

An Evaluation of the Snack Tax on the Obesity Rate of Maine

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ABSTRACT

Obesity has reached epidemic proportions in the United States and is becoming one of our nation's most discussed public health concerns. Americans are bombarded with advertisements for quick weight loss medications, diet plans, and novelty fitness equipment, all of which guarantee results overnight. But what impact has this had on the weight of Americans?

Traditionally viewed as an individual's disease, research now indicates that the environment is a main causative agent of overweight/obesity. Manipulation of food pricing to encourage consumers to make healthy purchases is a new area of public policy that can help address this epidemic, and has received reasonable academic interest.

As a pricing strategy, healthy foods can be subsidized to increase consumption, or unhealthy foods can be taxed to increase prices in order to discourage consumption. The state of Maine had a snack tax from 1991 to 2001 and provides a setting to evaluate the impact of taxing snacks, pastries, and soft drinks on a state's obesity rate.

According to the "law of demand", individuals will reduce their consumption of an item if its price rises. A snack tax increases the price of snack foods and soft drinks. Because consumption of these foods is associated with increased weight gain, it is hypothesized that a statewide tax on snacks and soft drinks in Maine would have a negative impact on the state's obesity rate.

This study utilizes an interrupted time series comparison group design to conduct a regression analysis with obesity data obtained from the Behavioral Risk Factor Surveillance Survey. This study seeks to examine the relationship between a snack tax and obesity rates. Although the regression model for the interrupted time series design was significant, the findings did not provide any significant results for independent variables that could help identify and interpret a relationship between the snack tax and obesity rates for Maine.

CHAPTER ONE – INTRODUCTION

Obesity has reached epidemic proportions in the United States and is becoming one of our nation's most discussed public health concerns. Americans are bombarded with advertisements for quick weight loss medications, diet plans, and novelty fitness equipment, all of which guarantee results overnight. But what impact has this had on the weight of Americans? In 2001, the Surgeon General initiated a *Call to Action* to highlight the growing prevalence of overweight and obesity, and more importantly, to engage the community about the urgent need to develop and implement strategies to prevent and reduce the incidence of this disease (U.S. Department of Health and Human Services 2001, 27). An estimated 64.5% of Americans are overweight and data indicate that the prevalence of obesity has grown (Flegal et al, 2002, 1723). Americans are increasingly becoming overweight and obese and the health risks associated with being overweight continue to rise as well.

Traditionally viewed as an individual's disease, research now indicates that the environment is a main causative agent of overweight/obesity. In an effort to curb obesity, some researchers have proposed the manipulation of food prices.

Food price manipulation to encourage consumers to make healthy purchases is a new area of public policy that may help address this epidemic. As a pricing strategy, healthy foods can be subsidized to increase consumption or unhealthy foods can be taxed to increase prices in order to discourage consumption.

Research Purpose

The purpose of this research is to evaluate the impact of the taxation of unhealthy foods, such as snacks and soft drinks, on obesity rates. This study seeks to assess the impact of these "snack taxes" on obesity rates for the state of Maine. Findings should assist state health departments and policymakers in developing and implementing policies that utilize food price manipulation to curb obesity.

This research is compelling for two reasons. First, a number of states have levied taxes on junk food and soft drinks, but no analysis of their impact on states' obesity rates were found in the literature. This study seeks to analyze the impact by identifying a relationship between snack taxes and overweight/obesity rates.

Second, the literature suggests that environmental factors are major contributors to overweight and obesity, and that they provide the greatest opportunity for actions and interventions designed for prevention and treatment (U.S. Health and Human Services 2001, 1 and Jacob and Brownwell 1996, 792). Public policy represents the new frontier for addressing the obesity epidemic because government's influence and authority can be utilized to significantly impact the environment. Snack taxes are one tool that government entities will have at their disposal to address this issue and there is a need for research to evaluate impact and effectiveness.

Chapter Summaries

Chapter Two presents a review of the literature. This chapter outlines the obesity epidemic in America and discusses the utilization of pricing as a public policy tool to influence food consumption in an effort to reduce the burden of overweight and obesity. This chapter also explores the obesity epidemic to highlight the extent and seriousness of the issue, and provides an understanding of the environmental influences of overweight and obesity that have guided public policy to influence food choices. The conceptual framework, or research hypothesis, is located within this chapter as well.

Chapter Three focuses on the setting for this research project, the state of Maine. It reviews the Maine Snack Tax that was enacted in 1991 by discussing the political climate and details of the tax. This chapter also provides information on obesity and overweight trends for the state, as well as general demographics.

Chapter Four operationalizes the hypothesis and describes the methodology developed to address the research question. The research method selected is an interrupted time series comparison group analysis. The existing data used to evaluate overweight and obesity rates are reviewed therein. Statistical analysis is possible because the existing data are entirely quantitative in nature. The test being used to measure the impact of the policy is also described in this chapter.

Chapter Five covers the results of the research. The results of the statistical procedures used will be explained in this chapter as well. Results are summarized in tabular form and then interpreted in the text.

Chapter Six summarizes the conclusions drawn from the results in Chapter Five. This final chapter includes suggestions for future research and conclusions. This chapter communicates how this study provides an opportunity to fill gaps in the existing body of research, as there have been few opportunities to evaluate the long-term impact of a snack tax.

CHAPTER TWO - LITERATURE REVIEW

PURPOSE

The purpose of this chapter is to provide a literature review of the obesity epidemic in America, and to discuss the utilization of pricing as a public policy tool to influence food consumption behavior that reduces the burden of overweight and obesity. This chapter discusses the obesity epidemic to highlight the extent and seriousness of this issue, and also provides an understanding of the environmental influences of overweight and obesity that, in turn, have guided public policy to influence food choices. The chapter concludes with a hypothesis that links obesity rates to a policy strategy designed to reduce obesity through taxation of snack foods.

Obesity Epidemic

Obesity has reached epidemic status in the United States; it is not a trivial issue. Obesity manifests itself in premature deaths, disability, increased health care costs, lost productivity, and social stigmatization (U.S. Department of Health and Human Services 2001, 1). The following section is a review of obesity in America highlighting measurement, prevalence, mortality, health risk, and disease burden.

Measuring Overweight and Obesity

Before discussing the impact that obesity has on the nation, it is important to review how obesity and overweight are measured in various studies. Body mass index (BMI) is the standard method for measurement in most studies (U.S. Department of Health and Human Services 2001, 4). BMI is a practical measurement for obesity that requires only two things: accurate measures of an individual's height and weight. BMI is a measure of weight in the relation to height. BMI is calculated as weight in pounds divided by the square of the height in inches, multiplied by 703.

The Dietary Guidelines for Americans establishes healthy weights and BMI guidelines for the public (U.S Department of Agriculture 2000, 7). A person is said to be obese when his or her BMI is ≥ 30 . Overweight is defined as BMI ≥ 25 and < 30 , and a healthy or normal BMI is ≥ 18.5 and < 25 . In some cases, extreme obesity is measured as a BMI of ≥ 40 .

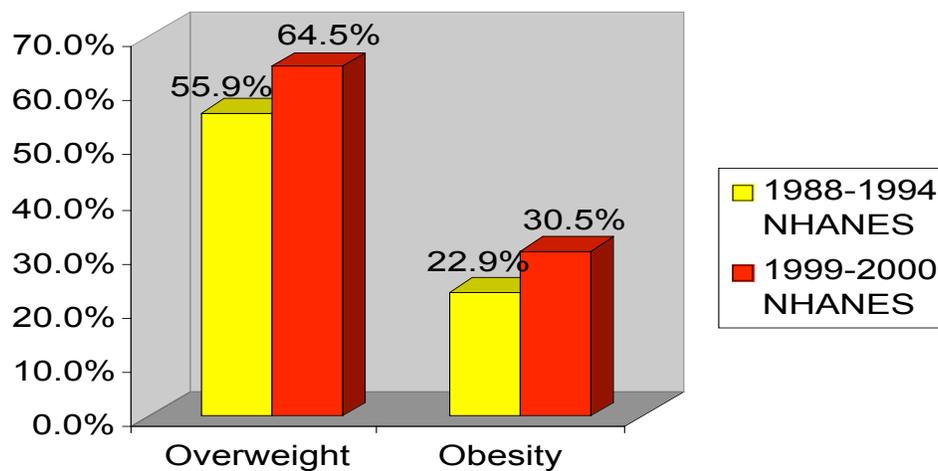
Prevalence of Obesity

Research has indicated that obesity is on the rise in the United States. Flegal et al (2002, 1723) used data from the National Health and Nutrition Examination Survey (NHANES) to

monitor differences in obesity rates from 1999-2000 when compared to 1988-1994, to examine trends and prevalence of overweight. By using BMI to measure overweight and obesity, data were analyzed for 4,115 participants. Results indicated that the age-adjusted prevalence of obesity was 30.5% in 1999-2000 compared with 22.9% in the 1988-1994 NHANES. The prevalence of overweight also increased during this period from 55.9% to 64.5%. Extreme obesity increased significantly as well, going from 2.9% to 4.7%. Table 2.1 illustrates this growing prevalence of overweight and obesity.

Table 2.1

**Adult Overweight and Obesity Rates:
A Comparison of National Health and Nutrition
Examination Surveys**



A most disturbing fact in the prevalence of obesity is that it is not limited to the adult population. Research that analyzes obesity rates among children also demonstrates a growing trend. Ogden et al (2002, 1728) used data from NHANES to evaluate trends in overweight and obesity among children and adolescents in 1999-2000. This data was compared to 1988-1994 NHANES to identify significant differences.

Overweight increased across all age groups. Adolescents 12-19 years old (15.3%) and 6-11 year-olds (15.3%) had the largest increase in BMI. This growing rate of childhood obesity was also significant in minority children. The prevalence of overweight among non-Hispanic black

and Mexican-American adolescents increased more than 10 percentage points between 1988-1994 and 1999-2000.

Mortality Associated with Overweight and Obesity

The growing prevalence of obesity and overweight among Americans is a major concern. Obesity is more than a cosmetic condition. What is most dangerous about obesity are the associated health risks. Overweight and obesity are associated with an increased risk for coronary heart disease; type 2 diabetes; endometrial, colon, postmenopausal breast, and other cancers; and certain musculoskeletal disorders, such as knee osteoarthritis (U.S. Department of Health and Human Services 2001, 9) (see Table 2.2).

Table 2.2 Health Risks Associated with Obesity	
Obesity is Associated with an Increased Risk of:	
• premature death	• high blood cholesterol
• type 2 diabetes	• complications of pregnancy
• heart disease	• menstrual irregularities
• stroke	• hypertension
• hirsutism (presence of excess body and facial hair)	• stress incontinence (urine leakage caused by weak pelvic-floor muscles)
• gallbladder disease	• increased surgical risk
• psychological difficulties due to social stigmatization	• psychological disorders such as depression
• sleep apnea	• breathing problems
• asthma	• osteoarthritis
• cancer (endometrial, colon, kidney, gallbladder, and postmenopausal breast cancer)	•
adapted from www.niddk.nih.gov/health/nutrit/pubs/statobes.htm	

Calle et al (1999, 2) examined the relationship between BMI and the risk of death from cardiovascular disease, cancer, and other chronic diseases. In healthy people who never smoked, high BMI was a significant predictor of death. And high BMI was the most significant predictor of cardiovascular disease. Even moderate weight excess (10 to 20 pounds for a person of average height) increased the risk of death from a chronic disease, particularly among adults aged 30 to 64 years.

In addition to health risks, overweight and obesity carry disease burden as well. Almost 80% of obese adults have diabetes, high blood cholesterol levels, high blood pressure, coronary artery disease, gallbladder disease, or osteoarthritis, and almost 40% have 2 or more of these comorbidities (Koplan and Dietz 1999, 1579).

Must et al (1999, 1523) conducted a study to examine the disease burden associated with overweight and obesity. An analysis of the 1999-2000 NHANES was conducted to examine the relationship between weight status and prevalence of health conditions by severity of overweight and obesity in the US. In regard to burden, high blood pressure was the most common overweight- and obesity-related health condition, and its prevalence showed a strong correlation with the increasing weight category. The prevalence of type 2 diabetes, gallbladder disease, and

osteoarthritis increased sharply among both overweight and obese men and women, corresponding with the increasing weight classes.

There were many substantial health conditions associated with elevated BMI. Those included: high blood pressure, type 2 diabetes, gallbladder disease, and osteoarthritis. The study demonstrated a general pattern of increasing prevalence with increasing severity of overweight and obesity from all of these health conditions.

Morbidity Associated with Overweight and Obesity

Now that mortality, health risk, and burden of overweight and obesity have been reviewed, it is important to discuss their effects on morbidity. Articulating the morbidity of obesity is a difficult task because obesity is highly associated with other chronic diseases. How does one discern if a death was directly attributable to obesity, or to one of its associated health risks? By using relative hazards associated with elevated BMI in 6 studies, the national distribution of adult BMI, and estimates of population size and total deaths from the same era, Allison et al (1999, 1536) estimated annual number of deaths attributable to obesity to be approximately 280,000. The largest proportion of deaths attributable to overweight or obesity (more than 80%) occurred in persons with BMIs of at least 30 kg/m^2 .

In discussing mortality, it is also important to review life expectancy. Peeters et al (2003, 1) provided an estimate of the effect of obesity and overweight in adulthood on life expectancy, taking into account the various possible weight trajectories throughout the life course. This study used a cohort from the Framingham Heart Study to analyze differences in life course for the three BMI classes; normal, overweight, or obese. The primary objective was to analyze the reductions in life expectancy associated with overweight and obesity at 40 years of age. Overweight and obesity in adulthood were linked through the literature to an increased risk for death and disease. Peeters et al view obesity as a potentially preventable cause of premature death because of its increasing prevalence and association with death and disability from other chronic diseases.

Results indicated that large decreases in life expectancy were associated with overweight and obesity. Non-smoking 40-year old men and women who are obese lose 7.1 and 5.8 years of life, respectively, compared to men and women of the same age range who are normal weight non-smokers. Non-smoking 40-year old men and women who are overweight lose 3.3 and 3.1

years of life, respectively, compared to men and women of the same age range who are normal weight non-smokers. Obese women have a 115% increased risk for premature death, and obese men have an 81% increased risk for premature death. Overall, obesity in adulthood is associated with a decrease in life expectancy of about 7 years in both men and women.

Measurement, prevalence, mortality, health risk, and burden have been reviewed. To complete the discussion of the obesity epidemic in America, its economic impact must be reviewed.

Economic Impact

Overweight and obesity and their associated health problems have substantial economic consequences for the U.S. health care system. The nation can no longer afford to ignore obesity as a major medical problem. The direct and indirect costs of obesity in the U.S. make up approximately 10% of the national health care budget (Koplan & Dietz, 1999, p. 1579).

The increasing prevalence of overweight and obesity is associated with both direct and indirect costs. Direct health care costs refer to preventive, diagnostic and treatment services related to overweight and obesity. For example, direct costs include physician visits, and hospital and nursing home care. Indirect costs refer to the value of wages lost by people unable to work because of illness or disability, as well as the value of future earnings lost by premature death.

According to the *Surgeon General's Call to Action*, the total (direct and indirect) costs attributable to obesity amounted to an estimated \$99 billion (2001, 9). In 2000, the total cost of obesity was estimated to be \$117 billion (\$61 billion direct and \$56 billion indirect). Most of the cost associated with obesity is due to type 2 diabetes, coronary heart disease, and hypertension.

In conclusion, reviews of the method of measurement, prevalence, mortality, health risk, burden, and economic impact of obesity have been provided for better understanding of the obesity epidemic and pertinent literature. The next area of discussion examines the causes of this epidemic, and the public policy implications.

ADDRESSING OBESITY

In order to identify how public policy should address obesity, it is essential to understand how weight is gained, lost, and impacted by environment. This section of the literature review examines these key topics and concludes with a discussion on public policy recommendations.

Weight Loss and Gain

The formula for weight loss and weight gain is simple. The human body follows the rules of thermodynamics. If intake of energy from food is greater than the body's energy expenditure, weight is gained (Koplan and Dietz, 1999, 1579). If intake of energy from food is less than the body's energy expenditure, then weight is lost. Given this principle, there are two sides to understanding obesity: 1) intake or consumption of food energy and 2) expenditure of energy increased by physical activity.

In terms of intake, any over-consumption of food can lead to weight gain, but whether those calories are derived from fat, carbohydrates, or proteins makes a difference (Harvard Women 1994, 2). Fat contains 9 calories per gram, while protein and carbohydrates have only 4 calories per gram. It is extremely difficult for the body to convert protein to fat, and carbohydrates can be converted to fat only after $\frac{1}{2}$ of the energy they contain is consumed in the process. Dietary fat has a similar composition to stored fat. It requires the expenditure of little energy and only a slight chemical modification to be stored as fat cells.

Adipose tissue (fat cells) stores energy in the form of fat to meet the body's energy needs when other sources, such as glucose, are unavailable or depleted. The body has an almost limitless capacity to store fat. Not only can each fat cell balloon to more than 10 times its original size, but should the available cells become full, new ones will propagate (Papazian 1991, 2). The body's ability to store fat was an evolutionary advantage that benefited during times of famine and short supply. This evolutionary advantage has become a disadvantage in modern society. In the last two decades, the obesity epidemic has been fueled by an imbalance of energy intake and expenditure (Koplan and Dietz 1999, 1579).

Strategies to treat obesity are linked to the formula for weight loss and weight gain. These strategies increase energy expenditure, decrease intake, or some combination of the two. Battle and Brownell (1996, 762) identified two areas of strategies to treat obesity: 1) behavioral treatment, and 2) pharmacological approaches.

Behavioral treatment emphasizes changes in diet and physical activity. These programs that seek to modify food consumption and exercise patterns have been consistent in yielding

significant weight loss in moderately obese patients¹. Improvements in psychological wellbeing and risk factors such as blood pressure have been documented with these strategies as well (Battle and Brownell 1996, 762).

Pharmacological approaches to the treatment of obesity involve the use of medications that focus on reducing energy intake or increasing energy expenditure, or both. Battle and Brownell cite studies on fenfluramine and phentermine that have shown success (1996, 762). Over the course of three years these drugs have been able to achieve approximately 30 pounds in weight loss. However, the Food and Drug Administration removed these drugs from the market late in 1997 when reports arose of their roles in causing heart valve disease and pulmonary hypertension.

Additional medications to treat obesity cited in the literature work by preventing calories from being absorbed by the intestine, and include various starch blockers and fat blockers. Many of these medications lose appeal because of the side effects that accompany malabsorption.

Amphetamines and their derivatives are also still used, some of which, such as phenylpropanolamine (Dexatrim, Accutrim), are available in over-the-counter versions. These drugs stimulate the central nervous system, suppress appetite and increase metabolic rate. In response, they also increase heart rate and blood pressure, which can be hazardous and cause dependency (Harvard Women Health 1994, 3).

In addition to medication and behavior modification programs, it should be noted that surgery is now an option to treat extremely obese individuals. Gastroplasty entails using sutures or staples to close off the upper third of the stomach, and create a narrow vertical channel to connect it to the small intestine. An older procedure, gastric bypass, involves closing 90% of the stomach and reconnecting the upper 10% to the small intestine. Both procedures delay the time it takes food to travel from the stomach to the small intestine, which makes it impossible to eat a

¹ A good example of a behavioral treatment program is Weight Watchers. I have personally lost 35 pounds over the last three years by joining the program and it espouses that dieting along with emotional, mental, and physical health are all components of long-term weight management. Weight Watchers provides information, knowledge, tools and motivation to help you make healthy decisions about nutrition and exercise. To provide motivation and peer support Weight Watchers organizes group meetings for participants to gain knowledge and share personal success stories with others to promote behavioral change.

large amount of food at any one time. Nausea and vomiting are common side effects of these procedures (Harvard Women's Health 1994, 3).

While there are numerous options for treatment of obesity, the reality is that few are successful in the long run. Researchers concur that obesity is extremely resistant to treatment. For example, behavior modification programs have successful results for up to two years. However, research shows that people regain that weight within five years (Battle and Brownell 1996, 762). Medications show initial improvement as well, but weight is regained when medication is no longer administered. It has been proposed that, due to its resistance, obesity should not be considered an acute ailment to be cured, but rather a chronic condition like diabetes or heart disease, requiring lifelong management. (Harvard Women's Health 1994, 3).

In sum, significant research has been given to the treatment of obesity, but it has proven difficult to address. Given the state of the increasing prevalence of obesity, treatment strategies have not curtailed the obesity problem. Perhaps what makes obesity so difficult to treat is the role that environment plays in this condition.

The Role of the Environment

One of the greatest challenges in addressing obesity in America is overcoming the perception that obesity is a personal issue, determinant solely on individual choice and will. The Surgeon General reported that overweight and obesity are caused by many factors. For each individual, body weight is determined by a combination of genetic, metabolic, behavioral, environmental, cultural, and socioeconomic influences. Behavioral and environmental factors are large contributors to overweight and obesity, and provide the greatest opportunity for actions and interventions designed for prevention and treatment (U.S. Health and Human Services 2001, 1)

Battle and Brownell (1996, 762) argue that environment, more so than physiology and behavior, explains the problems of obesity. This may be evident in obesity data as well. Flegal et al. (2002, 1727) noted that in the increase in obesity rates from 1988-1994 NHANES to 1999-2000 NHANES, the entire distribution of BMI appeared to be affected with a shift toward the right occurring in all age-sex groups. Such a shift indicates a population change.

Battle and Brownell (1996, 762) espouse the idea that environment is the true causative agent of obesity because we live in a weight-toxic environment. "America has a damaging

paradigm when it comes to weight and visual beauty. We place great emphasis on leanness and curvature to represent the ideal body, but our environment provides access to and encourages consumption of a diet that is high in fat, high in calories, great tasting, easily available, and low in cost.”(1996, 761-762).

Kopland and Dietz (1999, 1579) add support to the argument that our weight-toxic environment is to blame for obesity. They identified a host of environmental influences that impact our intake and expenditure of energy. Environmental changes that foster eating more are: excess availability to food, and to foods with higher energy content; the growth of the fast food industry; and an increase in the number of snack foods and their marketing.

Environmental factors have also influenced our energy expenditures. Some factors that diminish our opportunities in daily life to expend energy are: more television watching, less physical activity in schools, lack of sidewalks and safe walking trails, automated workplaces, technological advances in household duties require less labor, and walking or bicycling has been replaced by automobile travel for most trips.

In sum, all of these environmental influences are toxic to our weight as Americans. Public policy represents the new frontier for addressing the obesity epidemic because it is through the public that we have the opportunity to change the environment. Battle and Brownell cite the following recommended policy guidelines to improve the weight-toxic environment:

- A. Healthy foods be subsidized to decrease prices and thus increase per capita consumption
- B. Subsidies be removed or taxes imposed on unhealthy foods to decrease per capita consumption
- C. Food advertising be more regulated to prevent deception and to minimize advertising of snack foods, soft drinks, and sugared cereals aimed at children
- D. Public policy is aggressive in providing opportunities for physical activity in the community, and providing incentives for efforts made by individuals to become more physically fit. (1996, 761)

The second half of this literature review builds on the public policy recommendations of Battle and Brownell. Because the focus of this literature review is on food pricing as a policy strategy to address obesity, the recommendations that will be discussed in depth are A and B.

FOOD PRICING POLICY AS A STRATEGY TO REDUCE OBESITY

Fat and sugar provide dietary energy at very low cost. Food pricing and marketing practices are an essential component of the eating environment (French 2003,1). Public policy that utilizes food price manipulation seeks to encourage consumers to make healthier food decisions. As a pricing strategy, healthy foods can be subsidized in order to decrease prices and increase consumption, or unhealthy foods can be taxed in order to increase prices in an effort to lower consumption. Because a large percentage of food choice decisions are made at the point of purchase (grocery stores, cafeterias, and restaurants), it is proposed that public health interventions aimed at influencing consumption should concentrate on these settings (Jeffrey et al. 1994, 788).

Elasticity of Demand and Snack Foods

Any analysis of consumer response to food price manipulation should begin with an evaluation of elasticity of demand, which helps estimate the impact of prices on the quantity demanded of a good.² Elasticity of demand is a critical component in evaluating the impact of pricing strategies on food consumption and diet because it is elasticity that reveals the extent to which consumers are responsive or unresponsive to a change in price.

In regard to evaluating how consumers respond to changes in price of snack foods, Kuchler et al. (2005, 4) estimated price elasticities of potato chips, all chips, and other salty snacks to examine the extent to which taxes might act as a lever for manipulating dietary choices. On average, potato chips, all chips, and other salty snacks were determined to be inelastic goods. It was calculated that a 20% tax solely on potato chips would reduce purchases by only 5.54 ounces per person per year, or 830 calories per year. Assuming that food would not be substituted, at 3,500 calories per pound of body weight, the reduction would translate into less than a $\frac{1}{4}$ of a pound in a year (Kuchler et al. 2005, 17). Under this model, it would take over four years to see a one pound reduction in weight as a result of consuming fewer potato chips due to taxation.

² Elasticity of demand is a measure of responsiveness. The demand for a good is elastic when a relatively small change or difference in price causes a large change in the quantity demanded. The demand for a good is inelastic when a large change or difference in price has a relatively small impact on the quantity demanded (O'Connor and Faille 2000, 45).

Kuchler et al. (2005, 18) concluded that the price inelasticity of salty snacks forecasts that neither a small or large tax on these goods would have much impact on consumers' dietary choices. However, there were some limitations to their study that must be noted. Kuchler et al only examined one type of snack food. Could a tax levied on the entire range of junk foods, including soft drinks, pastries, candy, and ice cream, have a different outcome in their model and have the potential to affect dietary quality? Nevertheless, elasticity of demand reveals the mechanism at work when attempting to determine if an increase or reduction in price impacts consumer behavior.

Consumer Behavior

In addition to elasticity, there are other factors to review in order to understand the connection between price manipulation and consumer purchase decisions. Research suggests that many consumers are aware of nutritional issues, but choose to ignore them based on costs and benefits. There are three main dimensions related to food choice: taste, perceived value, and perceived nutrition (French 2003, 2). Based upon personal preference, people place different weights on these dimensions to determine their food choices. The strategy for reducing or increasing food price is linked to influencing the dimension of "perceived value". Manipulation of pricing can influence the equation of food choice because it can be lowered to increase perceived value or raised to reduce perceived value. Public policy that addresses this concept in the form of price increases seeks to deter unhealthy food consumption, while utilization of price reductions seeks to encourage healthy food consumption. This is the next topic of discussion.

Price Reductions

As previously mentioned, pricing strategies to alter consumption patterns influence food choice by changing perceived value. Price reductions decrease the price of a product, thereby increasing its perceived value to the customer. Although few public policy studies demonstrate this principle, there has been some field research that examines the impact of price reductions on healthy food choices.

One of the first experiments was an attempt to increase consumption of fruits and salads in a cafeteria setting. This study explored the relationship between fruit and salad consumption and pricing. Jeffery et al. (1994, 789) proposed that a price reduction in fruits and salads would

lead to higher sales of these food items. Food purchases in the cafeteria were observed for three weeks to establish a baseline for sales. Prices on fruits and salads were reduced by 50% for a three-week period. Prices were then returned to their baseline rate and were observed for a three-week period after the intervention. This study demonstrated that increasing food choices and making them more attractive economically had an impact on food choice behavior. After a reduction in price, fruit and salad sales increased three-fold. When the intervention was removed, sales dropped significantly but were still slightly higher than the baseline. This study revealed that price reductions could affect food choices. It supports the argument that interventions that make healthier food choices more economically attractive, or raise “perceived value”, when compared to less healthy food choices are an effective strategy for influencing food choice behavior (Jeffrey et al 1994, 789).

A similar study was conducted in a high school cafeteria to monitor the influence of pricing. This study examined the effects of lowering prices to improve sales of fruits and vegetables in an adolescent population. Fruit, carrot, and salad purchases were monitored in two high school cafeterias for an initial baseline period. Prices on these items were then reduced by 50% and sales were monitored. Prices were returned to baseline and sales were monitored for an additional three weeks. Fruit sales increased fourfold during the 50% price reduction period, from an average of 14.4 to 63.3 total weekly. Carrot sales increased twofold, from an average of 35.6 packets to 77.6 packets total weekly. Results suggest that lower pricing for fruits and vegetables has a positive relationship with sales. (French et al, 1997, 1009).

A criticism of early priority experiments were their applicability to the real world. Reducing prices on a product as much as 50% can reduce overall revenue from sales drastically. Profits represent a major barrier in lowering prices to encourage greater consumption of healthy foods. In a vending snack study, profits per machine per week were \$116 at baseline, and were reduced to \$66 per machine per week when the 50% price reduction of healthy snacks was in place.

French (French et al. 2001b) tested a new strategy by putting smaller price reductions into place to see if patterns of healthy food consumption increased while improving profitability in vending machines. Price reductions of 10%, 25%, and 50% on low-fat snacks were associated

with significant increases in low-fat snack sales: percentages of 9%, 39%, and 93%, respectively. Reducing relative prices on low-fat snacks was effective in improving low-fat snack purchases from vending machines at all discount levels. This study demonstrated that lowering prices was still a very effective method of promoting desired food consumption while improving profitability (French et al. 2001b, 115-116).

In sum, research has documented that in experimental settings, price reductions on healthy food items lead to greater purchase and consumption. But the question remains: how does this translate into public policy? French et al. (2001a) recommend that pricing strategies such as government subsidies be enacted. It is suggested that government subsidies to offer fruits and vegetables “at cost” in high school cafeterias could encourage youth to select a more healthy diet and further progress toward national nutritional health objectives. (2001a, 329 and 1997, 1008). In regard to food assistance programs, would it be possible to develop an incentive system to encourage food stamp recipients to purchase healthier food?

Price Increases

Although field studies on lowering prices to increase consumption are strong, few experiments have been conducted to monitor the effect of price increases designed to lower consumption of unhealthy foods. However, price increases have been implemented into public policy for a number of years. These pricing strategies have been referred to as snack taxes, or fat taxes. In 2000, there were 19 states and cities that levied taxes on soft drinks, candy, chewing gum, and/or snack foods. Taxes can be levied at the wholesale or retail level, and may be levied in terms of a fixed tax per volume of product or as a percentage of sales prices (Jacobson and Brownell 2000, 855).

The rationale for the snack tax is as follows: To compensate for a weight-toxic environment, foods high in calories, fat, or sugar are subjected to special taxes. A tax is needed to increase the price of unhealthy foods in order to reduce consumption of these foods. Given the political nature of taxation, many researchers have debated if current snack taxes actually influence consumption, and at what level does a soft drink or bag of chips need to be taxed to influence “perceived value”. At the center of the argument is elasticity of demand. How

responsive are Americans to changes in prices of soft drinks and snack foods and at what tax rate will Americans make fewer purchases of these unhealthy foods to curb obesity?

Jacobson and Brownell (2000, 6) proposed a national tax of 1 cent per 12.oz soft drink that would generate \$1.5 billion annually. They also proposed a 1-cent per pound tax on candy, chips, and other snack foods or fats and oils. This was projected to raise \$70 million, \$54 million, and \$190 million, respectively. They set the bar low for taxation because they felt the political climate would not support a steep tax. Numerous states have repealed snack taxes due to pressure from the soft drink and snack industry. A more feasible option would be to establish a low tax that is agreeable but still generates revenue. This revenue could be used to fund public education campaigns and other programs that alter the weight-toxic environment.

Another economic model provides a more in-depth analysis of snack tax projections. Kuchler et al (2004, 10) identify that expenditures on snack food represent a small portion of the annual budget of American households. The average household spends \$76.39 a year on salty snacks. It is argued that snack food demands would not respond very much to tax-induced price changes. They propose that snack foods are inelastic, suggesting that taxes on the order of 1 cent per pound as suggested by Jacobson and Brownell would not have much influence on quality of consumer diet or health (Kuchler et al. 2004, 10).

While Jacobson and Brownell (2000) and Kuchler et al (2004) espouse the idea that a snack tax would not be influential in changing consumption patterns, Marshall (2000, 301) offers a significantly different approach for taxation. He proposes an economic method of lowering the rate of heart disease by taxing products heavy with saturated fats, the primary contributor to high cholesterol levels, which in turn is a primary cause of ischaemic heart disease. Based upon identifying the primary food sources of fat in the diet, Marshall proposed that the following foods be targeted for taxation: milk, butter, and cheese, along with pastries, puddings, and ice cream.

Unlike, Jacobson and Brownell (2000) and Kuchler et al (2004), Marshall assumes that the products selected for taxation are elastic because they are easily substituted. For example, under Marshall's taxation strategy whole milk would be taxed, but skim milk (because of its lower saturated fat content) would not. Consumers would be very responsive to a price increase in whole milk because a substitutable good, skim milk would be readily available at a lower price.

Under the Marshall taxing structure, food choices are elastic and therefore consumers are responsive to a tax on certain foods.

In sum, snack taxes exist in some states and localities, but the effects of these taxes on the consumer consumption pattern is unknown. There is a need for research to evaluate the impact that these taxes have on consumer behavior. Perhaps an industry that can help shed light on whether a snack tax would alter consumer consumption is a review of the impact of taxation on cigarettes, the next topic of discussion.

A Look at Cigarette Taxes

A look at the impact that taxation has on cigarette sales and consumption offers a good look at how the taxation of snacks and soft drinks may impact consumer behavior. A review of the literature on cigarette taxes reveals that taxation is an effective pricing strategy to encourage healthy behavior. Governments began to levy taxes on cigarettes primarily as a source of raising revenue, but studies revealed that this taxation also yields positive results which aid in the regulation of this public health hazard.

Research indicates that taxes on cigarettes lower both sales and consumption of the product (Peterson et al., 1992 and Meier and Licari, 1997). Meier and Licari (1997, 1126) explain that the logic of tobacco taxes is taken directly from economic theory. Since a rise in the tax rate increases the cost of cigarettes, the law of supply and demand suggests that fewer cigarettes will be consumed if taxes on them are raised. One could apply the same theory to snack taxes.

Peterson et al. (1992, 94), examine the effect of state cigarette tax increases on cigarette sales. By reviewing cigarette sales data from 1955 to 1988 in all 50 states, they find that there is a significant inverse relationship between tax increases and cigarette sales. Controlling for changing attitudes on smoking and enactment of clean indoor air policies, it is identified that for each 1-cent increase in cigarette taxes, sales fall by 0.75 packs per capita.

Meier and Licari (1997, 1126), monitor the effect of cigarette taxes on consumption. By utilizing tobacco consumption data from 1955 through 1994, they evaluated the impact of both federal and state taxes on cigarette consumption. Controlling for government health warnings on cigarette labels and changing public opinion on smoking, they find that a 1-cent increase in state tax per pack of cigarettes is associated with a 0.631 pack per capita reduction in consumption.

The impact of federal taxes is even greater. Every 1-cent increase in federal tax per pack of cigarettes is associated with a 1.12 packs per capita reduction in consumption.

In sum, the aforementioned studies indicate that taxes on cigarettes have been an effective public policy to lower both sales and consumption of these good, and provide a framework of how a similar tax may effect consumption of snack foods. It is interesting to note and discuss the role of elasticity of demand in cigarette taxation. Peterson et al. (1992, 95) explained that in the literature the estimated price elasticity for cigarettes has ranged from -0.14 to -1.44. In their study, they estimate the elasticity to be -0.49, indicating that for every 1% cigarette tax increase, sales decline by 0.49%. A point to be made is that although cigarettes are not the most elastic products, results indicate that elasticity does not have to be extremely high to yield changes in long-term consumption patterns.

Taxation as a strategy to influence consumers to purchase healthier food represents a new frontier for public policy, and a review of the success of cigarette taxes provides some insight into how this policy could be effective in changing consumer behavior. The last portion of this review focuses on a discussion of the foods that have been targeted for taxation through snack tax policies.

FOODS TARGETED FOR SNACK TAXES

Manipulating food prices through taxation in order to encourage consumers to purchase healthier food is a fairly uncharted field. There is a need for more empirical research on this topic. Early pricing policies and research have focused on addressing consumption of soft drinks, snack foods, and fruits and vegetables. The next section reviews how these items contribute to obesity and explores the rationale for targeting them for taxation or subsidy.

Snack Foods

Snack foods are targeted for price increases through taxation in an effort to lower consumption of these unhealthy foods (Jacobson and Brownwell 2000, 854). On average, snack foods tend to be energy dense with little or no nutritional value (Field et al. 2004, 1211). Many snack food manufacturers have developed low-fat and non-fat choices, but these alternatives contain calories comparable to the normal fat options of similar types of snack foods (Field et al. 2004, 1211). Furthermore, the consumption of snack food has increased in the United States

(Borud 1996, 3). The percentage of individuals eating snacks has increased by one-fourth, from 60 percent to 75 percent. Snacking has increased by 35 percent among females 6 to 11 years old, and by 31 percent among children 3 to 5 years old and males 12 to 19 years old. Snacks provided 17 percent of food energy in 1994 compared with 11 percent in 1977-78. In 1994, snacks provided 21 percent of food energy for young children and teenage males, and 22 percent for teenage females (Borud 1996, 3).

Although consumption of snack food has been on the rise, is there any evidence that associates snack foods with obesity? Field et al. (2004, 1210) conducted a study to examine the relationship between snack food intake and weight change. They hypothesized a positive relationship between consumption of snack food and weight. As consumption increases, weight gain was expected to increase. To assess whether intake of snack foods including reduced-fat snack foods were predictive of weight gain, they analyzed data from approximately 15,000 pre-adolescent and adolescent girls and boys in the *Growing Up Today Study*. Taking into account level of physical activity, the study does not find any significant relationships between snack food consumption and weight gain (Field et al. 2004, 1215).

Phillips et al. (2004, 462) conducted a similar study. They examined intakes of energy-dense snack foods commonly consumed by adolescents such as: chips, soda, candy, baked goods, and ice cream. Using longitudinal data collected annually over a 10-year period, they observed no significant relationship between total snack food consumption and BMI. Snack food consumption was not related to body weight or fatness (Phillips et al. 2004, 466).³

Soft Drinks

In addition to snack foods, soda has been targeted for taxation in order to lower consumption (Jacobson and Brownwell 2000, 854). As cited, sugar-sweetened soft drinks contribute 7.1% of total energy intake and represent the largest single food source of calories in the American diet (Apovian 2005, 978). Consumption of soft drinks is on the rise in the United States. Among children 5 years of age and under: consumption of non-citrus fruit juices increased by 308 percent between 1977-78 and 1994; carbonated soft drinks by 23 percent; and fruit drinks

³ It is a widely accepted urban myth that consuming junk food leads to weight gain. I am personally surprised that the literature does not support this opinion. This is important to note because most tax levies have been focused on targeting snack food an energy intake source that has no link to weight gain.

and -ades by 36 percent (Borrud 1996, 2). The proportion of individuals drinking carbonated soft drinks increased by 52 percent. Half of all Americans drank a carbonated soft drink on any given day, with the highest percentage increases among those 12 to 19 years of age (74 percent of males and 65 percent of females) (Borrud 1996, 2).

Research indicates a positive relationship between consumption of soft drinks and weight gain. Schulze et al (2004, 927-930) conducted a study to monitor the impact sugar-sweetened drinks had on weight gain and incidence of type 2 diabetes. The study provides evidence that excess calories from sugar-sweetened soft drinks are responsible for the increasing prevalence of obesity among adults and also implicates sugar-sweetened soft drinks as a cause of type 2 diabetes. The longitudinal study of women in the *Nurses' Health Study II* identifies that weight gain over a 4-year period is highest among women who increase their sugar-sweetened soft drink consumption from 1 or fewer drinks per week to 1 or more drinks per day. Women consuming one or more sugar-sweetened soft drinks per day have a relative risk of type 2 diabetes of 1.83% compared with those who consumed less than 1 of these beverages per month (Schulze et al 2004, 930).

While Schulze et al. (2004) focused on adult women, Ludwig et al (2001, 505) examines the relationship between consumption of soft drinks and childhood obesity. As cited, soft drinks constitute the leading source of added sugars in the diet, accounting for 32g daily for adolescent girls and 57.7g for boys. Results of the study indicate that the odds of children becoming obese increased significantly for each daily serving of sugar-sweetened drink. Findings suggest that sugar-sweetened drink consumption is a contributor to obesity. The odds of becoming obese among children increased 1.6 times for each additional can or glass of sugar-sweetened drink a child consumed every day.

To better understand why soft drinks are associated with weight gain, Apovian (2005, 978) explains that the body's response to liquid calories has a major role to play in the relationship. Liquid calories are a relatively new addition to the human diet and the body's circuits to detect fullness have not adapted to register these calories (Apovian 2005, 978).

The eating pattern of women in the Schulze et al. (2004, 927-930) study reinforces Apovian's (2005) hypothesis of the body's difficulty in detecting satiety with liquid calories.

Women who increased sugar-sweetened soft drink consumption also increased energy intake from other foods, indicating that these beverages may induce hunger and food intake. For women who increased food intake, total calorie consumption increased by 358 kcal on average. Most excess calories were attributed to soft drinks (Schulze et al. 2004, 930).

In sum, the case is strong for taxation of soft drinks in order to increase price decrease consumption. Soft drinks add unnecessary calories to the diet and have a well-established link with greater weight gain. The next food item discussed is fruits and vegetables.

Fruits and Vegetables

Unlike snack foods and soda which have been targeted for taxation to reduce consumption, fruits and vegetables have been targeted for subsidies to promote greater consumption. Extensive research has been conducted on the relationships between calories, amount of food eaten and body weight, but the impact of eating fruits and vegetables on weight management has not been widely researched. The National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP) provides an overview of studies that can help shed insight on some of the possible links between consumption of fruits and vegetables and weight (NCCDPHP.html 2005).

Their review of literature supports the conclusion that consumption of fruits and vegetables may be linked to weight management through the concept of satiety. People do not limit consumption based on calories alone. Feeling full is one reason that people stop eating. Some studies indicate that the volume of food people eat at a meal is what makes them feel full and stop eating, rather than the calorie content of the food.

As cited, a study by Duncan et al. monitored 20 obese and non-obese participant diets. Subjects could eat as much as they wanted over five days from a diet that alternated from low-energy density to high-energy density foods. On the low-energy density diet, the participants achieved satiety with just over half the calories (1570 kcal) they needed to feel full on the high-energy density diet (3000 kcal).

In sum, for the same number of calories, people can eat foods with low-energy density in greater volume than foods with high-energy density. This helps people feel full and yet consume fewer calories.

Fruits and vegetables offer an excellent source for low-density energy. Water and fiber in foods increase volume and thereby reduce energy. In their natural state, fruits and vegetables have high water and fiber content and are low in calories and energy density.

Fruits and vegetables help individuals feel full because they contain water and fiber. Fat increases the energy density of foods, while water and fiber decrease energy density. Water has the greatest impact on energy density because it adds weight to food without increasing calories. Most fruits and vegetables are low in energy density because of their high water and fiber content and their low fat content.

Although more research needs to be done to establish a link between greater consumption of fruits and vegetables and weight loss, fruits and vegetables provide benefits for some of the comorbidities associated with obesity. The *Dietary Approaches to Stop Hypertension Study* examines the impact of increased fruit and vegetable consumption on blood pressure (Appel 1997, 1). The study enrolled 459 adults with blood pressures of less than 160/95 mm Hg. For three weeks, subjects received a control diet that was low in fruits, vegetables, and dairy products, with a fat content typical of the average American diet. Subjects were randomly assigned to receive eight weeks of the control diet, a diet rich in fruits and vegetables, or a diet rich in fruits and vegetables along with low-fat dairy products with reduced saturated fat and total fat. A combination diet that was rich in fruits and vegetable, along with low-fat dairy products with reduced saturated fat and total fat has the most significant impact on lowering blood pressure. A diet just rich in fruits and vegetables alone is also able to lower blood pressure but at a lesser level.

A diet rich in fruits and vegetables along with low-fat dairy products with reduced saturated fat and total fat reduces systolic blood pressure by 5.5 mm Hg and diastolic pressure by 3.0 mm Hg. A diet just rich in fruits and vegetables reduces systolic blood pressure by 2.8 mm Hg and diastolic pressure by 1.1 mm Hg. Subjects who had hypertension of blood pressure that was greater than 140/90 mm Hg had the most improvement with changing their diet. The combination diet reduces systolic blood pressure for people with hypertension by 11.4 mm Hg and diastolic pressure by 5.5 mm Hg (Appel 1997, 6)

In addition to benefiting blood pressure, fruits and vegetables provide protection against heart disease and cholesterol. Research suggests that a diet rich in fruits and vegetables can lower the risk of heart disease and stroke (hsph.harvard.edu/nutritionsource/fruits.html 2005, 1-2). The Harvard-based *Nurses' Health Study and Health Professionals Follow-up Study* included almost 110,000 men and women whose health and dietary habits were followed for 14 years. Research indicated that the higher the average daily intake of fruits and vegetables, the lower a person's chances were for developing cardiovascular disease. Compared with those in the lowest category of fruit and vegetable intake (less than 1.5 servings a day), people who ate 8 or more servings a day were 30% less likely to have a heart attack or stroke (hsph.harvard.edu/nutritionsource/fruits.html 2005, 1-2).

Although research has not established a direct link between increased fruit and vegetable consumption and weight reduction, these foods benefit other risk factors such as blood pressure, cholesterol and heart disease, which in turn help to reduce the overall disease burden. Now that foods that have traditionally been targeted with pricing strategies have been discussed, the literature review concludes with a discussion of a preliminary conceptual framework.

PRELIMINARY CONCEPTUAL FRAMEWORK

According to the "law of demand", individuals will reduce their consumption of an item if its price rises. A snack tax increases the price of snack foods and soft drinks. Since consumption of these foods is associated with increased weight gain, it is hypothesized that Maine's statewide snack tax will have a negative effect on the obesity rate for the state. Table 2.3 illustrates the hypothesis and includes the sources utilized to defend it.

Table 2.3 – Hypothesis and Supporting Literature

Hypothesis	Supporting Literature
Maine's statewide snack tax will have a negative effect on the obesity rate for the state.	French 2003 Jacobson and Brownell 2000 Kuchler et al. 2004

Although snack taxes exist in some states and localities, the actual effects of these taxes on consumer consumption patterns and obesity rates are unknown. Many states have passed snack taxes on the argument that it will help fight obesity, but how true is this? Due to inelasticity of demand, research indicates that consumer demand will be unresponsive to taxed soft drinks and

snack food. Although taxation of snack foods and soft drinks would lead to only small changes in consumer demand, could these slight changes in demand still lead to long term benefits, as is the case with cigarette taxes?

The state of Maine had a snack tax from 1991 to 2001. It is one of the few states that had a tax in place long enough to evaluate the effects of this policy. It is hypothesized that a statewide tax on snacks and soft drinks in Maine would have a negative impact on the state's overweight/obesity rate. This formal hypothesis should help shed light on the relationship between snack taxes and obesity rates

In conclusion, a review of the obesity epidemic was provided, strategies on treatment of obesity were discussed and the role environment plays in combating this issue. Public policy is the new frontier for the fight against obesity and it is increasingly evident that obesity is not an individual issue. Americans live in a weight-toxic environment, but strategies that focus on price manipulation to alter consumption patterns may be the tool of the future. Several states have levied taxes on junk food and soft drinks. These taxes have been in place for a number of years, but no analyses of their impact on those states' obesity rates were found in the literature. The next chapter will focus on the research setting. The state of Maine offers an opportunity to evaluate the impact of a snack tax on obesity rates.

CHAPTER THREE - SETTING

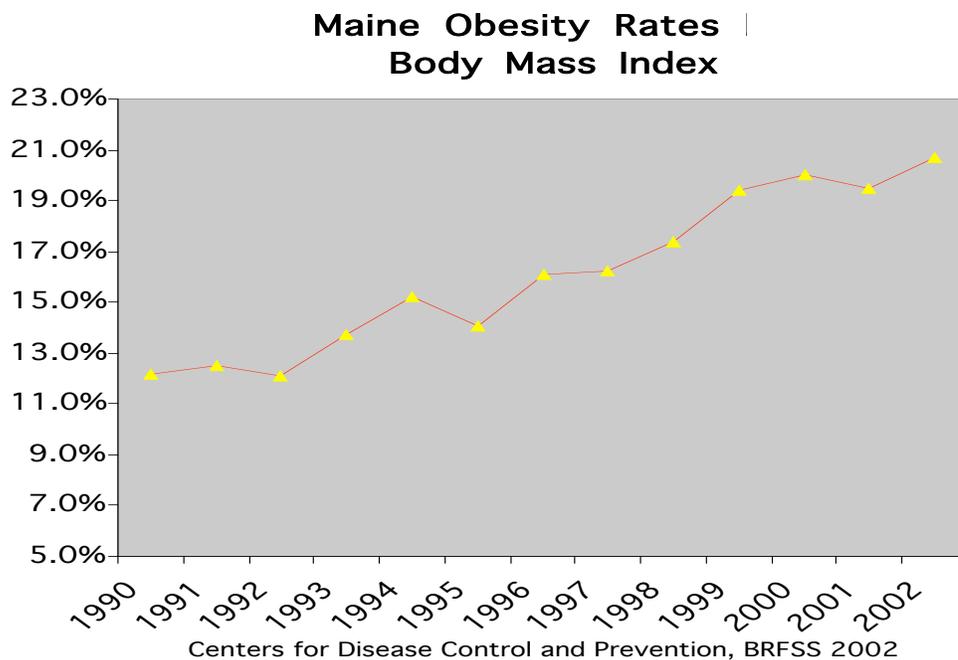
PURPOSE

The purpose of this chapter is to review Maine's policy environment. This chapter provides information on obesity and overweight trends for the state, and reviews the political climate and other factors that led to the 1991 Maine Snack Tax.

OBESITY IN MAINE

Research identifies that obesity is on the rise in the United States and is reaching epidemic proportions (Flegal et al 2002, 1723). This has definitely been the trend in Maine as well. In 1990, about 1 in 10 Mainers were obese, and by the year 2002, more than 1 in 5 Mainers were obese. Since 1990, obesity rates have risen by 75% in the state (Mills 2004, 2). Nationally, Maine has overweight and obesity rates that are comparable to other states, but it has the highest rate of adult obesity in New England (Bureau of Health 2004).

Table 3.1



The issue of overweight and obesity is not just limited to adults in the state. A 2002 survey of kindergarten students in Maine found that 36% of entering kindergartners had a body mass index (BMI) that fell at or about the 85th percentile. In regard to older youth, it is estimated that 27% of Maine high-school students and 30% of middle school students are overweight or at risk for overweight (Centers for Disease Control and Prevention, 2005). Overall, about 33% of Maine youth have BMIs greater than or equal to the 85th percentile, which identifies youth that are either overweight or at risk of becoming overweight (Mills 2004, 2).

In regards to demographics, Mainers with lower socioeconomic attainment are more likely to be overweight or obese. 66% of Mainers with less than a high school education are overweight or obese, as compared to 53% of those with a college degree. In terms of income, Mainers with less than \$25,000 annual household income have a 25% obesity rate, compared to a 15% obesity rate for those with incomes of \$50,000 or greater (Mills 2004, 2).

Perhaps the most concerning facts about the growing epidemic of obesity are the health risk, disease burden, and cost associated with the condition. In Maine, nearly 75% of people die from cardiovascular disease, cancer, chronic lung disease, and diabetes - all chronic diseases. Tobacco addiction has traditionally been the leading underlying cause of these chronic illnesses, but recent analysis indicates that obesity is equally to blame. The Maine Bureau of Health estimates that tobacco and obesity both contribute to the deaths of about six Mainers every day (Mills 2004, 1). Obesity incurs healthcare costs of \$400 to \$800 per capita per year (Maine Bureau of Health, 2003).

In regard to interventions designed to address obesity, Maine has developed a *Physical Activity and Nutrition Plan for 2004–2010*. The state has focused efforts on addressing the issue of childhood obesity, and one intervention that is currently being piloted by the state is the *A la Carte and Vending Machine Policy* intervention (Centers for Disease Control and Prevention, 2005). This intervention introduced nutritious food and beverage selections to a la carte food service and vending machines in public high schools. This was accomplished by collaboration between school leaders, school food service staff, and vendors. Each intervention school has a committee that includes student representatives and is working on policy development to sustain environmental changes.

Now that we have examined obesity in the state of Maine, the next topic of discussion is the state's snack tax.

MAINE'S SNACK TAX

The Maine snack tax was passed into law during 1991. The following section discusses the tax, the political climate in which it was passed, and some of its criticisms.

The snack tax law was a 5.5% tax placed on soft drinks and snacks such as crackers, bread sticks, ice cream, frozen yogurt, muffins, pies, cookies, cakes, gelatin, puddings, hot cocoa mix, marshmallows, breakfast bars and roasted nuts (Grocery Manufacturers of America, 2000).

Although taxation of unhealthy food is a proposed intervention to promote healthy eating, Maine passed its snack tax primarily due to fiscal concerns (Finkelstein et al. 2004, 169 and St. John 2002, 2). During 1991, the state had a projected budget shortfall of \$749 million. The legislature cut many programs and raised taxes to reduce the deficit, and the snack tax was passed as a revenue generator to help solve the state's fiscal crisis.

The legislative intent of the snack tax was to be a temporary measure to help the state endure during the crisis, but the tax stayed in place for ten years (Hawkes, 2000). In 2000, Secretary of State Dan Gwadosky found that 48,597 valid signatures from Maine registered voters had been properly filed on the initiative petitions calling for repeal of the snack tax. This was more than the minimum 42,101 signatures necessary to place the issue before the Maine Legislature. The snack tax was quickly repealed during the session, officially ending the policy.

During the life of the snack tax, there were criticisms of the policy that should be noted. Opponents lobbied against the snack tax claiming that it was a discriminatory and unfair policy. It was often claimed that the tax on food was considered to be regressive and unfair because it placed a disproportionate burden on lower-income households who could least afford to pay the tax (Hawkes, 2000).

The snack tax was also criticized for inconsistently identifying which items were subject to taxation. Both retailers and consumers found the tax confusing and constantly challenged the state on what items should be taxed. For example, a baked apple pie was taxed but not a frozen apple pie. Blueberry muffins were taxed, but not English muffins. There were numerous inconsistencies such as these in the snack tax policy and the state was under constant pressure to more rationally define which items should be considered "snacks".

In summary, although the snack tax could have had health benefits for the residents of Maine, the legislature's primary motivation was increasing revenue to make up for a budget shortfall. The tax was in place for ten years and offers the longest time frame to monitor the

effects of a snack tax on obesity rates. The next chapter discusses the methodology used to evaluate the impact of this policy on the obesity rates of the state.

CHAPTER FOUR - METHODOLOGY

PURPOSE

This chapter provides a discussion of the data collected to test the hypotheses developed in Chapter Two, and explains the design and statistical techniques used to address the research question. The hypothesis is operationalized through associated variables. Independent and dependent variables are defined and the source of data is identified. Table 4.1 illustrates the operationalization of the conceptual framework.

Table 4.1 Operationalization of the Hypothesis

Hypothesis: Maine's statewide snack tax will have a negative effect on the obesity rate for the state.

Variables	Definition	Unit of Measurement	Source
Dependent			
Obesity rate	percentage of individuals in Maine that have a body mass index ≥ 30	Body mass index	Behavioral Risk Factor Surveillance Surveys 1987-1996
Independent			
Snack Tax	Enactment of a tax on snacks and or soft drinks levied at the wholesale or retail level and may be levied in terms of a fixed tax per volume of product or as a percentage of sales price	0 before the tax, 1, 2, 3 ... to measure changes in the trends resulting from the tax	Jacobson and Brownell 2000 Kuchler et al. 2005 Kuchler et al. 2004
Time Counter	A counter variable which measures the presence of trends	(1 to 30)	
Dummy	A variable to measure slope changes as a result of the program which is a dummy variable, 0 before the program, 1 after;	0=before the tax 1=after the tax	
State	The treatment group, Maine and comparison group, New Hampshire.	0= Maine 1= New Hampshire	
Covariant			
Income	Annual income per capita	Average state income per capita in dollars	U.S. Department of Commerce

DATA COLLECTION AND SOURCE

The data collection instrument for this study is the use of existing statistics. The Behavioral Risk Factors Surveillance Survey (BRFSS) was used as the data source because it provides obesity rates annually by state. Therefore, data on obesity rates before and after the enactment of the snack tax are available.

BRFSS is a state-based system of health surveys that generates information about health risk behaviors, clinical preventive practices, and health care access and use, primarily related to chronic diseases and injury. These cross-sectional telephone surveys are conducted by state health departments with technical and methodological assistance provided by the Centers for Disease Control (CDC). Every year, states conduct monthly telephone surveys using a standardized questionnaire to determine the distribution of risk behaviors and health practices among non-institutionalized adults. The states forward the responses to the CDC, where the monthly data are aggregated for each state. The data are returned to the states, and published annually.

The BRFSS uses body mass index (BMI) to measure overweight obesity. BMI is the standard method for measurement in most studies (U.S. Department of Health and Human Services 2001, 4). The Dietary Guidelines for Americans establishes healthy weights and BMI guidelines for the public (U.S Department of Agriculture 2000, 7). Obesity is defined as having a BMI of ≥ 30 .

DESIGN

The research design selected for this applied research project is an interrupted time series comparison group - a quasi-experimental design. This design examines whether and how an interruption (program) affects a social process and whether the observed effect is different from the process observed in an untreated group. The interrupted time series comparison group is a strong design because its nature eliminates the bias that results when only one observation of a phenomenon is made (Bingham and Felbinger 2002, 123). The model is further strengthened by the number of observations over time. In this case, the design is adequate because historical data is available on obesity rates in Maine both before and after the snack tax was implemented.

The state of Maine is the treatment group in this study. The treatment is the enactment of a snack tax. Maine's snack tax was enacted in 1991 and was a 5.5% tax on snack foods, soft

drinks and carbonated water, ice cream, and toaster pastries. New Hampshire, a state similar in geographical location, size, and demographics was selected as the comparison group because a snack tax does not exist in this state.

The research design is schematically shown in table 4.2. “X” is treatment or enactment of the snack tax, “O” is the observation of obesity rates, “t” is the treatment group (Maine), and “C” is the untreated comparison group (New Hampshire). “t-1” through “t-4” are observation times four years before treatment, whereas “t+1” through “t+10” are observation times following the treatment.

Table 4.2 – Schematic Research Design

Interrupted time series comparison group

Before					After										
Ot,t-4	Ot,t-3	Ot,t-2	Ot,t-1	X	Ot,t+1	Ot,t+2	Ot,t+3	Ot,t+4	Ot,t+5	Ot,t+6	Ot,t+7	Ot,t+8	Ot,t+9	Ot,t+10	
Oc,t-4	Oc,t-3	Oc,t-2	Oc,t-1		Oc,t+1	Oc,t+2	Oc,t+3	Oc,t+4	Oc,t+5	Oc,t+6	Oc,t+7	Oc,t+8	Oc,t+9	Oc,t+10	

STATISTICS

The statistical technique chosen to evaluate the interrupted time series comparison group is regression analysis, which will determine if there is a relationship between a snack tax and obesity rates. If there is a relationship between these two variables, the regression will also describe its direction.

The outputs calculated for the regression include the adjusted R² (which measures the percentage of variance in the dependent variable that is explained by the independent variables), and the unstandardized coefficients (which measure the change in the dependent variable for every unit of change in an independent variable). Other outputs are the F ratio, which indicates whether the model’s results were obtained by chance, with higher F values indicating lower likelihood of chance results, and the standard error.

The standardized beta coefficients standardize different units of measurement among the independent variables and make their influence comparable. The next chapter focuses on the interpretation of the results from the regression analysis.

CHAPTER FIVE – RESULTS

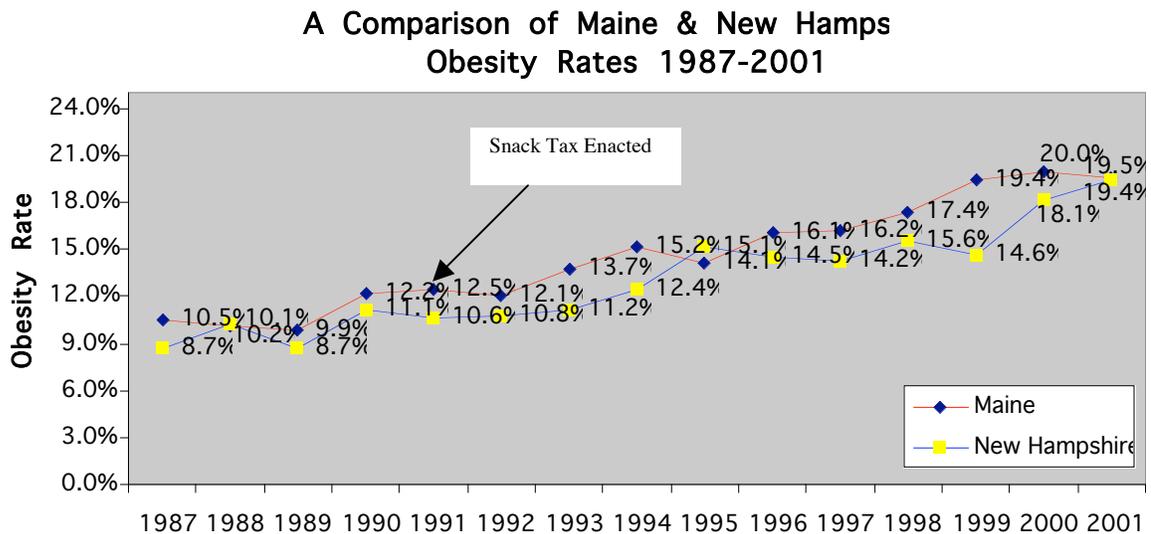
PURPOSE

This chapter seeks to review the results of the regression analysis for the interrupted time series comparison group. The results discussed in this section will help determine if there is a relationship between snack taxes and obesity rates and if so, what the direction is of that relationship.

DESCRIPTIVE STATISTICS

Obesity rates in both the treatment group (Maine) and comparison group (New Hampshire) have risen between 1987 to 2001 (See table 5.1). This trend mirrors the literature that has well-documented the growing prevalence of obesity in the United States over the last decade (U.S. Department of Health and Human Services 2001, 27 and Flegal et al 2002, 1723).

Table 5.1



Despite the snack tax being enacted in 1991, Maine’s obesity rates increased by 7.3 percentage points before the act was repealed in 2001. In 1990, about one in 10 Mainers were obese, and by the year 2002, more than one in five Mainers were obese. Since 1990, obesity rates have risen by 75% in that state (Mills 2004, 2). Nationally, Maine has overweight and obesity

rates that are comparable to other states, but it has the highest rate of adult obesity in New England (Bureau of Health 2004).

Although obesity rates have increased in the state, it still does not indicate whether the snack tax had any impact on these rates. The regression analysis provides the most insight on the relationship between the snack tax and the state's obesity rates.

REGRESSION ANALYSIS

The regression results for the interrupted time series comparison group are presented in tabular and narrative forms. Tables 5.2, 5.3 and 5.4 show the results of the analysis.

Table 5.2

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.031	5	.006	71.180	.000 ^a
	Residual	.002	24	.000		
	Total	.033	29			

a. Predictors: (Constant), State Income Per Capita, State, DUMMY, Snack Tax, Year

b. Dependent Variable: Obesity Rate

Table 5.3

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.968 ^a	.937	.924	.009343	2.573

a. Predictors: (Constant), State Income Per Capita, State, DUMMY, Snack Tax, Year

b. Dependent Variable: Obesity Rate

Table 5.4**Coefficients^a**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	9.965E-02	.032		3.086	.005
	Year	3.021E-03	.002	.787	1.793	.086
	DUMMY	-7.77E-03	.008	-.103	-.941	.356
	Snack Tax	1.097E-03	.002	.246	.710	.484
	State	-1.91E-02	.010	-.288	-1.939	.064
	State Income Per Capita	-1.08E-07	.000	-.016	-.049	.962

^a. Dependent Variable: Obesity Rate

The regression model for the interrupted time series comparison group is significant. The results of the regression indicate that the snack tax, along with other independent variables for the study, accounts for 93.7% of the variations in obesity rates ($f= 71.18$ with $p < .05$).

Although the regression model is significant, results indicated that there were no relationships between independent variables and the dependent variable. Therefore, findings are unable to support the hypothesis that the implementation of a snack tax would lower obesity rates in Maine.

The findings of this regression analysis for the interrupted time series comparison group support previous findings in the literature that utilize economic forecasts to evaluate the potential impact of snack taxes on obesity rates (Kuchler et. al 2004 and Kuchler et al 2005). These studies hypothesized that snack taxes would have minimal influence on consumer behavior and thus no effect on diet and weight.

Although this study failed to establish a significant relationship between a snack tax and obesity rates, there were some limitations to this project and alternative research designs could be applied to better research the relationship between snack taxes and obesity rates. The conclusion chapter focuses on discussing these limitations and suggestions for future research.

CHAPTER SIX - CONCLUSION

RESEARCH SUMMARY

The purpose of this research was to evaluate the impact of snack taxes, or the taxation of unhealthy foods such as snacks and soft drinks, on obesity rates for the state of Maine.

Chapter One presents an introduction to the research purpose. Chapter Two contains a review of the literature that outlines the obesity epidemic in America and discusses the utilization of pricing as a public policy tool to influence food consumption in efforts to reduce overweight and obesity. This chapter also introduces the conceptual framework and research hypothesis.

Chapter Three discusses the setting for the research project - the state of Maine - while Chapter Four operationalizes the hypothesis and describes the methodology developed to address the research question.

Finally, Chapter Five covers the results of the research. The results of the statistical procedures used are explained in this section. By conducting an interrupted time series comparison group analysis with obesity data obtained from the Behavioral Risk Factor Surveillance Survey, this study sought to examine the relationship between a snack tax and obesity rates.

Although the regression model for the interrupted time series design was significant, the findings did not provide any significant results for independent variables that could help identify and interpret a relationship between the snack tax and obesity rates for Maine. However, there were some limitations to this study and alternative research designs could be applied to better research the relationship between snack taxes and obesity rates.

LIMITATIONS

One limitation identified in this study was the length of time that obesity rates were available prior to the implementation of the snack tax. Only obesity rates four years prior to enactment were available. The interrupted time-series design is more useful and accurate when there are numerous data points (Bingham and Felbinger 2002, 169). More data points prior to the enactment of the tax may have yielded more accurate results for the regression analysis.

SUGGESTIONS FOR FUTURE RESEARCH

Although this study was unable to identify a relationship between snack taxes and obesity rates, alternative research designs could help shed light on the impact of snack taxes. Instead of evaluating snack taxes' direct impact on obesity rates, studies could be done to monitor their direct impact on consumer behavior.

Interrupted time series analysis could be done by utilizing consumption data of snack foods and soft drinks as dependent variables. In designing this research project, attempts were made to collect consumption data from snack food and soft drink trade associations, but the cost of these data exceed the budget for this project.

The last suggestion for research is the evaluation of price increases in the experimental settings. Numerous studies have been done that monitor the impact of price decreases on healthy food to encourage greater consumption. These studies could be replicated to monitor the impact of increasing prices in order to discourage consumption of unhealthy foods.

SUGGESTIONS FOR POLICYMAKERS

Although the findings of this research indicate that snack taxes may have no effect on obesity rates, it does not declare them obsolete in the government's arsenal to fight the growing epidemic of obesity. Some researchers have proposed that snack taxes are beneficial because they can generate significant revenue. This revenue generated from snack taxes could be utilized to help support other public initiatives that may have a greater impact on obesity rates. Jacobson and Brownell (2000, 6) proposed a national tax of 1 cent per 12.oz soft drink that would generate \$1.5 billion annually. They also proposed a 1-cent per pound tax on candy, chips, and other snack

foods or fats and oils. This was projected to raise \$70 million, \$54 million, and \$190 million respectively.

Americans live in a weight-toxic environment and policymakers will need an array of tools that can influence citizens to become more active and be more conscious about the dietary decisions they make. In terms of influencing diet, the literature suggests that public policy focus on the following strategies:

- A. Healthy foods be subsidized to decrease prices and increase per capita consumption
- B. Subsidies be removed or taxes imposed on unhealthy foods to decrease per capita consumption
- C. Food advertising be more regulated to prevent deception and to minimize advertising of snack foods, soft drinks, and sugared cereals aimed at children
- D. Aggressive public policy aimed toward providing opportunities for physical activity in the community and incentives for efforts made by individuals to become more physically fit. (Battle and Brownwell 1996, 761).

In conclusion, the snack tax could play an important role in future of public policy by providing revenue to support initiatives that have a greater impact on addressing the challenge of obesity in this country.

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