provides insight into possible causes of this phenomenon, but a 2012 report published by the Robert Wood Johnson Foundation concludes that it may be the result of reduced activity in older populations coupled with life-shortening co-morbidities experienced by those who are obese (p. 19). In addition, if Kit, Fakhouri, Park, Nielsen, & Ogden's (2013) hypothesis is correct, knowledge gained from public education campaigns to reduce SSB consumption should carry over into other food choices and result in reductions in obesity over time. The fact that this positive correlation between consumption and obesity seems to cast doubt on it.

Figure 2.3: Obesity Trends by Age Group, Accounting for Gender



Source: Black & Macinko, 2008

Socioeconomics

In contrast to static demographics, socioeconomics encompasses a number of variables that can change throughout the life of an individual independent of traits locked

in at birth such as race, ethnicity, gender, and age. While they may not be causal, they do provide insight into other possible factors such as access to nutritional information, healthier food choices, and opportunities for physical activity. For example, people living in low-income neighborhoods may not have easy access to healthy food that higher income neighborhoods have. In addition, these low-income neighborhoods may not be safe enough for citizens to feel comfortable walking in their neighborhoods.

Income

In studying the consumption patterns of sugar-sweetened beverages in the United States, Han & Powell (2013) find that low income adults age 35 and up (<135% of FPL) consume 89% more SSBs than high income (>300% of FPL) earners. Han & Powell make a distinction between adults and young adults in the study, although the difference between the two groups still holds to the same pattern of higher consumption for lower income people.

While this thesis focuses only on the California adult population, Babey, Hastert, Wolstein, & Diamant's (2010) study of California's adolescent population found no statistically significant difference in obesity trends between 2001 and 2007 at any examined income level (<100% FPL, 100% to 299% FPL, and >300% FPL). When focusing on each individual survey year, there is a significant difference. Income has a negative correlative relationship with the rate of obesity. While this study focusses only on adolescents, Black & Macinko (2009) confirm that this negative correlation carries over to adulthood. It is interesting to note that women are the only gender that has a statistically significant negative correlative relationship between income and obesity.

Although the author does give, a caveat that, the sample size for men is relatively small. This study also divides income level by neighborhood and does not use individual income relative to federal poverty level guidelines.

In a separate meta-analysis of SSB consumption studies, Malik et al. (2010) found that one possible reason for the negative correlation between income level, SSB consumption, and obesity is that poor dietary and health habits cluster together. When someone consumes large amounts of SSBs, they also eat energy dense foods and do no frequently exercise.

Geographic Area

From the studies I found for this project, I am unable to locate any information regarding geographic area. The lack of control for urban, suburban, and rural areas present a potential problem with omitted variable bias within all of the reports because it does not take into account the potential effects of food deserts. People who live in certain urban areas may not have the same access to healthier food choices as people who live in the suburbs. Black & Macinko (2009) do include a distinction between geographic areas, but the geographic division they do employ is based on mean population income rather than population density.

Employment Type

As with geographic area, I am unable to locate any information in studies regarding SSBs that control for employment. Although in regards to the rate of obesity, Black & Macinko (2009) do control for it and find that individuals that are employed have an 89% lower prevalence of obesity than their unemployed counterparts. In

addition to examining whether employment affects the prevalence of obesity, the author also finds that obesity for those born outside of the United States and employed have a lower rate of obesity than their unemployed counterparts (no regression data available). The lack of control for this variable in the rest of available literature again presents a problem with omitted variable bias.

Family Status

Unlike geographic area and employment type, marital status accounts for in a number of studies I reviewed. In regards to consumption of sugar sweetened beverages, Mullie, Aerenhouts, & Clarys (2011), in a report studying consumption patterns among the United States military find that those who are married consume fewer SSBs, but this relationship was not significant. In addition, Black & Macinko (2008) also find that there was no significant correlation with marital status and obesity. Per these two studies, whether an individual is married or not has no effect on either SSB consumption or the prevalence of obesity. In addition, no study accounts for whether or not a respondent lives with children under the age of 18.

Citizenship Status

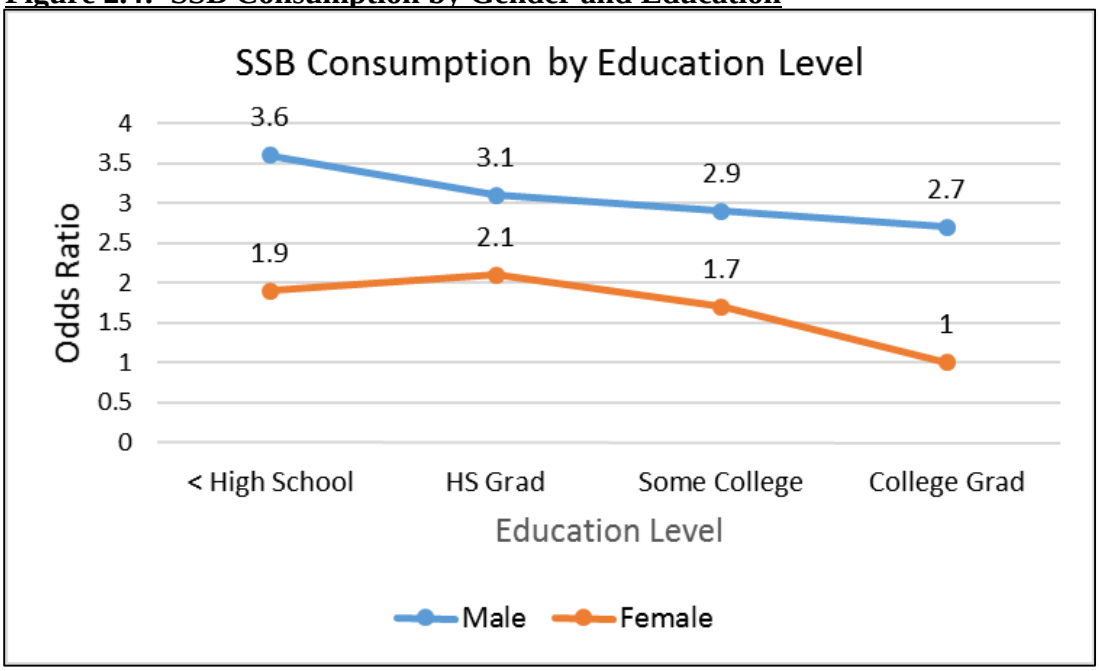
Again as with previously mentioned variables of socioeconomic status, there are no studies in my review of the previous research that include citizenship as a controlling variable in a regression study. Regarding obesity though, Black & Macinko (2008) find that there is a small negative significant correlative relationship with nativity to the United States. Those that were born in the United States have a higher rate of obesity either than those that are naturalized, visiting, or of non-legal status.

Education Level

In contrast to the availability of information regarding other factors of socioeconomic status, there is a wealth of data about educational attainment in relation to SSB consumption and the prevalence of obesity. The consensus among all of the studies in this review is that education has a negative correlative relationship with the daily consumption of SSBs, but many of them have a problem with omitted variable bias or endogeneity.

In examining the consumption patterns of SSBs in the United States, Han & Powell (2013) find that adults who have at most graduated high school are 23% more likely than those with any level of college education to consume any type of SSB daily. This study has a couple of weaknesses though that may cast doubt on the authors' results. While the report does control for race, education, income, and education, it lacks controls for gender and geographic area. The author's may be missing influences from differences in gender and the potential for geographic food deserts.

Figure 2.4: SSB Consumption by Gender and Education



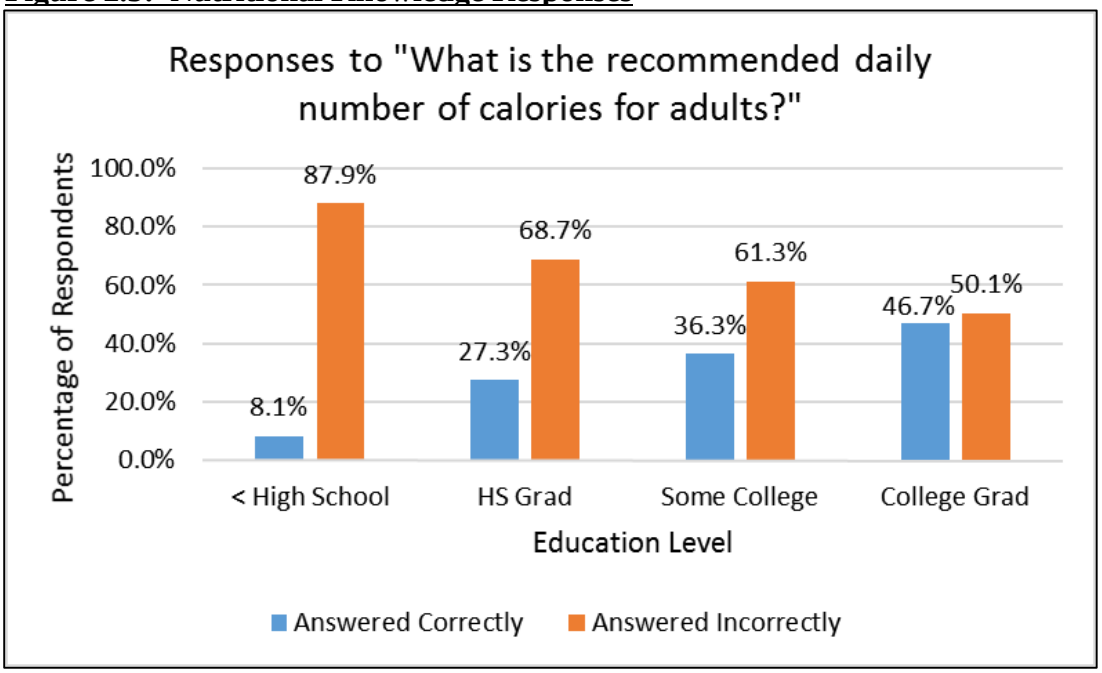
Source: Rehm, Matte, Wye, Young & Frieden, 2008

In addition to Han & Powell's 2013 study, when examining consumption patterns in New York City, Rehm, Matte, Wye, Young, & Frieden (2008) find that there is also a significant negative correlation between SSB consumption and an individual's education. Unlike Han & Powell's study though, Rehm, Matte, Wye, Young & Frieden include controls for males and females. The authors also subdivide the genders into education levels. This differentiation reveals the same trend of men having a higher propensity to consume SSBs than women, but share somewhat similar negative correlation trends between consumption and education as shown in Figure 2.4. SSB consumption for women seems to plateau but then decline upon entering college.

Rehm, Matte, Wye, Young & Frieden's study, as with Han & Powell, is not without its weaknesses. A potential problem arises with the exclusion of geographic

region in their regression study. In addition to this omitted variable, there is also a problem with endogeneity by including controls for physical activity and hours spent watching television. Is it a lack of physical activity or increased television watching that causes obesity, or is it the state of being obese that causes people to reduce activity and watch more television?

Figure 2.5: Nutritional Knowledge Responses



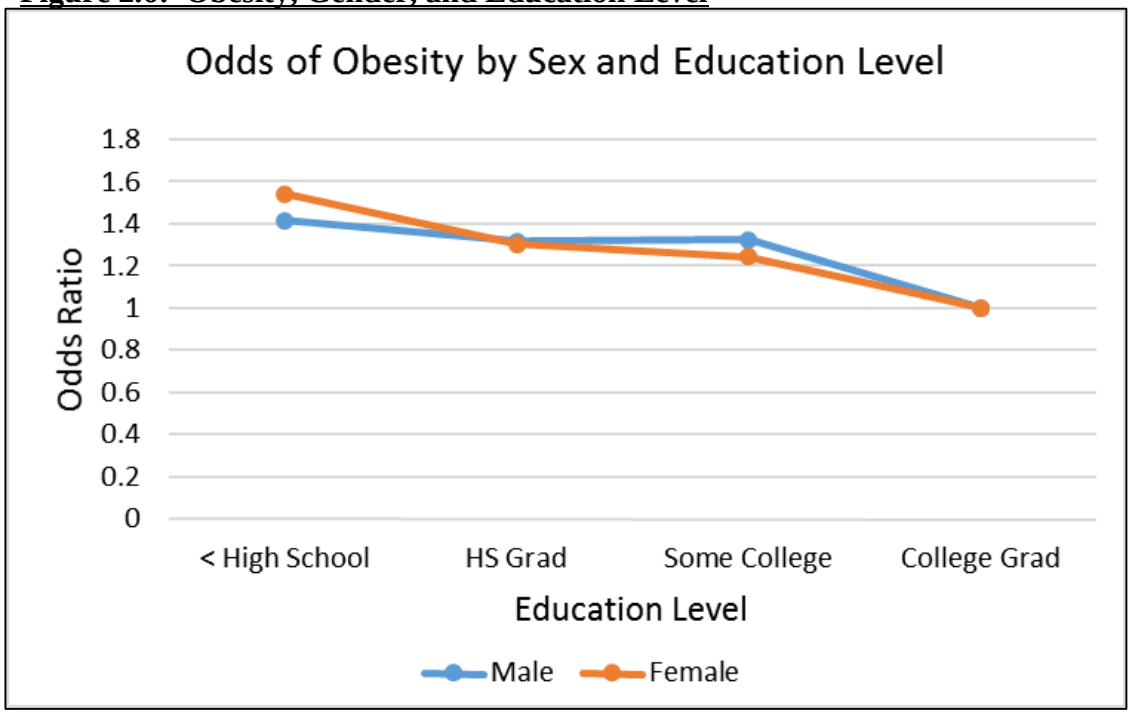
Source: Gase, Robles, Barragan, & Kuo, 2014

Beyond simply examining education levels, Gase, Robles, Barragan, & Kuo (2014) take their investigation a step further by asking respondents about, and then testing on, nutritional knowledge in relation to SSB consumption. When testing adult respondents' knowledge of daily calorie requirements, only one third of 1,041 surveyed answered correctly and most of them have higher levels of education. The authors

conclude that lower educated people tend to estimate energy content in food incorrectly and more often than not their incorrect estimates are lower than the actual calorie content.

Education level also has an affect on the prevelance of obesity in adults. Black & Macinko (2002), in examining the interplay between education, gender, and obesity, finds that education negatively correlates with obesity. It is interesting to note though that women who do not graduate high school are at higher risk for obesity than men, but women who have some college education are at a lower risk than similarly situated men as shown in Figure 2.6. A benefit of Black & Macinko's study is that the authors do not use variables that pose a serious risk of endogeneity or omitted variable bias.

Figure 2.6: Obesity, Gender, and Education Level



Source: Black & Macinko, 2002

One final point of interest regarding educational attainment and obesity is that in an investigation of this issue by Cohen, Rehkopf, Deardorff, & Abrams (2013)

controlling for race and ethnicity, the authors found almost no statistically significance in African Americans, Hispanics, and whites in the relative effects of education on the prevalence of obesity.

Summary

Obesity and the consumption of SSBs have increased over the past few decades, but this increase is disproportionately affecting various demographic groups. Men consume greater amounts of SSBs than women, but women are more obese than men. In addition, the consumption of SSBs decrease with age, but obesity increases with it. While these metrics alone do not quash my hypothesis regarding education and nutritional knowledge, it does raise an interesting question about the use of taxation of SSBs alone as a means of reducing consumption and decreasing obesity. Taxation would affect the highest consumers of SSBs, but that population is not dealing with the brunt of the obesity epidemic. There are other factors at play here beyond the scope of the literature reviewed for this chapter and of my thesis in general.

Regardless of this disparity in SSB consumption and obesity prevalence, the literature does provide some evidence on how education appears to have a moderating effect on both obesity and SSBs. Another variable, income, negatively correlates to both dependent variables in this study as with educational attainment, but it could be its relationship to education that is the cause of it.

Unfortunately, the literature does not clarify how education affects different demographic and socioeconomic groups. It also does not look into the possible existence of a consistent moderating effect education may have on them. To address this deficit,

my thesis will also include interaction variables between education & gender, education & race, and education & age. In addition to this, I will mitigate the problem of endogeneity by avoiding the use of variables such as physical activity and smoking that were present in some of the prior research.

My hope is that by completing this section of my two-part thesis that I will not only be able to provide evidence to policymakers that nutritional awareness reduces consumption of SSBs and the prevalence of obesity, but that I will also provide actionable advice on how to best educate the people about better dietary choices through front-of-package nutrition labeling.

Chapter 3

METHODS

The literature provides an unclear picture of the relationships between the consumption of sugar-sweetened beverages and the explanatory factors covered in Chapter 2 (Demographic and Socioeconomic). If education level does coincide with an individual's level of nutritional knowledge, then this interaction should be visible in a regression analysis of SSB consumption. That is, the more educated (holding other factors expected to cause differences in SSB consumption) should consume less. Furthermore, if a statistically significant relationship exists, then it will provide a foundation for the comparative analysis of front-of-package nutrition labeling in Chapter 6of my thesis.

For this chapter, I describe my data source and explain why I used negative binomial regression. I will then present my functional forms and follow up by describing my variables in detail. In addition to an examination of the average effect of an increase in education on SSB consumption, the regression modelling is set up to also explore the likelihood that the education varies by the type (age, ethnicity, and gender) of person with that education. I present my regression results in Chapter 4.

Data Source

For this regression study, I use the 2011-2012 California Health Interview Survey (CHIS) dataset from the University of California, Los Angeles (UCLA) Center for Health Policy Research. From this survey, I derive a dependent count variable representing the number of SSBs a respondent is said to consume on a weekly basis and a series of

socioeconomic and demographic variables expected to explain differences in this consumption. The CHIS is a stratified random annual telephone survey of more than 42,935 adult Californians between the ages of 18 to 85. Survey questions cover a broad range of health issues and various factors that affect them. In addition, the CHIS dataset includes a series of weights to aid in accurately approximating the population of all adults in California based on information from the Department of Finance and the 2010 Census. Sampling also includes a large number of cell phone respondents to accommodate for the social trend away from land-lines. Methods such as oversampling of small minority ethnic groups of interest(such as Native Americans) to insure that the diverse population of California is sufficiently represented in the final product. A full explanation of the survey methodology is available from the University of California Los Angeles website at *http://healthpolicy.ucla.edu/chis/design/Pages/methodology.aspx.*

Method

The most common regression model literature reviewed is the use of the logistic regression model which relies on the use of a dichotomous dependent variable when analyzing determinants of SSB consumption because prior research focuses on the odds of consumption. A weakness in this method is that it relies on the creation of a somewhat arbitrary definition of "high SSB consumption" that is set equal to one and levels below that set equal to zero. So if six sodas consumed in a week deemed "high", soda consumption of zero through five considered "not high", and six to dozens considered high. This dichotomous nature of the dependent variable in the binary model may miss potentially important details about demographic and socioeconomic groups on the cusp

of becoming “high SSB consumers” but not included in the definition. I will not be using this method because I want to find the overall risk of consumption. I will be using a count model regression instead.

For my regression study, I will leave the dependent variable as discrete values representing the number of sodas a respondent states that he or she consumes in a week. Out of two major count regression forms, I will then use a negative binomial model as the method of regression analysis. The method of a Poisson regression, while also appropriate for a dependent variable containing discrete entries that represent a count of something, is not preferred in this instance because I find that the dependent variable for SSB consumption is overdispersed. A Poisson model assumes that the square of the mean and the variance of the discrete dependent variable are equal, but in this instance they are not (2.10 and 3.92 respectively). This inequality means that a Poisson model would provide unreliable results and that a negative binomial study is more appropriate.

Table 3.1: Model

Functional Forms	
Sugar-Sweetened Beverage Consumption	$= f(Demographics, Socioeconomics, Culture, Location)$
Demographics	$= f(Age\ Range, Male, Citizenship\ Status)$
Socioeconomic Status	$= f(Academic\ Achievement, Employment\ Type, Family\ Status)$
Culture	$= f\begin{pmatrix} Black, Asian, Native\ American \\ Pacific\ Islander, US\ Born\ Latino, Non-US\ Born\ Latino \end{pmatrix}$
Location	$= f(Geographic\ Region)$
Academic Achievement	$= f(Some\ College\ or\ Higher)$
Income	$= f(0\% - 299\%\ Federal\ Poverty\ Level)$
Employment Type	$= f(Full-Time, Part-Time)$
Family Status	$= f(Married, Children)$
Geographic Region	$= f(Urban, Small\ City, Suburban)$
Citizenship Status	$= f(Naturalized\ Citizen, Non-Citizen)$

Dependent Variable - Sugar-Sweetened Beverage Consumption

The dependent variable represents the total number of regular, non-diet sodas a respondent states that he or she consumes on average in a one-week period. It is a count variable consisting of discrete values representing the number of SSBs a respondent reported as consumed in a week.

Unlike in previous literature, the CHIS dataset does not contain information regarding consumption of sugar-sweetened energy and sport drinks that make up a large portion of the SSBs consumed. This presents a potential problem when analyzing consumption patterns of various racial and ethnic groups. In Han & Powell's (2013) study of consumption patterns in various demographic groups, they found that African Americans and Latinos consume more sport and energy drinks than Caucasians do, but

consume more SSBs overall. As a result, the lack of inclusion of energy and sport drinks in the CHIS dataset may reduce the accuracy of the racial and ethnic control variables as measurements for total SSB consumption. This disparity may present a problem when applying interaction effects to racial and ethnic groups and may reduce the overall reliability of them as an indicator of consumption entirely.

Explanatory Variable Age Range

The CHIS dataset includes a continuous variable for age of the respondent. For this regression study, I break the original variable into dummy variables representing age ranges. They are as follows: 25 to 34 years, 35 to 44 years, 45 to 54, 55 to 64, and 65 and older. I use the 18 to 24 age group as the reference. A benefit of this method is that I can compare age groups and possibly provide insight into generational differences. While I expect there to be a decline in SSB consumption with age per the literature, using this method will reveal changes in the downward slope between 18 and 85 years of age.

Explanatory Variable Male

In Kit, Fakhouri, Park, Nielsen, & Ogden's (2013) study of SSB consumption patterns in United States adults and adolescents, men consistently consume more SSBs than women. I expect a similar result in my regression study using a dummy variable for the male gender.

Explanatory Variable Racial and Ethnic Groups

The CHIS provides a large amount of information regarding a respondent's racial and ethnic identity. A potential problem with this is that some groups only have a couple of respondents, making it unreliable for this study. For example, the Asian subgroup

Hmong, is very small. To remedy this potential problem, I will create dummy variables for the general categories of African American, Asian, Native American, and Pacific Islander. A complete breakdown of these general categories is available in Table 3.2. I also will the Latino ethnic group, but I will divide the variable into two separate dummy variables: US born, and non-US born Latinos. Latinos represent a large portion of California's population and breaking the Latinos into these two groups will help shed light on potential generational changes in SSB consumption.

Explanatory Variable Academic Achievement

The CHIS dataset provides a broad range of potential responses for academic achievement from those who have no formal education to those who have completed a doctorate. For this analysis, I compress academic achievement into a single dummy variable using people who have a high school diploma or less as the reference. I use this method for two reasons. First, I am only interested the overall effect that higher education has on SSB consumption, and second, it allows for easier use when creating education interaction variables. In addition, compressing educational attainment into a binary resolves the problem of small sample sizes. For example, less than 1% of respondents have no formal education.

Explanatory Variable Income

A consensus within the literature is that people of low income are at the highest risk for high SSB consumption relative to other income groups. For this analysis, I create a single dummy variable for people below 300% of the federal poverty level as a measure

of "low income." This variable will be in reference to those at 300% of FPL or above and I expect it to be in line with the other studies as well.

Explanatory Variable Employment Type

While most studies do not include a variable for employment type, as to avoid omitted variable bias, I will include it in my analysis. Full and part-time employment is broken up into two dummy variables with unemployed as reference.

Explanatory Variable Family Status

There are four dummy variables representing an individual's family status in this study. The first three are whether a respondent is married, unmarried but living with a partner, or was previously married and is now divorced, separated, or widowed. These three are in reference to unmarried and living alone. The fourth asks if the respondent lives with children under the age of 18 reference to living without children. These four dummy variables are not mutually exclusive. In addition, the CHIS dataset does not specify the status of the children, just that someone under the age of 18 lives under the same roof with the respondent.

Explanatory Variable Geographic Region

Specific information regarding geographic location is not accessible to me for this thesis. The CHIS dataset does make available the population density of the area in which the respondent lives though. Per the survey's methodology report (2008), geographic regions are divided by zip code and coded as either urban, small city, suburban, or rural per the Claritas Prizm. The Claritas Prizm is a geo-coding marketing tool that private and governmental organizations use when conducting social surveys. From this I create three dummy variables as follows and in relation to rural, lightly populated areas.

- Urban Areas - densely packed neighborhoods consisting of downtown areas of major cities and nearby surrounding areas.
- Small Cities – Moderately dense satellite cities. For example, Citrus Heights and Rancho Cordova in relation to the City of Sacramento would fit in this definition.
- Suburban – Moderately dense population areas surrounding urban areas.

Explanatory Variable Citizenship Status

For this study, I create two different dummy variables representing a respondent's citizenship status with US born citizen as the reference. The first represents those that are in California who are either documented or undocumented, and the second represents those that are have become naturalized US citizens. From the previous literature, there is a pattern of lower SSB consumption among people who were not born in the United States, and I expect that this pattern will be present in my regression study as well.

Table 3.2: Descriptive of Regression Variables

Variable	Description
Dependent Variable	
Soda Consumption	A count of how many sodas an individual consumes in a 7 day period
Independent Variable	
Demographics	
Male	Dummy variable for male gender
Age 25 to 34	Dummy variable for age group 25 to 34
Age 35 to 34	Dummy variable for age group 35 to 44
Age 45 to 54	Dummy variable for age group 45 to 54
Age 55 to 64	Dummy variable for age group 55 to 64
Age 65+	Dummy variable for age group 65 and older
Non-Citizen	Dummy variable for undocumented and non-naturalized citizen
Naturalized Citizen	Dummy variable for naturalized citizen

Socioeconomics	
Higher Education	Dummy variable for some college, vocational school, AA or AS degree, BA or BS degree, some graduate school, MA or MS degree, Ph.D. or equivalent
Low Income	Dummy variable for income levels from 0% to 299% of federal poverty level
Full Time Employment	Dummy variable for 21 or more hours worked per week
Part Time Employment	Dummy variable for 0 to 20 hours worked per week
Married	Dummy variable for married
Living With Partner	Dummy variable for unmarried but living with partner
Post-Marriage	Dummy variable for divorced, separated, or widowed
Living with Children	Dummy variable for living with 1 or more minor children

Culture	
Black	Dummy variable for African American
Native American	Dummy variable for American Indian or Native Alaskan
Asian	Dummy variable for Bangladeshi, Burmese, Cambodian, Chinese, Filipino, Hmong, Indian (India), Indonesian, Japanese, Korean, Laotian, Malaysian, Pakistani, Sri Lankan, Taiwanese, Thai, Vietnamese
Pacific Islander	Dummy variable for Samoan/American Somoan, Guamanian, Tongan, Fijian
US Born Latino	Dummy variable for Latino born in the United States
Non-US Born Latino	Dummy variable for Latino born outside of the United States

Geographic Region	
Urban	Dummy variable for individuals living in downtown areas or major cities and surrounding neighborhoods
Small City	Dummy variable for satellite cities near major metropolitan areas
Suburban	Dummy variable for areas surrounding urban areas

Source: 2011-2012 California Health Interview Survey for

Table 3. 3: Descriptive Statistics

Variable	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*Count*
Dependent Variable					
Soda Consumption	1.4494	3.9204	0	69	42,935
Demographic Variables					
Male	0.4156	0.4928	0	1	17,848
Age 25 to 34	0.0856	0.2798	0	1	3,677
Age 35 to 44	0.1234	0.3289	0	1	5,300
Age 45 to 54	0.1776	0.3822	0	1	7,627
Age 55 to 64	0.2139	0.4100	0	1	9,183
Age 65 and Older	0.3288	0.4698	0	1	14,115
Non-Citizen	0.1023	0.3031	0	1	4,393
Naturalized Citizen	0.1570	0.3638	0	1	6,741
Socioeconomic Variables					
Higher Education	0.6227	0.4847	0	1	26,737
Low Income	0.4727	0.4993	0	1	20,294
Full Time Employment	0.4183	0.4933	0	1	17,958
Part Time Employment	0.0792	0.2700	0	1	3,400
Married	0.4975	0.5000	0	1	21,361
Living With Partner	0.0526	0.2233	0	1	2,260
Post-Marriage	0.2760	0.4470	0	1	11,848
Living With Children	0.2393	0.4267	0	1	10,276
Culture					
Black	0.0465	0.2106	0	1	1,997
Native American	0.0108	0.1035	0	1	465
Asian	0.0984	0.2979	0	1	4,226
Pacific Islander	0.0015	0.0383	0	1	63
US Born Latino	0.0951	0.2933	0	1	4,081
Non-US Born Latino	0.1264	0.3323	0	1	5,425
Geographic Region					
Urban	0.3631	0.4809	0	1	15,588
Small City	0.1904	0.3926	0	1	8,173
Surburban	0.2221	0.4157	0	1	9,538

Interactions

Along with the main explanatory variables in the regression study is a selection of interaction variables. These interactions will test to see if the main effect of age, gender, and race/ethnicity change depending on education status. If education consistently reduces the consumption of SSBs throughout all populations, then all of these interaction variables should reflect it. These interactive variables are as follows:

Table 3.4: Interaction Variables

Interaction Variables
Education * Age 25 to 34
Education * Age 35 to 44
Education * Age 45 to 54
Education * Age 55 to 64
Education * Age 65 and Older
Education * Male
Education * Black
Education * Asian
Education * Pacific Islander
Education * Native American
Education * US Born Latino
Education * Non-US Born Latino

Summary

To summarize, this chapter outlines the methodology I used to analyze available data from the 2011-2012 California Health Interview Survey. By using the set of interaction variables in Table 3.4, I will be able to determine how education and the dependent variables age, gender, and race/ethnicity affect the risk of an adult consuming

higher amounts of SSBs. From my review of the literature, I am able to make some predictions of expected effects for this study. These are available in Table 3.5. In addition, Chapter 4 contains my description and interpretation of the results of my study.

Table 3.5: Expected Effects of Independent Variables

Demographics	
Male	+
Age 25 to 34	-
Age 35 to 34	-
Age 45 to 54	-
Age 55 to 64	-
Age 65+	-
Non-Citizen	-
Naturalized Citizen	-

Socioeconomics	
Higher Education	-
Low Income	+
Full Time Employment	?
Part Time Employment	?
Married	?
Living With Partner	?
Post-Marriage	?
Living with Children	?

Culture	
Black	+
Native American	+
Asian	-
Pacific Islander	+
US Born Latino	?
Non-US Born Latino	?

Culture	
Urban	?
Small City	?
Suburban	?

Chapter 4

RESULTS & ANALYSIS

This chapter presents the implementation of my negative binomial regression study and the results from my quantitative analysis. I first detail my use of regression diagnostics to reduce the risk of common regression mistakes and then present the results from the regression study. I will then run a second regression including interaction variables to explore how education affects age, race/ethnicity, and gender in relation to sugar-sweetened beverage consumption. Finally, I will conclude the chapter with a summary of my findings.

Multicollinearity

Prior to starting my regression analysis, I must first evaluate my selected model for potential correlation issues that I may need to correct. Multicollinearity arises when two or more explanatory factors are highly correlated. It may present a problem to interpreting the results of a statistical analysis because if present, it biases the standard errors calculated for a regression coefficient upward, which in turn biases the t-statistic for it downward. This may result in declaring an explanatory variable as exerting a statistically insignificant on a dependent variable when it really is not. There are two methods that I employ to test for this potential pitfall. The first is a pairwise correlation table. In a pairwise correlation, any absolute value between .80 and 1.0 is indicative of a high level of correlation between factors. In looking at my results that I present in Appendix B, I find that there is no strong correlation between variables.

A second method to check for multicollinearity is the variance inflation factor (VIF) test. A VIF test gauges the severity of multicollinearity if it is present. Table 4.1 shows the results of this test for my regression study. I rank the variables in order of multicollinearity from most to least severe. Any score above a five means that multicollinearity is likely present. While the variable representing respondents 65 years and older scores is the only one above 5.0 with a score of 6.29, it does not necessarily mean that it will be a problem that needs to be dealt with unless this explanatory variable is found to exert a statistically insignificant influence in the regression analysis.

Table 4.1: Variance Inflation Factor Test Results

Variable	VIF
Age 65 and Up	6.29
Age 55 to 64	4.56
Age 45 to 54	3.93
Age 35 to 44	3.28
Married	3.08
Non-US Born Latino	2.92
Post-Marriage	2.87
Non-Citizen	2.45
Age 25 to 34	2.36
Naturalized Citizen	2.17
Urban	1.87
Asian	1.80
Living with Children	1.74
Suburban	1.60
Employed Full-Time	1.54
Small City	1.53
Low Income	1.41
Living with Partner	1.35
Higher Education	1.30
US Born Latino	1.19
Employed Part-Time	1.12
Male	1.08
SSB Consumption	1.08
African American	1.07
Native American	1.02
Pacific Islander	1.00

Mean VIF	2.14

Heteroskedasticity

To test for heteroskedasticity, I first run an OLS regression with my selected variables in their original form. I then follow up with a Breusch-Pagan test and find that the level of heteroskedasticity in my model is rather high with a 99.99% confidence level. To correct for this, I modify my model by breaking down the only continuous variable, age, into multiple generational dummy variables and then use robust standard errors in my final regression.

Dispersion

When using a count regression model, it is important to note the relation of the variance to the mean of the dependent variable. The Poisson model requires that the square of the mean be nearly equal to the variance to produce correct standard errors, and in this instance it does not (Chatterjee & Simonoff, 2013, pp. 191-215; and "STATA Video #6 Poisson and NB Regression," 2010). By testing for dispersion, I find that the square of the mean is 2.10 while the variance is 3.92. The fact that the variance is much higher means that this variable is over dispersed and an alternative count model more desirable. I have chosen to use the negative binomial regression model because it is best suited for count variables with over dispersion. It is also better at dealing with a large number of zero responses in the data. In addition, when comparing the mean-dispersion model vs. the constant-dispersion model in this negative binomial regression, I find that the constant-dispersion model is superior because it has a log-likelihood closer to zero.

Final Model

After correcting for heteroskedasticity, multicollinearity, and over dispersion, I present my final regression. The complete results are available in Appendix C. Table 4.2 below contains the statistically significant factors of my study. All results are in "incidence-rate ratios" and are in order of highest to lowest rate. For example, the incidence-rate for variable *male* in Table 4.2 is 1.843. This means that men consume SSBs 84% more than women do. In addition, the variable *low income* is 1.265 means that the effect of being a person with low income is to increase the expected number of SSBs consumed by 26%. I exclude insignificant explanatory factors from this table. Table 4.3 at the end of this section contains a summary of my expected effects and actual outcomes (Hilbe, 2007, p. 9).

Table 4.2: Final Negative Binomial Regression Results

Dependent Variable	Negative Binomial Regression				
Number of Sugar-Sweetened Beverages Consumed in a Week				90% Confidence Interval	
Independent Variables	Rate Ratio	Robust S.E.	Significance	Lower Bound	Upper Bound
Non-US Born Latino	1.843***	0.078	0.000	1.720	1.976
Male	1.799***	0.030	0.000	1.751	1.850
African American	1.531***	0.055	0.000	1.444	1.626
Native American	1.475***	0.117	0.000	1.294	1.681
US Born Latino	1.305***	0.034	0.000	1.250	1.364
Low Income	1.265***	0.025	0.000	1.226	1.307
Living with Kids	1.111***	0.026	0.000	1.069	1.156
Living with Partner	1.081**	0.040	0.036	1.017	1.149
Age 25 to 34	0.935**	0.031	0.047	0.885	0.989
Employed Part-Time	0.934**	0.029	0.029	0.888	0.983
Married	0.919***	0.025	0.002	0.879	0.962
Suburban	0.893***	0.023	0.000	0.857	0.932
Urban	0.888***	0.020	0.000	0.856	0.922
Non-Citizen	0.790***	0.033	0.000	0.739	0.847
Higher Education	0.783***	0.014	0.000	0.760	0.809
Age 35 to 44	0.761***	0.027	0.000	0.717	0.808
Naturalized-Citizen	0.715***	0.026	0.000	1.793	0.760
Age 45 to 54	0.592***	0.021	0.000	0.559	0.628
Age 55 to 64	0.443***	0.016	0.000	0.418	0.472
Age 65 and Up	0.336***	0.013	0.000	0.316	0.359

Number of Significant Results	20

Notes:

(1) Sample size is 42,935

*(2) *Statistically Significant with 90% confidence*

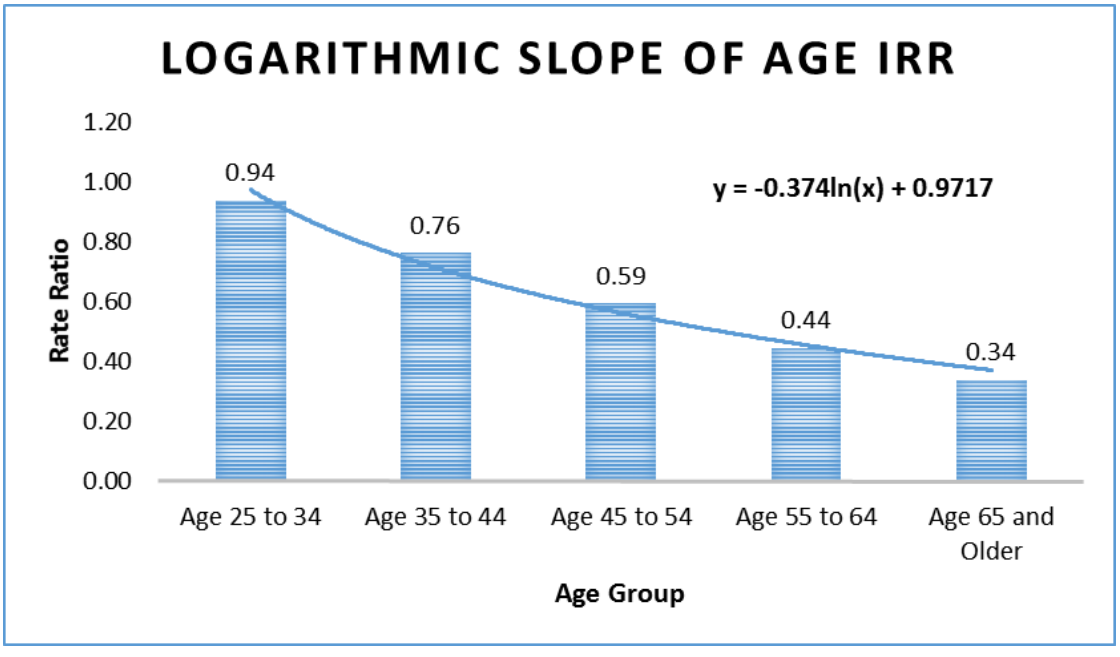
*** Statistically significant with 95% confidence*

****Statistically significant with 99% confidence*

I begin my analysis of the results by noting that 20 out of the original 25 explanatory factors are significant with at least 90% confidence. All demographic variables in this study are significant, but only *male* had a higher level of rate in relation to its reference. Men consume sugar-sweetened beverages in a given week 79% more than females. This variable ranks second-highest out of all other significant variables with *non-US born Latinos* being first with consumption being 79% higher than the reference.

Unlike with *males*, all *age* groups, *non-citizens*, and *naturalized citizens* have lower rates of consumption than their respective references. It is interesting to note that by using dummy variables to highlight generational differences, a non-linear slope in the consumption reduction becomes apparent. Figure 4.1 below shows the logarithmic trend

Figure 4.1: Visual Representation of the Logarithmic trend-line



line of the different rate ratios for each generational grouping. With each succeeding *age* group, the slope begins to level off so that the difference in rate is not as drastic.

Another point of interest in the demographic variables is that while *non-US born Latinos* are at the highest consumers of SSBs, their counterparts consisting of non-Latinos born outside of the United States who are either *non-citizens* or *naturalized citizens* are among the lowest consumers of SSBs in this regression study (21% and 29% fewer SSBs weekly, respectively).

Continuing on to socioeconomic independent variables, my key explanatory factor *higher education* performs as expected. People with some college education or more consume 22% fewer sodas per week than those with a high school diploma or less. In addition, people below 300% of the federal poverty level consume 26% more than the reference.

Employment type on the other hand does not provide a consistent significant relationship with the amount of SSBs consumed. While those employed part-time consume 7% less soda per week than the unemployed reference, there is no significant relationship between SSB consumption and full-time employment.

A surprising finding occurs in the family status variables under the umbrella of socioeconomics. People who live with another adult and are married consume fewer SSBs than those that live with another adult and are not married (7% less and 8% more respectively). The nature of these unmarried relationships is unclear, as the data does not differentiate between roommates sharing a space or romantically involved partners. Regardless of this lack of information, it does shed light on the possibility that the

relationship status between two people living together may have some correlative relationship with individual health lifestyles. Living with children under the age of 18 though has the effect of increasing consumption by 11%.

While the data does not provide information on potential romantic involvement between individuals living together other than marriage status, it does show via my regression study that there is no significant difference between people who are either divorced, widowed, or separated in SSB consumption and the reference single individual. Whatever factor that reduces consumption of SSBs in married couples disappears when an individual reverts to a *single* status.

Cultural differences though present a mixed bag of results. While *African Americans*, *Native Americans*, *US born Latinos*, and *non-US born Latinos* consume more SSBs than Caucasians (53% and 47% respectively), there is no significantly significant relationship with the Asian population. The literature regarding SSB consumption consistently shows that Asians consume less than the reference Caucasian population. This conflict with the literature may arise from the definition of *Asian* as a variable. The California Health Interview Survey has a broad definition of the term and may include ethnicities not present in prior studies. For example, the CHIS dataset includes *Indian* under the heading of *Asian*, but people from the Indian subcontinent have a distinctly different culture than those from China, Japan, and Vietnam. Pacific Islanders also have an insignificant relationship with SSB consumption, but this may arise from the fact that the sample size of Pacific Islanders is relatively small (n=68).

Table 4.3: Expected Effects vs. Actual Outcomes

Variable	Expected Effect	Actual Outcome
Demographics		
Male	+	+
Age 25 to 34	-	-
Age 35 to 34	-	-
Age 45 to 54	-	-
Age 55 to 64	-	-
Age 65+	-	-
Non-Citizen	-	-
Naturalized Citizen	-	-
Socioeconomics		
Higher Education	-	-
Low Income	+	+
Full Time Employment	?	Insignificant
Part Time Employment	?	-
Married	?	-
Living With Partner	?	+
Post-Marriage	?	Insignificant
Living with Children	?	+
Culture		
Black	+	+
Native American	+	+
Asian	-	Insignificant
Pacific Islander	+	Insignificant
US Born Latino	?	+
Non-US Born Latino	?	+
Geographic Region		
Urban	?	-
Small City	?	Insignificant
Suburban	?	-

Application of Interactions

Upon completion of the first negative binomial regression study, I will now introduce my interaction variables. For this part of the study, I run three separate count regressions. In order to analyze the interaction effects properly, the results of the following regressions will be in coefficients rather than in risk ratios. I will then use the following formula to interpret the results. A benefit of using this formula is that the results will be in the form of risk ratios which simplify their interpretation.

$$IRR_{BxB} = exp[\beta_1 + \beta_2 x]$$

β_1 = Coefficient on Higher Education
β_2 = Coefficient on Interaction
χ = 0 if either White or Age Group 18 to 24
χ = 1 if not White or not Age Group 18 to 24

Out of my three interaction studies, only age and race/ethnicity have significant values. The interaction effect for *male* is not significant and is not shown in the following tables. The interactions that are represented in the Table 4.4 are as follows: Table 1 contains *higher education * Age 25 to 34, Higher Education * Age 35 to 44, Higher Education * Age 45 to 54,* and *Higher Education * Age 65 and Older;* Table 2 contains *Higher Education * African American, Higher Education * Native American, Higher Education * Asian, Higher Education * Pacific Islander, Higher Education * US Born Latino,* and *Higher Education * Non-US Born Latino.*

Table 4.4: Interaction Effects of Race/Ethnicity and Age Group - Results

Race/Ethnicity Interaction with Higher Education Regression Results				
Variables	**Coef.**	**Significance**		**Interpretation (IRR)**
African American Interaction	0.2608	0.000		0.886
Native American Interaction	0.0758	0.003		0.736
Asian Interaction	0.6530	0.000		1.311
Pacific Islander Interaction	***Insignificant***			
US Born Latino Interaction	0.1610	0.000		0.802
Non-US Born Latino Interaction	0.2779	0.000		0.901

Higher Education	-0.3819	0.000

Age Group Interaction with Higher Education Regression Results				
Variables	**Coef.**	**Significance**		**Interpretation (IRR)**
Age 25 to 34 Interaction	-0.1142	0.057		0.783
Age 35 to 44 Interaction	-0.1692	0.004		0.741
Age 45 to 54 Interaction	-0.2105	0.000		0.711
Age 55 to 64 Interaction	-0.1511	0.012		0.754
Age 65 and up Interaction	***Insignificant***			

Higher Education	-0.1307	0.002

By converting the results of the interaction effects into risk ratios, the resulting pattern appears to show that people who have an education beyond a high school diploma consumer fewer sugar-sweetened beverages than their less educated peers do. For example, among *African Americans,* those who have an education beyond a high school diploma consume 12% fewer SSBs than *African Americans* with at most a high school diploma. This pattern is nearly consistent with all groups shown in Table 4.5 except for *Asians*. It is interesting to note that only the Asian ethnic group with a higher education consumes more SSBs than their less educated peers (31% more). This disparity is not the result of a small sample size as the total number of *Asians* in the dataset is over 4000. *Asians* are second only to the total number of *Non-US Born Latinos* in this study. There may be other factors such as culture that could be increasing SSB consumption within the Asian population. While this is not within the scope of this thesis, it may warrant further research in another study.

Conclusion

To answer the first part of my thesis question, a low level of educational attainment *is* a positive determinant of risk for consumption of high levels of sugar-sweetened beverages in the general population. By looking closer at the data via interaction effects between higher education and race/ethnicity, and higher education and age group, I find that education is a mitigating factor for SSB consumption. For example, African Americans may consume more SSBs than Caucasians, but within the total population of African Americans, those with a higher education consume much far fewer SSBs than their lower educated peers. If education truly is a positive indicator of

nutritional knowledge as Parmenter, Waller, & Wardle (2000) find in their own research, then the results of my regression study serve to reinforce their assertion.

Given that educational attainment is negatively correlated to SSB consumption, and the evidence that it is also positively linked to nutritional knowledge, then the question arises on what methods can be employed to bridge the information gap with lower educated consumers so that they can make informed decisions when confronted with a wide variety of sugar-sweetened and non-sugar-sweetened beverages. I will be addressing this question in the next part of my thesis.

For the remainder of my thesis, I will be comparing the effectiveness of front-of-package (FOP) labeling in both the United States (US) and the United Kingdom (UK). Both nations utilize this type of product labeling on SSBs and are very similar in appearance but with a few key differences, such as color and type-font. In Chapter 5, I will develop a framework using key themes that I find in the available literature. I will then employ and test this framework in Chapter 6 when I analyze and compare the effectiveness of US and UK label designs. In Chapter 7, I will use the results of my analysis to provide policy guidance to both state and federal policymakers on workable FOP label design options to reduce consumption of SSBs.

Chapter 5

QUALITATIVE LITERATURE REVIEW

Although front-of-package (FOP) nutrition labels are becoming a popular method of informing consumers of a product's nutritional value, with both government and industry support, there are relatively few studies published in peer-reviewed journals of how to best design an FOP that will effectively reduce consumption of SSBs (Bleich, Barry, Gary-Webb, & Herring, 2014; & Aschemann-Witzel et al., 2013). A majority of the available literature only focuses on comparative analysis of current FOP labeling schemes. To address this deficit, I will include research pertaining to tobacco product labeling in my review as well.

In this chapter, I will review the available literature and focus on four different themes from which I will be able to develop a framework for comparative analysis. First, I will discuss how the use of color in an FOP label draws the consumer's attention and assists in his or her decision making processes. I will then explore how much information is too much in regards to avoiding consumer confusion, and how contextually relevant labeling bridges the knowledge gap between the consumer and the producer. Next, I will discuss the problem of label desensitization and how Health Canada is working around that problem. Finally, I will conclude with a detailed explanation of my framework which I will apply to my comparative analysis in Chapter 6.

Color as an Influencing Factor

Color carries within itself a strong contextually relevant psychological meaning. Certain colors tell a person to avoid something, while others cue a person to potential positive qualities. Using such colors on front-of-package nutrition labels may affect consumer choice by informing him or her about the potential healthfulness of a product. The question is, which colors will be most effective? According to Rohr, Kamm, Koenigstorfer, Groeppel-Klein, & Wentura (2012) , the use of the color red on a product evokes an avoidance response by the consumer, while Schuldt (2013) finds that green evokes an opposite approach response. It is important to note that while both green and red evoke strong approach/avoidance responses, other colors such as blue and white do not illicit a similar response (Schuldt, 2013). In addition, the colors red and green are shown to increase the salience and noticeability of a warning label to consumers (Rodriguez, 1991). Given this, the use of red and green on product nutrition labeling may be a valuable tool in gaining the attention of the consumer, and assisting them in their comparative analysis of the healthfulness of sugar-sweetened and diet beverages.

Exploring the relationship between color and consumer further, Genschow, Reutner, & Wänke (2012) study the effects of plate and cup color on the consumption patterns of consumers. In their study, they track the quantity of food consumed on three different color plates. From this, they find that people consume less food and fewer soft drinks when they are associated with the color red, and more when it is associated with the color white. It is interesting to note that the plate and cup color that correlates to the highest food consumption is blue. The authors conclude that red elicits an avoidance

response within consumers, and that if producers want to sell more of a product, they should probably stick with blue packaging (Genschow, Reutner, & Wänke, 2012).

A complicating factor with the use of red or green labeling on packages is that a consumer's preconceived notions of a product's healthfulness moderates the influence that the label color may have on him or her. This is especially true for the color green. The use of a green label on items such as fresh produce or diet colas does not evoke a similarly powerful approach response as does a red label and its coinciding avoidance response. This may not necessarily be a problem though because the overall purpose of mandating FOP labeling is to dissuade consumers from purchasing SSBs (Rohr, Kamm, Koenigstorfer, Groeppel-Klein, & Wentura, 2015).

Quantity of Information

A difficulty in designing a front-of-package nutrition label is knowing how much information is too much. Too much information on a nutrition label affects its visual salience and reduces the likelihood that a consumer will spend time reading it (Graham, Orquin, & Visschers, 2012). This is a common complaint from consumers regarding the older nutrition facts panel found on the rear of most prepackaged foods. There is too much information, the font is too small, and the label is not large enough. It provides accurate and pertinent information, but it takes time to read, time that most consumers do not have (Clare & Burghardt, 2014).

If the purpose of an FOP label is to educate and persuade the consumer to make a healthier choice, then the label should be easily identifiable and contain only as much information that will efficiently achieve that end (Vanderlee, Goodman, Yang, &

Hammond, 2012). A 1988 study by Magat, Viscusi, & Huber provides insight into the problem of labels containing too much information and the resulting overload for the consumer. They find that informational remedies to the market failure that consumers possess too little information on the healthfulness of a product, can only be effective at helping consumers if they have the ability to process it. Thus, just adding more nutritional information to an FOP label risks confusing the consumer and reducing its effectiveness. In addition to confusing the consumer, Magat, Viscusi, & Huber (1988) also find that adding additional information to a label reduces the ability of the consumer to recall the parts that he or she is able to understand. More information increases "label clutter" and reduces the amount of attention that consumers give it.

In a more recent study of nutrition labeling content, Leek, Szmigin, & Bak (2015) investigate the use of multiple health indicators on FOP labels. FOP labels that contain many health indicators such as calorie content, saturated fats, sugars, vitamins, and minerals lead to consumer confusion because it is hard to compare the overall healthfulness of one product over another. For example, if Product A is high in one negative and two positive nutrients, and Product B is high in two negative and three positive nutrients, how does the consumer know which product is healthier? As with the study by Magat, Viscusi, & Huber (1988), the addition of more nutritional indicators on an FOP label does not help the consumer if it does not address the inability process them.

On the other end of the information spectrum is the problem of not providing enough information at all. While most of the current literature focuses on labeling that

Figure 5.1: Example of Vague

Source: PNNS, 2015

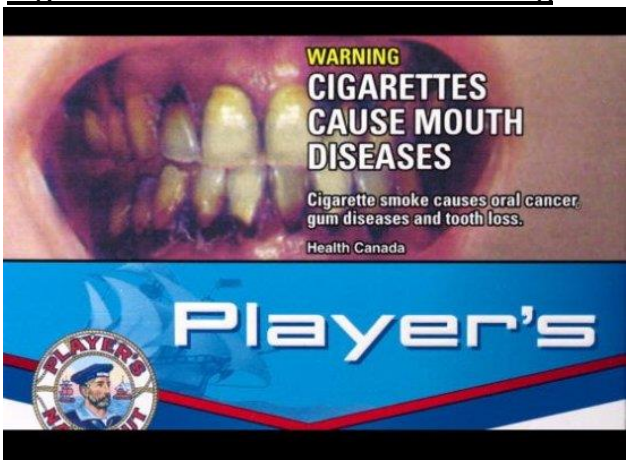
confuses consumers with information overload, there is not as much literature looking at vague and uninformative FOP labels. In a study by Mejean, Macouillard, Péneau, Hercberg, & Castetbon (2013), FOP labels such as the one in Figure 5.1 do not provide enough information to consumers about the healthfulness of a product. In this example, the presence of the logo on a package means that it meets certain nutritional standards set by the French Nutrition and Health Program. The label does not come with a definition of the standards and does little to inform low-knowledge consumers.

Striking a balance between the two extremes will require finding the specific health indicators that directly affect an individual's weight. Too much information will distract the consumer, while too little information will leave him or her uninformed.

Contextual Relevance

For labeling to be effective, the information it provides should be easy for the consumer to process. An FOP label with nutrition facts and figures is not effective if the consumer does not understand what it means. While there are no current FOP label designs on sugar-sweetened beverages that contain features addressing contextual relevance, there are many examples of this type of labeling in the tobacco industry. Canadian tobacco warning labels for example, use graphic imagery that covers at least half of the product package ("Tobacco Labeling Resource Center," 2016). The images on these warning labels are explicit and evoke strong negative responses from the consumer (Ratneswaran et al., 2014). Figure 5.2 shows one such Canadian warning label with a statement that says "Cigarettes Cause Mouth Diseases," and includes an explicit image of a diseased mouth. The benefit of using this labeling method is that the image adds context to the written warning which enhances the relevance to the consumer.

Figure 5.2: Canadian Tobacco Warning



Source: Health Canada, 2015

If consumers do not know what a “mouth disease” is, the addition of the graphic image along with the text will help to educate them (Ratneswaran et al., 2014).

In a study comparing the desire to quit of Canadian and Mexican smokers after exposure to each country’s new tobacco labeling mandates (Graphic label for Canada, text label for Mexico), Thrasher, Hammond, Fong, & Arillo-Santillán (2007) find that smokers who purchase tobacco products with warning labels containing graphic imagery are twice as likely to attempt to quit smoking than those who purchase tobacco products with a simple text warning. Further expanding on this concept, Hammond, Fong, McNeill, Borland, & Cummings (2006) examine labels in four different countries, including Canada, and conclude that graphic warning labels serve as an effective source of health information. Smokers in countries that have similar graphic warning labels to Canada’s are almost three times as likely than smokers in countries without graphic warning labels to correctly identify various health conditions such as throat cancer and emphysema as being risks of consuming tobacco.

Considering the effectiveness of contextual relevance enhancements on tobacco warning labels, they may be effective for use on SSBs as well. In one study investigating the use of such methods by Bleich, Barry, Gary-Webb, & Herring (2014), the authors find that by using store signs that connect the number of calories in an SSB to the amount of effort it takes to work off those calories to be effective at dissuading consumers from purchasing them. In the stores that are part of the study, the display of the experiment store signage correlates to about a 35% decline in total regular soda sales from the six-week period before the study. In addition to reducing the number of SSBs sold by the

stores, the effect persists post-intervention. This means the inclusion of contextually relevant store signage in this experiment may be effective at dissuading consumers from purchasing SSBs, and that the consumers remember the information after exposure to it, affecting their future purchasing decisions.

Novelty and Wear-Out

A problem with warning labels, both graphic and text, is the issue of wear-out, or desensitization after long-term exposure. In a cross-sectional survey study by Ratneswaran et al.(2014), the authors find that current graphic labeling designs, even those in Canada, can lose their effectiveness over time. To counter this trend, efforts to create a variety of labels to maintain visual novelty within the consumer are important. For example, Health Canada's uses a rotating series of a warning labels on tobacco products. Each new label briefly mentions a negative health consequence of smoking, and includes a graphic image to go along with it. Figure 5.3 provides an example of the wide array of Canadian tobacco warning labels. I am currently unable to locate research pertaining to the effectiveness of Canada's rotating label policy, but Health Canada believes that it is an effective remedy to warning label wear-out.

The study by Bleich, Barry, Gary-Webb, & Herring (2014), provides an example of how this same tactic is effective in the area of SSB consumption and sales. In their experiment, they use four signs, each with a different statement informing consumers about product health facts. Appendix C contains examples of these signs.

Figure 5.3: Various Canadian Tobacco Warning Labels

Source: Health Canada, 2015

Framework

. From my review of current literature, I am now able to create a framework from which I can analyze and compare FOP label designs from both the United States and Canada in Chapter 6. For an FOP label to be effective, it should have four distinct qualities.

Color Red for Unhealthy Nutrient Values

First, a label should limit the use of color to red to highlight high levels of certain nutrients that can be unhealthy. For example, if an item is high in calories, fats, or salts, then the color given to highlight the quantity should be red for its ability to trigger a strong avoidance response in the consumer. Colors such as blue, white, and yellow are not as effective in highlighting the positive or negative qualities of nutrient values. In addition, striking colors have the benefit of capturing the consumer's eye relative to lighter tones.

Clarity of Information

Second, nutrition labels can go wrong in one of two ways, they can either provide too much information as to confuse the consumer, or not enough information to provide the consumer any insight at all. In addition to quantity, overall label size, font style, and unit of measurement affect overall clarity as well. A difficulty in gauging this factor is that it is almost completely subjective. While the literature does provide examples of extremes in labeling which I can apply to this analysis, there is no simple way to find how much information will most efficiently affect consumer choice.

Contextual Relevance

Third, an FOP label should present information that consumers can easily process. Most people do not have the nutritional knowledge to know what a quantity of calories means, and how it would affect them if they consume it. If a product has a high level of unhealthfulness, then the label should present it in a manner that can fill in the knowledge gap.

Novelty

Fourth, to prevent label wear-out, producers should use a set of labels on a rotational basis or find an alternative method. Even the best FOP label will lose effectiveness over time if it is the only one consumers see on a repeated basis.

Conclusion

As shown in the literature, many factors contribute to the efficiency of FOP nutrition labeling designs. Some improve it while others confuse consumers and weaken their effectiveness. Applying the findings from this review to the creation of this framework, I will now apply it to my analysis of FOP labels from both the United States and the United Kingdom in the following chapter. My hope is that through this framework creation and analysis, that I will be able to provide guidance for policy makers in their drive to reduce overall SSB consumption in both California and the nation as a whole.

Chapter 6

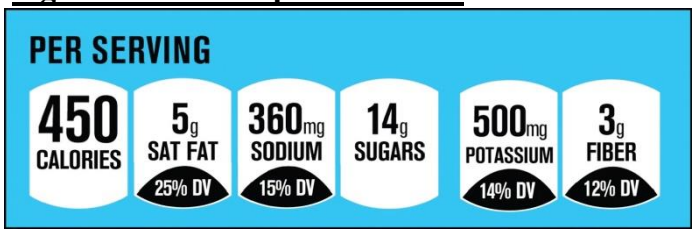
ANALYSIS

For this chapter, I will use the framework I developed in Chapter 5 to analyze current industry standard "Facts Up Front" front-of-package (FOP) labeling on sugar-sweetened beverages. This is a standard the Grocery Manufacturers Association and Food Marketing Institute developed in response to pressure from the Food and Drug Administration and First Lady Michelle Obama. First, I will examine the features of the Facts Up Front FOP label and then use my framework as a reference in my analysis of it. Next, I will compare the results of my analysis to current literature regarding the effectiveness of the FF labeling system. In addition to this, I will also include comparative studies of the American Facts Up Front label design with other FOP label designs from the European Union (EU). Labels from the EU are distinctly different than those in the United States (US) and contain visual features that are not present in the American counterpart. This will provide an opportunity to see if labels that satisfy more factors of my framework are more effective at educating consumers and reducing consumption of SSBs.

Facts Up Front

The Facts Up Front (FF) label, as shown in Figure 6.1, is a rectangular panel that appears on or near the front side of prepackaged food and beverages. Some manufacturers who take part in the Facts Up Front label program use a derivative of the original standard put in place by the Grocery Manufacturers Association (GMA) and the Food Marketing Institute (FMI). Mars Incorporated uses a label shown in Figure 6.2 on

Figure 6.1: Facts Up Front Label



Source: GMA, 2016

its candy bars which contains a green background color instead of the original light-blue. In addition, manufacturers may choose to use a condensed version of the label if the full size FF label will not fit on a package, as shown on a can of soda in Figure 6.3.

The purpose of each label is to make certain nutritional facts easier for the consumer to locate. The GMA chose to follow guidelines put in place by the United States Department of Agriculture (USDA) in deciding which nutrients to place on the label. The guidelines state that there are four nutrients to be limited by the consumer. These four are calories, saturated fats, sodium, and sugars, and in the case of Mars Inc.

Figure 6.2: Facts Up Front Label

Source: MARS Inc, 2016

candy bars, total fat as a fifth. When space is available to use the full FF panel,

manufacturers will include each of these four nutrients in large print and in their own individual shield shaped icons. The numerical values on display in the label are in metric form and represent the total quantity in a single serving of a product. Saturated Fats and Sodium include "daily value" percentages as well. Daily value, or "Recommended Daily

Figure 6.3: Facts Up Front Label

Source: PEPSI, 2016

Allowance" is the maximum amount an average person should consume of these two nutrients in a single day, a standard set by the Food and Drug Administration (FDA).

In addition to the four nutrients to avoid, manufacturers can also include up to two nutrients to encourage. These nutrients to encourage are in their own set, positioned to the right of the nutrients to avoid. A nutrient must be equal to or more than 10% of the daily value before it can qualify to be on the FF label. Daily value, in this instance is a minimum daily intake rather than a maximum as with saturated fats and sodium.

Applying the Framework

While the Facts Up Front label can take different forms, its design follows a certain set of parameters put forth by the GMA and the FMI. It is these parameters which I will analyze in the next part of this chapter applying my framework from Chapter 5.

Color

The basic design of the label incorporates a blue background with white icons, or a blue icon with white lettering on small individual packages of sugar-sweetened beverages. According the Schuldt (2013), these colors do not elicit an avoidance or approach response, and neither are they visually salient to the consumer (Rodriguez, 1991). In addition, there is no color differentiation between the USDA's nutrients to avoid, and those to approach as set forth by the FDA.

In the variation of the Facts Up Front label by Mars Inc., the label uses a green background with green shield icons for all nutrients. Considering that all of the nutrients on Mars's labels are those to avoid, the use of green may give a conflicting message of approachability to the consumer.

Clarity

All of the different variations of the FF label use a standard non-serif type font. Non-serif fonts are easier for the average consumer to read than serif fonts (Josephson, 2008). In addition, the numerical values are large and clear. A problem arises though with the inclusion of text and information on the rest of the label. Daily values and units of measure are in a smaller font size, and the serving size is unspecified.

The information in the labels may not be useful for someone without prior nutritional knowledge regardless of legibility. The use of a metric system of measure may be industry standard, but considering it is not in common use for American consumers, it may end up confusing him or her (Sifferlin & Sifferlin, 2014). In addition, the inclusion of fine print on the Mars FF label which contains further information increases label clutter and reduces readability.

Contextual Relevance

No variation of the FF label contains any contextually relevant information. Although it is interesting to note that the Mars FF label does use the phrase "What's inside.." rather than "Per Serving." The use of the term "Per Serving" has a tendency to confuse consumers who may consider an entire package a single serving, when in reality only a portion of the package is. "What's inside" seems to clearly state to the consumer that the information on the label pertains to the package as a whole (Brody, 1999).

Novelty

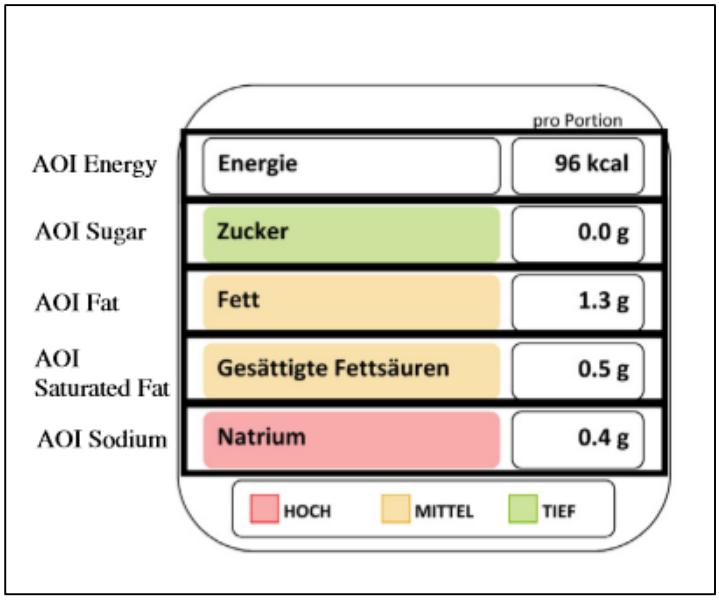
While there are different variations of the FF label, each variation is only used once on each product. For example, all Mars candy bars contain the same green FF label, and all Pepsi products contain the same single calorie content icon. As with Ratneswaran et al. (2014), the lack of novelty in the label can lead to wear-out and loss of noticeability with the consumer. From the perspective of my framework, it appears that the Facts Up Front labeling program does not contain design features that have the qualities of color, clarity, contextual relevance, and novelty to be an effective means of reducing consumption of sugar-sweetened beverages in groups that do not have sufficient

nutritional knowledge. The next step in my analysis will be to verify my conclusions via a review of the limited literature concerning the effectiveness of the FF label and other FOP label designs. There is not much research available concerning FF label effectiveness. As a result, I am only able to find information pertaining to clarity and the use of color.

Literature Review

One problem with the Facts Up Front label is that it is only helpful to those that have prior nutritional knowledge. In an eye-tracking study by Miller et al. (2015), the researchers find that the ineffectiveness of the FF label does not stem from low knowledge consumers ignoring the label, it is that they are not able to interpret the information in any meaningful manner. Compounding this problem is the addition of information regarding positive nutrients such as Vitamin A and Calcium. The addition of this information tends to confuse consumers with low levels of nutritional knowledge and hinders their ability to compare the healthfulness of multiple products. The authors also express concern that the use of these positive nutrients in the FF label design may lead to manufacturer manipulation of the overall healthfulness of the product. For example, a manufacturer can fortify an otherwise unhealthful product with vitamins just so it can add them to the label, inflating the perceived healthfulness of it (Miller et al., 2015). Roberto et al., (2012) echo Miller et al. (2015) in their concern regarding manufacturer manipulation. According to their study, they find evidence that the addition of positive nutrients on an FOP label impacts consumers' ability to process the information and make comparative choices.

Figure 6.4: Multiple Traffic Light Label

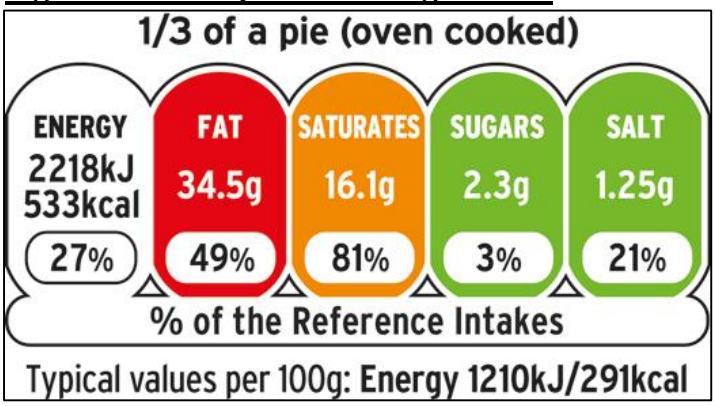


Source: Siegrist, Leins-Hess, & Keller, 2015

In another eye-tracking study, this time comparing an FOP label similar in design to GMA's Facts Up Front to the Multiple Traffic Light (MTL) label (Figure 6.4) currently in use in Europe, Siegrist, Leins-Hess, & Keller (2015) find that the FF style label is less efficient than the MTL model at conveying health information to consumers. The reason for this is due to the key differences between the two label formats. First, the MTL label uses colors such as red and green to highlight the relative healthfulness of quantities of certain nutrients while the FF label does not. In addition, the MTL label reduces the amount of text by color coding relative quantities to replace the more complex daily value percentages. According to the authors, the use of color on the MTL label decreases the label's complexity which makes it is easier for the consumer to interpret, and apply the information to their own decision making (Siegrist, Leins-Hess, & Keller, 2015). A potential weakness in their study though is that the authors do not use

a version of the MTL label currently in use. An example of the current MTL label is shown in Figure 6.5. The MTL label currently in use includes daily value percentages along with color coding.

Figure 6.5: Multiple Traffic Light Label



Source: UK Department of Health, 2016

From the limited available literature on the effectiveness of Facts Up Front labeling, I am able to find research supporting two out of the four components of my analysis. First, Roberto et al. (2012) and Miller et al. (2015) both echo my conclusion regarding the use of positive nutrients on the FF label in that it risks confusing the consumer and leaves an opening for manufacturer manipulation. Second, Siegrist, Leins-Hess, & Keller (2015) finds that the use of red and green on the MTL label does improve consumer ability to apply the information to his or her own decision making. In addition, they also conclude that replacing text information with color coding reduces label clutter which reduces label complexity and improves label efficiency.

Conclusion

This chapter answers my research question regarding the effectiveness of the Facts-Up-Front FOP nutrition label. Based on my analysis via my framework and a

review of current literature regarding FF label effectiveness, I find that the FF label is ineffective at persuading low nutritional knowledge consumers to make more healthful dietary choices. Effective FOP labeling should include colors such as red and green to denote the healthfulness of individual nutrients, be clear and concise, contain contextually relevant graphical imagery, and utilize strategies to prevent label wear-out.

While I am only able to confirm conclusions from two out of four of the parameters of my framework with available literature, I believe it may still be an effective guideline for the design of future front-of-package nutrition labels because the framework is based off of a broad range of literature including research on tobacco warning labels. The lack of analysis regarding the use of contextually relevant graphical imagery and tactics to reduce label wear-out on food products is due to the fact that there are currently no FOP labels that utilize these factors. Nutrition labels including these factors will need to be implemented in order to study their effectiveness.

In the next chapter, I summarize my findings from both sections of my thesis. I also provide policy guidance to both state and federal policymakers on future steps to take regarding FOP labeling on sugar-sweetened beverages.

Chapter 7

RECOMMENDATIONS

Obesity is on the rise in California, and current research shows that the consumption of high calorie sugar-sweetened beverages (SSB) is one of the top causal factors of it (Wang & Beydoun, 2007). At issue is the effectiveness of FOP nutrition labeling at promoting healthier dietary choices among consumers. Recent studies are finding that Facts-Up-Front, the current industry standard design by the Grocery Manufacturers Association, is ineffective at achieving meaningful reductions in SSB consumption (Siegrist, Leins-Hess, & Keller, 2015; and Miller et al., 2015). Here the question arises: Is the Facts-Up-Front label not effective because nutritional knowledge does not affect a person's beverage choice, or is it that the design of the label is not efficient enough to effectively inform and persuade consumers? Current studies in the area of FOP nutrition labeling suggest that it is the latter of the two. FOP labeling can be effective, but it must be designed in such a way as to be informative to consumers with little to no nutritional knowledge (Bleich, Barry, Gary-Webb, & Herring, 2014; Hodgkins et al., 2015; and Becker, Bello, Sundar, Peltier, & Bix, 2015). In this concluding chapter of my thesis, I provide policy recommendations on how to design front-of-package (FOP) nutrition labeling and in-store signage as part of a campaign to reduce consumption of sugar-sweetened beverages.

The purpose of my thesis is to add to the growing body of literature regarding efficient and effective design of FOP labels, specifically on sugar-sweetened beverages. To do so, I asked two questions. The first pertained to the relationship between an

individual's level of educational knowledge and his or her pattern of SSB consumption. Given that Parmenter, Waller, & Wardle (2000) find a positive correlation between an individual's level of educational attainment and nutritional knowledge, I was able to substitute nutritional knowledge with an explanatory variable representing education level in my regression study to answer this question. The second examined the effectiveness of the Facts-Up-Front FOP label at reducing consumption of SSBs. I conclude that an individual's level of nutritional knowledge affects SSB consumption and that by addressing this gap in knowledge for the less educated, via the use of graphically enhanced FOP labeling may be an effective means of bridging it and potentially promoting more healthful dietary choices among low-educated consumers. A surprising finding in my thesis is that the same graphically enhanced nutritional information that I suggest be applied to future FOP label designs may also be effective with a campaign using only in-store signage (Bleich, Barry, Gary-Webb, & Herring, 2014).

Four Factors of Effective Label Design

A hallmark of effective FOP labeling is that a consumer does not need prior nutritional knowledge to understand it and apply it to their own dietary choices. The current Facts-Up-Front label design reiterates nutrition information from the federally mandated nutrition facts panel on the back of pre-packaged foods, but it does not bridge the information gap because it lacks the contextual aids necessary to reach consumers with low levels of nutritional knowledge. From my survey of other's research, I have found that there are four graphical label enhancements that should bridge that information

gap and improve the consumer's comprehension and retention of nutritional information presented.

1. *Color:* Labels should use the color red to highlight high levels of certain nutrients that the US Department of Agriculture and the Food and Drug Administration deem to be unhealthy. For example, if an item is high in calories, fats, or salts, then the color given to highlight the quantity should be red for its ability to trigger a strong avoidance response in the consumer. Using colors such as blue, white, and yellow on FOP labels is not effective in highlighting the positive or negative qualities of nutrient values. In addition, striking colors have the benefit of capturing the consumer's eye relative to lighter tones (Rohr, Kamm, Koenigstorfer, Groeppel-Klein, & Wentura, 2012; Schuldt, 2013; and Rodriguez, 1991).
2. *Clarity:* Labels should limit text to the minimum amount necessary to inform clearly the consumer. All text should be large, easily read, and in a non-serif font such as Veranda. Daily value percentages should be avoided and instead represented via a system of red and green color codes (Graham, Orquin, & Visschers, 2012; Clare & Burghardt, 2014; and Vanderlee, Goodman, Yang, & Hammond, 2012).
3. *Contextual Relevance:* Labels should contain graphical enhancements that help the consumer to understand what the nutritional values mean to him or her. Effective graphical enhancements should evoke a strong avoidance response from the consumer when faced with an unhealthful product choice and persuade him or

her to choose a more healthful option. For example, a regular 20-ounce bottle of soda contains ~250 calories. Including an image of a person running, along with a statement saying that it takes the average person running for 50 minutes to burn 250 calories, will improve its salience and help the consumer internalize the information presented on the FOP label (Ratneswaran et al., 2014; Thrasher, Hammond, Fong, & Arillo-Santillán, 2007; Cummings, 2006; and Bleich, Barry, Gary-Webb, & Herring, 2014).

4. *Novelty:* Changing labels periodically will help to address and prevent label wear-out. Label wear-out occurs when a consumer no longer notices the information presented and the FOP label loses its effectiveness (Ratneswaran et al., 2014)

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Policy Recommendations

The Grocery Manufacturers Association's Facts-Up-Front FOP label is a response from pressure on the food and beverage industry from the Food and Drug Administration. There is no federal or state mandate requiring FOP labels on pre-packaged foods and sugar-sweetened beverages at this time, and neither is there a federal mandate which sets design standards. Given that the current industry standard Facts-Up-Front label design is ineffective at informing low-nutritional knowledge consumers of product nutrition and that there is market pressure against reforming this standard, it may be prudent for government to step in and mandate a more effective label design. ("Food Marketing and Labeling: Background Reading," 2016).

Recent studies provide some insight on how to accomplish this. A paper out of the University of Surrey adds to the body of evidence showing that a design similar to the Multiple Traffic Light system in the European market may be more effective than the current industry standard (Hodgkins et al., 2015). In another example, this time in the form of policy guidance from a committee commissioned by the National Academy of Sciences, the authors suggest using a set of icons on FOP labels to assist customers in their decision making processes (Wartella, Wartella, Lichtenstein, Yaktine, & Nathan, 2012).

While there is broad popular support for improving labeling on sugar-sweetened beverages in such a manner, it is not without opposition ("Statewide Field Poll Shows Growing Support for Warning Labels on Sugary Drinkgs," 2016). A recent attempt by California Senator Bill Monning to mandate a warning label similar to those found on tobacco products failed to pass due to complaints from other legislators, such as Assemblywoman Lorena Gonzalez, that the bill unfairly targeted sugar-sweetened beverages (SSBs) and that the warning label did not effectively educate consumers about healthful dietary choices (Zuraw, 2014). Issues of fairness aside, my regression analysis and review of the available literature show that people with low educational attainment vis a vis nutritional knowledge consume higher amounts of SSBs than their peers and that informational labeling should be effective at lowering consumption in this group. Given these findings, targeting SSBs via legislation may be prudent.

I believe that any future attempt by California legislators to implement any form of FOP labeling on SSBs will meet the same opposition and will be difficult to put into

action. This is why I am proposing two separate policy recommendations, one for federal government and two specifically for California policymakers. Unlike prior recommendations regarding FOP label designs, my thesis has the benefit of more recent cutting edge research regarding contextual relevance enhancements being made available (Bleich, Barry, Gary-Webb, & Herring, 2014).

1. *The FDA Should Mandate a New Graphically Enhanced Standard for FOP Labeling at Federal Level*

   I recommend that the Food and Drug Administration should mandate a new FOP label for use on sugar-sweetened beverages that follows guidelines set in the "*Four Factors of Effective Label Designs."* The Food and Drug Administration is the federal agency that currently mandates the format guidelines for the back-of-package nutrition panel, and is the body that successfully pressured the food and beverage industry and the Grocery Manufacturers Association to create FOP labels to inform low-nutritional knowledge consumers.

2. *California Should Mandate a New Graphically Enhanced Standard for FOP Labeling*

   Given the current political make-up of congress, it may be easier for this type of policy change to be done at the state level. California is in the best position out of all the other states to forge ahead with the creation of an FOP mandate because it is the most populous state in the nation and currently the 8th largest economy in

the world. The political climate of California is much friendlier to the idea of an FOP label mandate. Given California's unique political power position, I suggest that the state should mandate a new FOP label for use of sugar-sweetened beverages that follows guidelines set in the *Four Factors of Effective Label Designs."*

3. *California Should Implement a Pilot Project Employing Signage to Educate Consumers*

I started this thesis with the question of how to improve front-of-package nutrition labels to better inform consumers of their dietary choices and promote a reduction in consumption of SSBs. Through my research, I found a surprising yet effective alternative to FOP labeling that may prove easier to implement. Rather than apply the *Four Factors of Effective Label Design* to future FOP labels, it can be a guideline for the creation of nutritionally informative signage to be strategically placed around locations with populations that consume high levels of SSBs, such as urban and suburban locations with large minority and low education populations which are in line with my thesis regression findings. In Bleich, Barry, Gary-Webb, & Herring's 2014 study, the authors used in-store signage to test their contextually salient nutrition information in an effort to persuade consumers to purchase more healthful beverage options. They found that not only was a significant reduction in the purchase of SSBs realized, but that there was also an increase in purchases of more healthful options (eg. diet cola, water) and

that the change in purchase patterns continued after the removal of the signage. This suggests that this type of store signage is not only effective at persuading consumers to choose more healthful options, but consumers also improve their own nutritional knowledge and using it to adjust their future purchasing decisions.

Limitations of my Research

Education Attainment as an Indicator of Nutritional Knowledge

The California Health Interview Survey (CHIS) dataset does not contain a variable indicating a respondent's level of nutritional knowledge. To overcome this, I used a dummy variable for educational attainment in its place. While there is some research regarding the correlation between the two, it is difficult to claim a causal relationship. There may be other reasons why people with an education beyond a high school degree consume fewer sugar-sweetened beverages than their lower educated peers.

Sugar-Sweetened Beverages other than Sodas not Included

Another limitation of the CHIS dataset is that the survey does not include questions regarding the consumption of SSBs other than soda. Current literature shows that there is a variation in SSB consumption patterns among racial and ethnic groups. Some groups consume more fruit juice and sports drinks than others. This is not reflected in my data and it may impact the accuracy of my results.

Final Thoughts and Suggestions for Future Research

Graphically enhanced FOP nutrition labels and innovative in-store signage are not the panacea for obesity and all of its comorbidities. On the contrary, it is a part of a comprehensive campaign to reduce obesity. It is not a perfect tool, and there is plenty of room for improvement. I believe that future research should include an investigation of the relationship between nutritional knowledge and SSB consumption patterns. To achieve this, a dataset such as the CHIS should include specific measures to cover a respondent's level of nutritional knowledge and include a full spectrum of SSBs, not just regular soda. In addition, it will also be helpful to step "outside the store" and look for other efficient avenues to educate consumers about healthier consumption choices. The fight to mitigate the obesity epidemic will require policymakers to look at the issue holistically and not rely on one single policy to solve the problem.

Appendix A: Research Matrix

Authors and Publication Date	Title	Sample Size & Data Source	Dependent Variable	Independent Variable	Findings
Babey, Hastert, Wolstein, & Diamant (2010)	Income Disparities in Obesity Trends Among California Adolescents	Adolescents [12-19 yo.] (n=17535) California Health Interview Survey, 2001-2007	Obesity (BMI >30)	Age, Gender, Race/Ethnicity, Survey Year Federal Poverty Level	When focusing on each individual survey year, there is no significant difference in obesity trends between 2001 to 2007. When focusing on each individual survey year though, there is a significant difference.
Black & Macinko (2010)	The Changing Distribution and Determinants of Obesity in the Neighborhoods of New York City, 2003-2007	New York Adults [18+] (n=48,506) Community Health Survey, a stratified random sample of adults in 34 neighborhoods within New York City.	Obesity (BMI >30)	Age, Gender, Race/Ethnicity, Marital Status, US Nativity, Education, Employment Status	The study finds that women are more likely than men to be obese, and the disparity between the genders is growing. For each year in the study, there is a statistically significant increase in obesity for women of 3.4%, while there is no statistically significant increase for men. In addition, African Americans are 10% more likely than whites to be obese, but when examining only the African American population, black females have a 67% greater chance of being obese than their male counterparts.
Gase, Robles, Barragan, & Kuo, 2014	Relationship Between Nutritional Knowledge and the Amount of Sugar-Sweetened Beverages Consumed in Los Angeles County	English or Spanish Speaking Adults (n=1,041) Street interview survey of 1,041 individuals in the City of Los Angeles	Consumption of SSBs	Knowledge of Daily Calorie Recommendations, Age, Women, Underweight/Normal Weight, Race/Ethnicity, Education	Knowledge of daily calorie recommendations was a negative indicator of SSB consumption (Est. -0.424) as well as education level (High School Degree Est. 0.0989 and Some College Est. 0.329 in relation to College Graduate/Professional Degree holder). Study suggests that nutritional knowledge is tied to education level and understanding of daily calorie requirements but is weakened due to survey strategy.
Han & Powell, 2013	Consumption Patterns of Sugar-Sweetened Beverages in the United States	Children [2-11] (n=8,627) Adolescents [12-19] (n=8,922) Young Adult [20-34] (n=5,933) Middle-aged to Elder Adults [35+] (n=16,456) 1999 to 2008 National Health and Nutrition Examination Survey (NHANES) (Nationwide Longitudinal Study)	Heavy Sugar Sweetened Beverage Consumption (SSB) Consumption of Non-diet soda, non-diet energy drinks, non-diet fruit drinks, non-diet sport drinks (eg. Gatorade) greater than 500 Kcal/24hr period	Demographic (age, sex, race/ethnicity) SES (education level, per capita household income as % of federal poverty level)	Heavy consumption of total SSB (>500kcal/day)was high for adolescents, young adults, and children (16%, 20%, and 5%, respectively). Variation between type of SSB was noted for age group, race, and ethnicity. Black children were more likely than whites to consume fruit juice (OR 2.31) but not soda (OR .51), Low vs. high education level of parents for young adults (OR 1.68). Low income all races/ethnicities (OR 1.03 to 1.93 dependent on race/ethnicity/age group.)

Authors and Publication Date	Title	Sample Size & Data Source	Dependent Variable	Independent Variable	Findings
Kristal, Blank, Wylie-Rosett, & Selwyn, 2014	Factors Associated with Daily Consumption of Sugar-Sweetened Beverages Among Adult Patients at Four Federally Qualified Health Center, Bronx, New York, 2013	Adults [18+] (n=12,214) who fit four categories. Cat 1 - Received Care from 1 of 4 FHQC's, Cat 2- Answered Survey Questions, Cat 3- Age 18+, Cat 4 - Information regarding existance or non-existance of Type 2 diabetes. Cross sectional analysis of self-reported survey answers held in Electronic Health Record data from four federally qualified health centers in Bronx, New York, in 2013.	Consumption of 1 or more SSBs daily	Age, Sex, Race/Ethnicity, Language, Smoking Status	Age was negatively correlated to SSB consumption with age 18-29 (OR 2.93), 30-49 (OR 1.99), 40-49 (OR 1.65), 50-59 (OR 1.24), 60-69 (OR 1.02) relative to a base of 70+. Females are less likely to consume SSBs (OR .82). Whites consume the most SSBs (Black OR .77, Hispanic OR .78, Asian OR .46. English speakers also consume the most SSBs (Spanish OR .71, Vietnamese OR .43, Cambodian OR .36) Smoking did not have a significant effect. All respondents are low income and education level was not included. An interesting finding was that diabetics and the obese consume fewer SSBs that their healthier counterparts. This could be due to medical advice or other causes to change behavior patterns. In addition, the metric used for physical exercise was not significant.
Lesser, Zimmerman, & Cohen, 2013	Outdoor Advertising, Obesity, and Soda Consumption: a Cross-Sectional Study	Individual Respondents (n=2881), Los Angeles County Cenesus Tracts (n=114), South Louisiana Census Tracts (n=106) Census tract data was from a previous study (Alcohol Outlet Density and alcohol Consuption in los Angeles County and Southern Louisiana), Randomized telephone interviews with respondents in previously mentioned census tracts.	Three studies - Number of food advertisements, obesity rate, and rate of soda consumption.	Food advertisement percentage, total number of ads, gender, education, ethnicity (hispanic), race (white, black, asian, other),	Compared to high income white census tracts, all other census tracts except for high income latino (OR .93) had a higher density of food advertising. The highest being high and low income black (OR 2.94, 2.59 respectively), low income latino (OR 3.10), high and low income asian (OR 6.34, OR 2.15 respectively). Rates of obesity were higher in census tracts with higher rates of advertising on average (OR 1.05 for every 10% increase in advertising density). Obesity rate to advertising density was uneven when controlling for race/ethnicity/education. (Black/OR 2.22)(Hispanic/OR 1.38) (High school/OR 1.54). The logisitic regression for rate of soda consumption in relation to food advertisements closely paralelled the rate of obesity in relation to the same. The exception being hispanic were less likely to consume soda (OR .71) and blacks (OR .97).
Mcgeary, 2013	The Impact of State-level Nutrition-Education program funding on BMI: Evidecne from the Behavioral Risk Factor Surveillance System	Individual Observations (n=2,249,714) over 15 year period Behavioral Risk Factor Surveillance System, American Chamber of Commerce Research Association Cost of Living Index	Body Mass Index, Weight classification (Overweight, Obese)	Nutrition education funding, number of land grant universities, unemployment rate, region (west, midwest, south), population, number of land grant PhD graduates, Average BMI, Prevelance of obesity, prevelance of overweight, food price	For every $1 million spent in nutrition education over a 15 year period, there is a corresponding decrease in BMI of .003 points. Nutrition education may have differential effects across populations (income and education level). Low income and less educated people are less likely to benefit from nutritional education.

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Mcgeary, 2013	The Impact of State-level Nutrition-Education program funding on BMI: Evidecne from the Behavioral Risk Factor Surveillance System	Individual Observations (n=2,249,714) over 15 year period Behavioral Risk Factor Surveillance System, American Chamber of Commerce Research Association Cost of Living Index	Body Mass Index, Weight classification (Overweight, Obese)	Nutrition education funding, number of land grant universities, unemployment rate, region (west, midwest, south), population, number of land grant PhD graduates, Average BMI, Prevelance of obesity, prevelance of overweight, food price	For every $1 million spent in nutrition education over a 15 year period, there is a corresponding decrease in BMI of .003 points. Nutrition education may have differential effects across populations (income and education level). Low income and less educated people are less likely to benefit from nutritional education.
Miljkovic & Nganje, 2008	Regional obesity determinants in the United States: a model of myopic addictive behavior in food consumption	Regional observations of adults from Minnesota (n=12,690), Michigan (n=9,011), Idaho (n=11,699), and California (n=12,040) from BRFSS data including years 1991 (n=10,587), 1997 (n=16,372), and 2002 (n=18,481). Longitudinal study of BRFSS data including 1991, 1997, and 2002. Study focused on three separate demographic regions (Midwest, Rocky Mountains, and California) in terms of lifestyle with an emphasis on obese individuals.	Body Mass Index	Current and Historical prices of sugar, potatoes, and milk. Age, Income, Sex, Education, California, Idaho, Minnesota & Michigan, Black, Asian, American Native, Other, Hispanic Origin, and Employment.	Age (Coef. 0.0139), Black (Coef. 0.5088), American Indian (Coef. 0.3896), Hispanic Origin (Coef. 0.1087) were all significant and positively correlated to Obesity. Income (Coef. -0.0041), Sex - Female (Coef. -0.5261), Employment (Coef. -.0453), Education Level (Coef. -0.1110), and Asian (Coef. -0.7671) were all significant and negatively correlated to Obesity. Inclusion of dummies for regions could pose an endogeneity problem.

Authors and Publication Date	Title	Sample Size & Data Source	Dependent Variable	Independent Variable	Findings
Mullie, Aerenhouts, & Clarys, 2011	Demographic, socioeconomic and nutritional determinants of daily versus non-daily sugar-sweetened and artificially sweetened beverage consumption Demographic, socioeconomic and nutritional determinants of daily versus non-daily sugar-sweetened and artificially sweetened beverage consumption	Belgian Military Men (n=1,852) Two stage semi-quantitative proprietary survey instrument given to 1,852 men in the Belgian military between the ages of 20 to 59.	Sugar Sweetened Beverage Consumption, Artificially Sweetened Beverage Consumption	Age, Body Mass Index, Physical Activity, Use of Vitamin Supplementation, Smoking, Marital Status, Demographic Background (French vs. Flemish), Educational Level, Income, Weight-Loss Intention, Meals in Military Facility	Out of all respondents, 36.3% consumed SSBs on a daily basis and 33.2% consumed artificially sweetened. Only a few variables were found to be significant. Age and BMI were negatively correlated (OR .97 and OR .93 respectively) while Education, Marital Status, Intention to Lose Weight, and Physical Acitivity were not significant either way. Smoking (OR 1.58) and Demographic (OR 1.23) were significant positive indicators of SSB consumption.
Park, Blanck, Sherry, Brener, & O'toole, 2012	Factors Associated with Sugar-Sweetened Beverage Intake amond United States High School Students	Adolescents [9th to 12th grade] (n=11,209) 2010 National Youth Physical Activity and Nutrition Study (NYPANS) (Nationwide cross-sectional study)	High sugar sweetened beverage consumer (>3 12oz cans/day)	Demographic (age, sex, race/ethnicity), Weight status (underweight, overweight, obese as per body mass index scale), presence of SSB vending machines on campus, days fast food consumed/week, days physically active >60 min/week, television watching hours/day	Probability of SSB consumption peaked at 16 years of age (OR 1.05) and declined at 17 and above (OR .95). Males are also more likely (OR 1.66) while consumption is highest with black non-hispanic (OR 1.87) with hispanic at (OR 1.03) in relation to their white peers. There was not much of a difference between weight statuses with overweight (1.04) and Obese (1.04) in relatino to underweight. A lifestyle which includes frequent consumption of calorie dense fast food and >2 hours/day television watching also increases likelihood of SSB consumption (OR 2.94, OR 1.7 respectively). Phsyical activity was negatively correlated with SSB consumption though. (OR .85 for <5 days/week physically active >60minutes)
Rehm, Matte, Wye, Young, & Frieden, 2008	Demographic and Behavioral Factors Associated with Daily Sugar-sweetened Soda Consumption in New York City Adults	Adults [18+] (n=9,865) 2005 New York City Community Health Survey (NYCCHS) (New York City based cross-sectional study)	Regular sugar sweetened soda consumption (> 12 ounce serving/day), Body Mass Index (used in 2nd regression as dep. variable)	Demographic (Age, gender/sex, race/ethnicity), SES (education level, per capita household income as % of Federal Poverty Level guidelines), television watching hours/day, level of physically strenuous activity or exercise in relation to the Healthy People 2010 PA recommendations.	27.5% of New York City's population regularly consumes soda (>=12ozs sugar sweetened soda/day). Older people are less likely to drink soda than 25-44 year olds (45-65 OR .6) while the 18-24 group drinks more (OR 1.4). Minority populations black and Mexican-American are more likely to regularly consume soda (OR 3.1, OR 2.9) than their white counterparts. SES also shows that people below 200% of the FPL are 1.7 times more likely to consume soda than >600% FPL. In addition, the higher the education level of the respondent, the less likely they were to consume. (OR 3.6 to 1.7)
Wang & Beydoun, 2007	The Obesity Epidemic in the United States - Gender, Age, Socioeconomic, Racial/Ethnic, and Geographic Characteristics: A Systematic Review and Meta-Regression Analysis	Varying (NHANES data from 20 surveys) (1960-2002) Meta-analysis of 20 different surveys relying on NHANES I and NHANES II datasets. A standardized set of data was extracted including measures for obesity and overweight, sociodemographic variables, and quantitative findings	Overweight, Obese	Gender, age, ethnicity (non-white/black hispanic), adolescent male/female, Native American, Black, White, Asian, Pacific Islander, Socioecononomic status	In 2003-2004, two thirds of men and women over 20 years of age are overweight or obese. Greater than 60 years of age, +70% were overweight or obese. Annualy, the rate of increase in obesity for all people over 20 years of age is .682% annually while the rate for overweight is .772%.

Appendix B: Pairwise Correlation Table

	SSB Consumption	Male	African American	Native American	Asian	Pacific Islander
SSB Consumption	1.0000					
Male	0.1086*	1.0000				
African American	0.0297*	-0.0115*	1.0000			
Native American	0.0404*	-0.0111*	-0.0231*	1.0000		
Asian	0.0545*	0.0150*	-0.0730*	-0.0346*	1.0000	
Pacific Islander	0.0026	0.0010	-0.0085*	-0.0040	-0.0127*	1.0000
US Born Latino	0.0733*	0.0168*	-0.0716*	-0.0339*	-0.1071*	-0.0124*
Non-US Born Latino	0.0833*	-0.0115*	-0.0840*	-0.0398*	-0.1257*	-0.0146*
Age 25 to 34	0.0916*	0.0133*	-0.0083*	-0.0055	0.0118*	0.0144*
Age 35 to 44	0.0555*	-0.0089*	-0.0012	-0.0057	0.0281*	0.0051
Age 45 to 54	0.0098*	0.0039	0.0160*	0.0061	0.0060	0.0029
Age 55 to 64	-0.0461*	0.0093*	0.0051	0.0052	-0.0152*	-0.0066
Age 65 and Up	-0.1199*	-0.0408*	-0.0150*	-0.0004	-0.0322*	-0.0087*
Low Income	0.1154*	-0.0789*	0.0350*	0.0343*	0.0352*	0.0027
Urban	0.0043	0.0094*	0.1164*	-0.0378*	0.1840*	0.0078
Small City	0.0240*	-0.0145*	-0.0240*	-0.0072	-0.0847*	0.0000
Suburban	-0.0414*	0.0000	-0.0238*	-0.0256*	0.0051	-0.0015
Employed Full-Time	0.0346*	0.1496*	-0.0099*	-0.0194*	0.0056	-0.0029
Employed Part-Time	-0.0109*	-0.0485*	-0.0103*	0.0010	0.0044	-0.0022
Married	-0.0635*	0.0955*	-0.0948*	-0.0173*	0.0751*	-0.0004
Post-Marriage	-0.0409*	-0.1846*	0.0510*	0.0185*	-0.0681*	-0.0101*
Living with Partner	0.0572*	0.0134*	-0.0085*	0.0096*	-0.0527*	0.0100*
Living with Chidren	0.0657*	-0.0337*	-0.0119*	-0.0033	0.0265*	0.0013
Higher Education	-0.1306*	0.0231*	0.0138*	-0.0337*	0.0225*	-0.0103*
Non-Citizen	0.0704	0.0022	-0.0574*	-0.0353*	0.0809*	-0.0069
Naturalized Citizen	-0.0486	-0.0102*	-0.0616*	-0.0427*	0.4179*	-0.0065

US Born Latino	Non-US Born Latino	Age 25 to 34	Age 35 to 44	Age 45 to 54	Age 55 to 64	Age 65 and Up	Low Income	Urban
1.0000								
-0.1233*	1.0000							
0.0878*	0.0878*	1.0000						
0.0030	0.1571*	-0.1148*	1.0000					
-0.0222*	0.0470*	-0.1422*	-0.1744*	1.0000				
-0.0565*	-0.0385*	-0.1596*	-0.1957*	-0.2424*	1.0000			
-0.1157*	-0.1518*	-0.2142*	-0.2626*	-0.3253*	-0.3650*	1.0000		
0.0848*	0.2909*	0.0679*	0.0150*	-0.0457*	-0.0790*	-0.0038	1.0000	
0.0481*	0.1081*	0.0374*	0.0371*	0.0023	-0.0274*	-0.0446*	0.0844*	1.0000
0.0229*	0.0374*	0.0155*	0.0060	0.0042	-0.0036	-0.0217*	0.0426*	-0.3661*
-0.0278*	-0.0951*	-0.0290*	-0.0069	-0.0008	-0.0048	0.0353*	-0.1487*	-0.4035*
0.0285*	0.0539*	0.1333*	0.1813*	0.2217*	0.0773*	-0.4443*	-0.2099*	0.0226*
0.0155*	-0.0118*	-0.0019	-0.0031	-0.0068	0.0023	-0.0543*	0.0281*	-0.0031
-0.0774*	0.0555*	-0.0247*	0.1099*	0.0986*	0.0718*	-0.0727*	-0.2202*	-0.0890*
-0.0579*	-0.0706*	-0.1409*	-0.1254*	-0.0783*	0.0053	0.3197*	0.1367*	-0.0016
0.0257*	0.0717*	0.1075*	0.0466*	0.0083*	-0.0192*	-0.0946*	0.0415*	0.0088*
0.0362*	0.2319*	0.2038*	0.4208*	0.1907*	-0.1781*	-0.3713*	0.0734*	0.0107*
-0.0861*	-0.3156*	-0.0207*	-0.0053	0.0205*	0.0663*	0.0093*	-0.3853*	-0.0471*
-0.1094*	0.5868*	0.1265*	0.1854*	0.0315*	-0.0689*	-0.1684*	0.2202*	0.1090*
-0.1399*	0.2854*	-0.0445*	0.0204*	0.0359*	0.0097*	0.0090*	0.0904*	0.1488*

Small City	Suburban	Employed Full-Time	Employed Part-Time	Married	Post-Marriage	Living with Partner	Living with Children
1.0000							
-0.2591*	1.0000						
0.0022	0.0064	1.0000					
-0.0066	0.0008	-0.2487*	1.0000				
-0.0190*	0.0701*	0.1075*	-0.0141*	1.0000			
0.0216*	-0.0238*	-0.1865*	-0.0435*	-0.6143*	1.0000		
0.0108*	-0.0296*	0.0611*	-0.0116*	-0.2346*	-0.1455*	1.0000	
0.0110*	0.0040	0.2319*	0.0003	0.2566*	-0.1831*	0.0536*	1.0000
-0.0374*	0.1080*	0.1270*	0.0167*	0.0927*	-0.0482*	-0.0392*	-0.0341*
0.0187*	-0.0749*	0.0549*	-0.0003	0.0511*	-0.0826*	0.0760*	0.2362*
-0.0522*	-0.0018	0.0053	-0.0147*	0.0925*	-0.0237*	-0.0490*	0.0448*

Higher Edcucation	Non-Citizen	Naturalized Citizen
1.0000		
-0.2230*	1.0000	
-0.0595*	-0.1457*	1.0000

Appendix C: Store Signage Used in Study by Bleich et al. (2014)

Did you know that a bottle of soda or fruit juice has about

250 calories

Did you know that working off a bottle of soda or fruit juice takes about

50 minutes of running

Did you know that working off a bottle of soda or fruit juice takes about

5 miles of walking

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