ASSOCIATION BETWEEN STATE AVERAGE OBESITY RATES AND THE CREATION OF SCHOOL NUTRITION POLICIES

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ABSTRACT

Recent media and popular culture scrutinize and attempt to address rising obesity rates in America. This study aims to determine the association between state average obesity rates and the creation of school nutrition policies. This study develops two measures of strictness in school nutrition policies: offerings and environment. Through the use of linear regression of policy strictness on obesity rates and control variables including state politics and state student demographics, results conclude that state obesity rates are associated with the strictness of school policies related to food environment.

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CHAPTER 1

INTRODUCTION

School lunches have become an increasingly popular topic in the media and in legislation in recent years. A main reason for this interest in school lunches is the high rate of obesity in American youth (Ogden et al 2012). School lunch policies are a viable option for combatting the epidemic of child and adolescent obesity. Some states may even be using their policies as a means to control their higher levels of obesity. This study contributes to a growing body of literature on the topic of school health (ex CDC 1996, O'Toole et al 2007, Taber et al 2012). More people are growing concerned with the state of health among the nation's children and adolescents. Even the White House is taking an interest in the health of American youth through Michelle Obama's 2010 "Let's Move" campaign. This concern has led to growing interest in the subjects of physical activity, comprehensive school health, and school food environments. This type of research is of particular importance because if child and adolescent health is not improved, the state of health in the nation's adults will also continue to decline.

Existing studies address the relationship of obesity and school lunch policies in a few ways. There are studies on the impact of the federal school lunch policy, using national level data (Brescoll et al 2008, Greves and Rivara 2006, Longley and Sneed 2009, Taber et al 2012). These studies are now being updated because of the recent overhaul to the federal policies. Greves and Rivara (2006) concluded that no states fully address ever issue discussed on the national level, while Taber et al (2012) showed that states with stronger policies in one area of school health had stronger policies across the board than states with weaker policies. These results show that, while some states are working toward better student health through policy, there is are many improvements to be made.

Policy research is not a new subject area, with many studies devoted to finding the influences and issues related to policy making and implementation (Brown et al 2004, Gustafsson 2002, MacLellan et al 2009, MacLellan et al 2010, McKenna 2003, McKenna 2010, McLaughlin 1987, Schmid et al 1995, Walton et al 2010). MacLellan et al (2010), MacLellan et al (2009) and Walton et al (2010) identified some of the main barriers to implementation as inadequate communication, limited resources, and student food preferences, as well as variance betwen socioeconomic environments. These same studies also identified facilitating factors as community support and the support of individual change-makers, such as school principals (MacLellan et al 2010, MacLellan et al 2009). Identifying the key challengers and proponents to a given policy is critical in making it a success.

There are also national level studies on the quality of diets among American youth (Cole and Fox 2008, Jaime and Lock 2009, Crepinsek et al 2009, Lissau and Poulsen 2005, O'Toole et al 2007, Wojcicki and Heyman 2006). These studies range from looking at the effects of race or income on diet quality to the effects of school lunch participation on diet quality. Wojcicki and Heyman (2006) found that, when a healthy menu was provided, student participation in the school lunch program increased. Crepinsek et al (2009) and O'Toole et al (2007) both identified total fat, saturated fat, and sodium levels as a remaining issue in school lunches, while Crepinsek et al (2009) also emphasized increasing fiber and O'Toole et al (2007) focused on the problem of added sugar in foods.

Obesity research is also quite prevalent, particularly research on the way policy affects obesity (Foster et al 2008, Frieden et al 2010, Kersh et al 2011, Levi et al 2009, Levi et al 2011, McKinnon et al 2009, Montoya 2010, Nanney et al 2010, Phelan et al 2010, Riis et al 2012, Schwartz and Puhl 2002, Sharp et al 2011) or on the way obesity rates can affect the creation and implementation of a variety of policies (Cullen et al 2008, Dietz and Gortmaker 2001, Finkelstein et al 2008, Masse et al 2007, Peterson and Fox 2007, Pomeranz and Gostin 2009, Probart et al 2007, Story 1999, Story 2009, Story et al 2006). Some emphasize the importance of multicomponent policies and policy research (Foster et al 2008, MicKinnon et al 2009). Frieden et al (2010) found that policies that make the choice of healthier diet and activity options easier is inherently better than other policy changes, while other studies noted that states are currently most focused on food policies than physical activity or other health concerns (Nanney et al 2010). Riis et al (2012) and Cullen et al (2008) both found results that support the hypothesis of this research. After adjusting for other factors related to obesity, Riis et al (2012) found that states with higher obesity levels have greater implementation of school lunch policies.

This study proposes that the strictness of state school lunch policies are a means of combatting the obesity epidemic. Children and adolescents spend a large part of their waking hours in school, making it an environment of great impact on their lives. The food they are served and the environment in which they consume meals in school plays a large role in child and adolescent health. This study examines the relationship between child and adolescent statewide obesity rates and state school lunch policies. I hypothesize that states with higher rates of obesity will have stricter school lunch policies as a way to combat their greater obesity problem.

CHAPTER 2

LITERATURE REVIEW

Consequences of Obesity

Obese individuals are at risk for over 20 major diseases (diabetes, congestive heart failure, heart enlargement and other heart disease, high blood pressure and cholesterol, stroke, sleep apnea, indigestion and heartburn, polycystic ovarian syndrome, pulmonary embolism, osteoarthritis, fatty liver, erectile dysfunction, renal failure, lymph edema, incontinence, depression, cellulitis, gallbladder disease, gout, hernia, and some types of cancer), and medical and economic costs of obesity have skyrocketed in recent years. Story (1999) showed that child obesity, aside from its many health risks, can be linked to adult obesity. In 2009, Story's research showed how critical obesity prevention in childhood is because of the formation of habits that persist into adulthood. The Centers for Disease Control and Prevention estimate that over 110,000 Americans are killed by obesity-related illness each year; more than 150 billion dollars are spent each year on obesity-related health care; and, the cost of obesity in lost productivity for United States employers is 73 billion dollars annually (Levi, Segal, St. Laurent, Kohn 2011). Mehta and Chang (2011) show that, while life expectancy has increased due to medical advances, more people are living with disabilities related to obesity, especially later in life, such that quality-of-life adjusted life expectancy is reduced by obesity. Myrskyla and Chang's 2009 research shows that even weight loss can be dangerous, through "yo-yo" dieting and constant weight fluctuation that can be a greater risk than the overweight epidemic. The staggering costs of obesity to the individual's physical and mental health as well as the costs for the community and country as a whole give researchers and policy makers reason to search for the root causes and their solutions.

Measuring Obesity

Obesity is measured by Body Mass Index (BMI), that is calculated using the ratio of a person's weight and height:

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

Figure 1. BMI Equation

The resulting calculation is compared to other individuals' calculated BMI, thus creating a scale. BMI can be harder to calculate and much less accurate for children and adolescents because of the great variance in growth periods. The CDC defines overweight for children as those children who fall in the 85th to 95th BMI percentile according to their age (CDC 2012). Obese children are those equal to or above the 95th BMI percentile for their age (CDC 2012).

Factors Associated with Obesity

Chang, Hilier and Mehta (2009) found that racial segregation affected the social, economic, and health of the segregated minority. Because minorities tend to live in more disparate areas, their concern for personal safety was found to be a barrier to physical activity as well as a cause of chronic stress (Chang, Hilier, and Mehta 2009). This barrier and stressor can lead to a greater presence of obesity in the minority population..

Income also has a large impact on a person's likelihood to be obese (Frieden et al 2010)(Story 2009). Levi et al (2011) discuss the Pediatric Nutrition Surveillance Survey, which shows that, while 12.4 percent of all U.S. children are obese, 14.7 percent of children ages 2-5 in low income families are obese. This difference in obesity rates for low-income individuals has been largely contributed to the higher cost of healthier foods. Many American youth are not eating the recommended servings of nutritious foods, instead opting for the cheaper or faster alternatives. The Obesity Toolkit showed that only 20.1 percent of children eat five or more servings of fruits or vegetables daily. Even worse, 16.2 percent consume the recommended three or more servings of dairy (CDC 2012). The Obesity Toolkit (CDC 2012) study also found that children are now drinking more soft drinks than ever before, also contributing to the decline of youth health. Children and adolescents consume almost half of their daily calories, 19 to 50 percent of food, during the average school day, making the school an important place to begin searching for a solution to the childhood and adolescent obesity epidemic (Kaphingst and French 2006) (CDC 2012).

James Coleman's Theory

James Coleman created theoretical links between macro social structures and individual actions. He proposed that individual problems should be investigated at the macro level to identify how the structure influences individual actions. This link is apparent in many of his works, including those on education. Coleman agues that achievement in schools can be closely related to family background (Coleman 1987:35), the strength of the community (Coleman 1991:5), and the social capital and strength of relationships among parents in the community (Coleman 1991:5). The success of the individual is strongly tied to the strength of the groups in which they are involved.

Coleman (1987) identifies two types of actors in society, the natural person and the corporate actor. A corporate actor can be identified as any organization or government in a society, such as the school. Coleman (1987) next identifies four types of actions: one person toward another, one person toward a corporate actor, one corporate actor toward a person, or one corporate actor toward another corporate actor. The actions of corporate actors create policy. While all types of actions are important to social life, it is the actions of corporate actors that can create the greatest change.

Important smaller scale corporate actors are the family and the school. Coleman (1987) states that the family's role in mainstream society has been reduced and largely replaced by the schools. The home no longer serves as the principle welfare institution or domain of socialization, both roles have been assumed by the education system. Relatedly, schools tend to be personalized to the communities they serve, as they must adjust to fill in for the gaps made by weaker family lives (Coleman 1987).

Aside from his theories on education, Coleman also gives reason to study policy. Coleman call policy research a "guide to action" (Coleman 1987). This is of incredible importance to education because, as Coleman points out, schools are created by policies (Coleman 1987). Coleman notes in how work "Social Theory, Social Research, and a Theory of Action," that social research has shifted from the social system to accounting for individual behavior. Sociological studies are of great importance now because of the policies that affect schools are their participants.

Why Schools?

Lissau and Poulsen (2005) identified six levels of pediatric obesity prevention: family, school, health professionals, government, industry, and media. This study will focus on the school as the main level of pediatric obesity prevention. Masse et al (2007) show how successes in other areas of public health policy are indicative of success for school health policy development. Foster et al (2008) found that multicomponent school based policies are more effective than multiple separate policies.

Over 95 percent of children attend school an average of 180 days each year for six or more hours each day from ages 5-17 (Probart. McDonnell, Weirich, Birkenshaw and Fekete 2007) (Peterson and Fox 2007). Of this large portion of the youth population, over 90 percent eat lunch in school (Levi, Segal, St. Laurent and Kohn 2011). Peterson and Fox (2007) found that on an average day in 2005, 29.6 million children ate a lunch provided by the school. Taylor et al (2011) found that, given repeated opportunities for tasting and consuming healthier foods, children make healthier choices. Given the great number of youth that are affected by schools and the lunches they provide, this is an essential area of study.

Peterson and Fox (2007) demonstrate how policy and environmental changes are most effective at the population level. In instituting change on the community, or school-wide, level a greater improvement in behaviors is seen than when addressing individual behavior patterns (Peterson and Fox 2007). There are five categories of school policies: food or beverage contracts, portion size, timing, environment, and qualifications of food service staff (CDC 2012). A multicomponent and comprehensive policy would address all of these topics as well as include a plan for implementation and evaluation.

National School Lunch Program

The National School Lunch Program recently raised its standards for the first time in over fifteen years, leading to major overhauls in school lunches and state level policies. In the coming years, the changes due to the heightened standards will become an important addition to this body of literature. Nanney et al (2010) found that states with a higher prevalence of youth obesity have more comprehensive school based obesity prevention policies. These policies were also found to have a particular focus on food service and nutrition. In their 2010 report, Nanney et al show that, since youth overweight and obesity was first tracked in 1991, the obesity rate increased in every state. Levi et al (2011) report that nearly one-third of children and teens are currently overweight or obese.

The National School Lunch Program is run by the United States Department of Agriculture. There were four revolutions in the National School Lunch Program identified by Story (2009) that exemplify Coleman's theory of the increasing role of schools: the late 19th century need to provide meals to poor children, the passage of the National School Lunch Act in 1946, the creation of the School Breakfast Program and the passage of the Child Nutrition Act in 1966, and the application of the Dietary Guidelines for Americans in the mid 1990s. At its' inception the goal was to provide one third of the daily recommended dietary allowances as a way to provide for undernourished youth in America (Gordon, McKinney, Condon and Wilson 2009). Most recently, the NetScan (2006) report shows heightened activity in 2006 due to the Child Nutrition and WIC Reauthorization Act of 2004. In 2010, the Healthy, Hunger-Free Kids Act implemented the first overhaul of nutrition standards for school lunches in over fifteen years.

The final ruling makes the following changes in regards to the content of school meals, which will be described in further detail:

1. Increases the amount and variety of fruits, vegetables, and whole grains;
2. Sets minimum and maximum levels of calories; and
3. Increases the focus on reducing the amounts of saturated fat and sodium provided in school meals (NSLP 4110).

The rule also addresses the concerns mentioned about food waste, food environment, and adequate time period for lunch, as well as discussing the content of the School Breakfast Program and guidelines for other childcare requirements. There are ten main facets that will be directly related to this study.

<u>Planning lunches using age/grade groups</u>

In the final ruling of the new National School Lunch Program, menus must be planned according to the age/grade groups of K-5, 6-8, and 9-12. "The age/grade groups reflect predominant school grade configurations and are consistent with the IOM's Dietary Reference

Intake (DRI) groupings” (NSLP 4090). In these breakdowns, children of similar ages are fed meals that are appropriate to their specific nutritional needs

Fruits as a separate food component

Prior to recent changes, fruits and vegetables were one component of the nutritional demarcations in the guidelines. This ruling establishes fruits and vegetables as separate entities, however, “this rule also gives schools the option to offer vegetables in place of all or part of the required fruit component for menu flexibility and as a potential cost control measure” (NSLP 4091). There are stipulations for what constitutes a fruit component, such as “although 100 percent juice can be offered, no more than half of the per-meal fruit component may be juice. . . . Schools should offer fresh fruit whenever possible” (NSLP 4091).

Vegetables as a separate food component

Much like the ruling on fruits as a separate food component, this rule establishes vegetables as separate from fruits, and “allows schools to use fresh, frozen, and canned products to meet the vegetable requirement” (NSLP 4093). More specifically to vegetables, this section of the rule created subgroups of vegetables, as defined by the 2010 Dietary Guidelines. Categories of dark green, red/orange, beans and peas (legumes), starchy, and other are required to be served “over the course of the week at minimum required quantities as part of the lunch menus” (NSLP 4092).

Daily servings of grains

Children are not at risk of not consuming enough grains in the way they lack fruits and vegetables, however, most of the grains in their diets are highly processed. This portion of the rule “establishes a minimum whole grain-rich requirement in the NSLP and SBP to help children increase their intake of whole grains and benefit from the important nutrients they provide”

(NSLP 4093). The requirement of a “whole grain-rich food” is to “contain at least 51 percent whole grains and the remaining grain content of the product must be enriched” (NSLP 4093).

Meats and meat alternates

In this ruling, “schools must offer at least a minimum amount of meat/meat alternate daily (2 oz eq. for students in grades 9-12, and 1 oz eq. for younger students), and provide a weekly required amount for each age/grade group” (NSLP 4094). The supply of many essential vitamins and minerals in meats and meats alternatives is critical. This offering supplies B vitamins, vitamin E, iron, zinc, and magnesium in addition to the protein of a meat or meat substitute (NSLP 4094).

Milk requirements

There has been much debate over milk in schools, particularly regarding fat content and flavoring. The new rule “allows flavor in fat-free milk only, and fat-free and low-fat choices only. . . Flavored low-fat (1 percent or 1/2 percent) milk is not allowed in the NSLP” (NSLP 4095).

Caloric intake guidelines

This is one of the most critical and controversial aspects of the new ruling. “USDA acknowledges the school meal programs provide a nutrition safety net for food-insecure children and agrees with commentators that meals must supply adequate calories for growth and development” (NSLP 4096). The rule defines a minimum and maximum calorie level for each age/grade grouping. The average level must be met for the school week, so there is some flexibility to allow for a wider array of choices in menu.

Total fat and calories from saturated fats

This is one of few requirements that was not changed from the previous ruling. “Schools must continue to limit saturated fat in the school meals to help reduce childhood obesity and children’s risk of cardiovascular disease later in life” (NSLP 4096). There is no total fat standard. This is the least defined of all the new requirements.

Maximum sodium levels

Sodium levels have long been an issue in the National School Lunch Program as well as American diets more generally. The new ruling “requires schools to make a gradual reduction in the sodium content of the meals” (NSLP 4097). The reduction is “gradual” because of the current massively high amount of sodium in much of the program’s menu options.

Offer vs. serve

This allows students some freedom in their school lunch menus. The ruling “requires that the reimbursable lunch selected by the student includes a fruit or a vegetable beginning SY 2012-2013” (NSLP 4099). Students are able to opt out of some of the choices offered by the school. Students are able to choose from whatever the school offers, but must make some selection.

Other important aspects of a school lunch policy include monitoring the qualifications of individuals that manage the service (O’Toole, Anderson, Miller and Guthre 2007), adequate time to eat, and competitive food policies. O’Toole et al (2007) found that over 20 percent of schools do not give students at least 20 minutes to eat lunch, and a quarter of schools serve lunches before 11 am. Masse et al (2007) determined that length of meal time is positively associated with an improvement in nutrient intake. Competitive foods are a popular topic for the media and general population, but the federal law only limits some competitive food sales. While all three of these aspects of school lunch are acknowledged in the federal policy, they are not well defined.

The National School Lunch Program is voluntary for states, which must enter into a written agreement with the United States Department of Agriculture in order to enroll. If a school, district, or state is participating in the program, they must meet all minimum requirements of the federal regulation in order to receive the cash subsidies and donated commodities that are benefits of the program. Stats can make participation in the program mandatory for public schools. Federal law defers to the discretion of state and local governments for issues of implementation. The standards written in the federal law may take primacy over the state or local legislation, but when federal judgment is absent it is the duty of the state to provide guidance.

State Regulations

Story, Kaphingst and French (2006) found federal nutrition regulations to be inadequate for instilling better health in the youth population. Nanney et al (2010) found that multiple policies over a broad range can be more effective than a single all-encompassing policy as exists at the federal level. Levi, Segal, St. Laurent and Kohn (2011) found that 20 states have policies stricter than the federal regulations. Many of these stricter standards relate to competitive foods, as 35 states have set a nutritional standard and 29 states limit the sale of competitive foods more strictly than the federal level (Levi et al 2011). This emphasis at the state level on competitive foods is likely due to the weak federal policy (Masse et al 2007). Finkelstein, Hill and Whitaker (2008) found that in the years between 2003 and 2005, over 200 pieces of legislation were introduced in the states related to nutrition standards and competitive foods in schools. Peterson and Fox (2007) found that of the legislation proposed in 2005 to limit competitive foods, 13 percent of policies were passed.

The state plays a clear role in the enactment and implementation of school health guidelines, but the local level is also important. There is a great level of control at the local level, which can be more strict (Masse et al 2007) and has the power as a school district to decide which state policies are implemented (Levi, Segal, St. Laurent and Kohn 2011). Local factors such as size, intraorganizational relations, commitment, capacity, and institutional complexity are important in local response to state policy (McLaughlin 1987). Communities and schools need the support of the state and state legislators to implement the higher nutrition standards that are being imposed.

The hypothesis for this study is that states with higher rates of child and adolescent obesity will have more strict school nutrition policies than states with lower obesity rates.

Issues and Contributions

Guidelines for implementation, enforcement, and evaluation are critical to create successful changes in health in the student population (McKenna 2003). Masse et al found that a measure of implementation does not currently exist in most areas (2007). The policies that currently exist are weak, and the quality of state and local policies is greatly varied (The Council of State Governments 2007). MacLellan et al (2009) iterate the argument that policy permitted foods are more expensive than current goods, and that student demand declines with healthier options. MacLellan et al (2009) also provide the counterargument to this point, showing that, by enacting such policies a more supportive environment is created for a healthier community. Current policies lack the support and evaluation mechanisms needed to become truly successful in changing the state of American youths' health.

There are many factors that may contribute to obesity, policy creation, and other variables in this study. Obesity is influenced largely by race, gender, and socioeconomic status. Socioeconomic status is affected by education. Lower income minorities are more likely to be obese than the majority race and individuals of higher socioeconomic status. The *state student demographic* control variable group attempts to account for these confounding factors. The creation of policy is often largely due to political affiliation and state funding. The *state politics* control variable accounts for these factors and their affect on policy creation. Democratic states are more likely to implement policies that aide the lower income bracket than their Republican counterparts.

Historically, the treatment and research of obesity has focused on individual behavior (Schwartz and Puhl 2002). Schwartz and Puhl (2002) show the challenges that parents and families face in combatting their children's obesity, dealing with the media, decreasing nutritional value in foods, and stigmatization of the overweight and obese. The focus is slowly shifting from the individual to the environment, which is the idea of this research. Riis et al (2012) and Nanney et al (2010) found positive associations between nutrition policies and obesity rates. Even having adjusted for other contributing factors, Riis et al (2012) find that higher odds of obesity exist in states with stricter school nutrition policies. This shows that states may be responding to increased obesity rates with raised nutrition policies (Riis, Grason, Strobino, Ahmed, Minkovitz 2012). The study at hand looks to further prove this hypothesis through the use of different tools of data and analysis. Different policy databases were used as well as a completely new method of classification. This study hypothesizes that states with higher average rates of obesity will have more strict school nutrition policies. This study will contribute more support and a new perspective on the issue of state obesity rates and school nutrition policies to the expanding body of literature.

CHAPTER 3

DATA AND METHODS

Policy

To find the state school nutrition policies, two databases were used. Both the School Nutrition Association and the National Association of State Boards of Education maintain updated databases of state school policies. In the School Nutrition Association (SNA) database, the following filters were used to search: competitive foods, comprehensive school health, school lunch, nutrition guidelines, food distribution, and meal mandates. In the National Association of State Boards of Education (NASBE) database the filters of health promoting environment-school meals program, health promoting environment-school food environment, and coordination/implementation-school health program coordinators were used. The resulting lists of school policies were available for download from these sites directly or from the state's government website. Policies related to farm to school programs were eliminated, as they do no directly relate to the meal content or food environment.

A scale was created to quantify the policies for analysis. The scale evaluated each state's policies on nineteen selected criteria, based on the National School Lunch Program guidelines. The individual criteria were separated into two main categories: *food-type* (fruits, vegetables, grains, meat/meat substitutes, milk, calories, saturated/trans fats, sodium, and fried foods) and *food environment* (offer vs. serve, vending machines, food as reward, time of lunch, time to eat, tracking, advisory committees, timelines, enrollment, and age breakdown). Each individual aspect of the policy was given a score between 0 and 4.

0=does not have a policy in this area
1=has a policy that states a standard less strict than the federal regulation
2=imposes the standard outlined in the federal regulation
3=has a policy that states a standard more strict than the federal regulation
4=has a policy that far exceeds the federal regulation

The scores of the individual criteria in each category were totaled to give each state overall scores for *food-type* (range, mean, standard deviation) and *food environment* (range, mean, standard deviation) policies. These scores served as the study's dependent variables, and distributions can be found in the appendix.

Obesity Rate

The obesity rate measure was taken from the National Conference of State Legislatures. This institution collected data on state obesity rates in 2003, 2005, and 2007 from the Childhood Obesity Action Network, The National Survey of Children's Health, and the U.S. Department of Health and Human Services. These percentages of obese children were averaged to create the *average obesity rate* variable. By creating a variable of historical averages of percent of obese children, the effect of obesity rate on policy implementation can be seen more clearly than in only choosing one year's data. Obesity for children is defined as a body mass index at or above the 95^{th} percentile, according to the CDC.

State Politics

These political control variables were found through The Henry J. Kaiser Family Foundation "statehealthfacts.org" website. The foundation keeps a record of the political affiliation of important figures in state politics. The *political affiliation* measure used in this study was the majority party (determined affiliation) of the State House and State Senate in 2012. States were given a score between 0 and 2. A score of 0 indicates that both the House and Senate are identified Republican. A score of 1 shows a split with either the State House or State Senate being Republican and the other being Democrat. A score of 2 was assigned to states where both the House and Senate were identified Democratic. *Per capita spending* was used as another control for the liberal nature of each state. A more liberal state would likely spend more money per capita than a conservative state, as traditionally the Democratic party provides more support for programs to aide the lower class.

State Student Demographics

The Food Research and Action Center (FRAC) conducts an annual survey titled “State of the States” which profiles food and nutrition programs through the United States. The report compiles data from both national and state level nutrition programs to show the reach of hunger and food insecurity. The data used in this study comes from the 2011 report, which was most recently updated in March 2012. This data formed the variables of *free and reduced price participation* and *percent over 25 with a high school* diploma.

The racial demographic variables of *percent Black* and *percent Hispanic or Latino* come from the most recent Census data. The data was created by the Census bureau from averages found in Population Estimates, American Community Survey, Census of Population and Housing, and other national surveys. The most recent Census was conducted in 2010 and counts every resident in the United States.

Methods

The dependent, independent, and control variables were imported into SPSS version 20. All tests were run in this data software. First, I created scatterplots of each dependent variable (Y axis) and the average state obesity rate (X axis). Cross-tabulation tables were made for each policy group (food-type, food environment).

Four ordinary linear regression models were predicted for each policy group. Model 1 included the policy group as the dependent variable and the average obesity rate as the independent variable. Model 2 also included the political control variables of political affiliation and per capita spending. Model 3 included the independent and dependent variables, as well as the demographic control variables of free and reduced price participation, education (percent over 25 with a high school diploma), percent black, and percent Hispanic or Latino. The fourth model included all variables and controls.

CHAPTER 4

RESULTS

This research hypothesized that states with higher averages rates of obesity would have stricter food-type and food environment school lunch policies than states lower obesity rates as a solution to their youth and adolescent obesity rate. Figure 2 is a scatterplot of both policy categories (food-type and food environment) against the average obesity rate variable. This figure shows that there is greater variation in food environment policy than in the food-type policy category. Food-type policies tended to fall into two main categories: no policy, or a median policy score of 18. The median score reflects a policy that is equivalent to the standards set by the National School Lunch Policy guidelines.

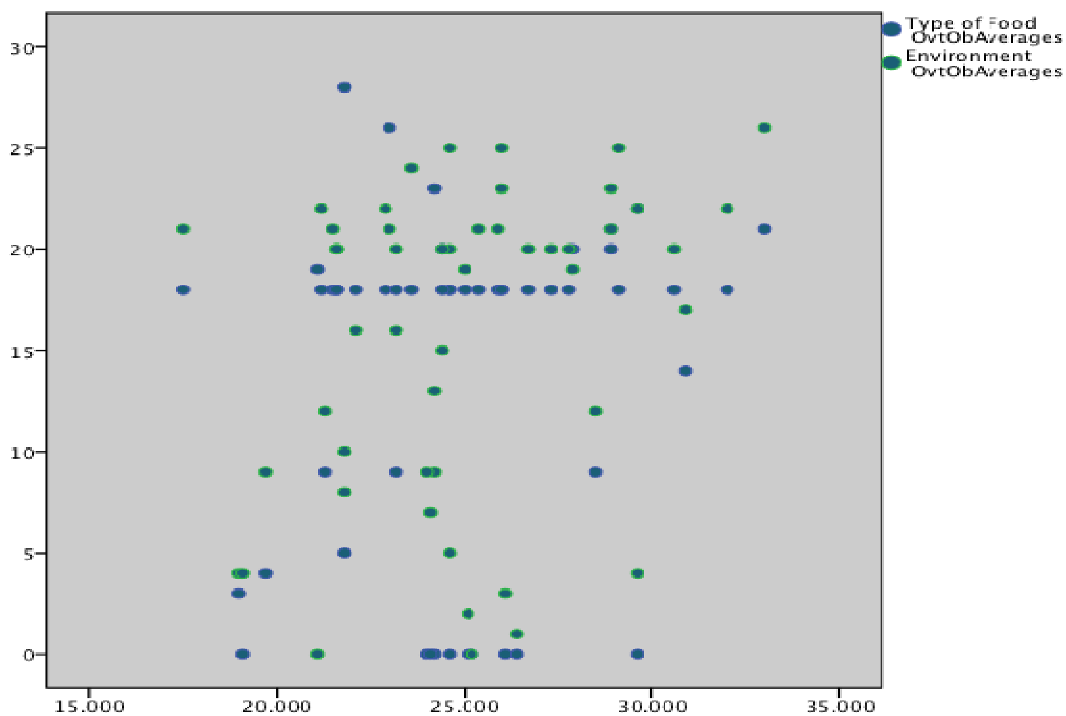

Figure 2. Scatterplot of Policies against Obesity Averages

Table 1. Linear Regression of State Implementation of Food-Type Policies in Schools on State-Level Obesity, State Politics, and State Student Demographic Variables

	Model 1	**Model 2**		**Model 3**		**Model 4**	
Average Obesity Rates	0.375	0.278		0.724		0.586	
	(0.342)	(0.337)		(0.549)		(0.583)	
State Politics							
Political Affiliation		1.253				0.437	
		(1.377)				(1.453)	
Per Capita Spending		-1.252	*			-0.670	
		(0.556)				(0.602)	
State Student Demographics							
Free and Reduced Price Participation				0.286	#	0.257	
				(0.172)		(0.179)	
Percent over 25 with a High School Diploma				-0.286		-0.214	
				(0.428)		(0.446)	
Percent Black				-0.372	*	-0.321	*
				(0.126)		(0.137)	
Percent Hispanic or Latino				-0.120		-0.127	
				(-0.128)		(0.184)	
Intercept	4.384	13.514		0.177		-1.131	
	(8.595)	(9.412)		(11.853)		(13.182)	
r squared	0.025	0.123		0.228		0.249	
F statistic	1.207	2.100		2.596		1.937	

*p<.05
#p<.10

I report results from the models estimating strictness of policies regarding food-type in Table 1. Model 1 examines the relationship between the strictness of existing state food-type policies and average state obesity rates. For every one percent increase in the state obesity rate, there is an estimated .375 point increase in food-type policy strictness, though we are not confident that this relationship is significantly different than zero. According to the r-square, 2.5 percent of the variation in state food-type policy strictness is accounted for in this model.

To begin assessing the relationship accounting for the control variables, model 2 includes the *state politics* variables. For every one percent increase in average obesity rates, there is an estimated .278 point increase in food-type policy strictness. Political affiliation estimates an estimated 1.253 point increase in food-type policy strictness for every one point increase in affiliation. For every $1,000 increase in per capita spending, a 1.252 point decrease in food-type policy strictness is seen. We can be confident that the per capita spending estimate does not include zero ($p<.05$). This model accounts for 12.3 percent of the variation in food-type policy strictness.

In model 3, *state student demographic* variables are used as controls in place of state politics. In this model, for every one percent increase in average obesity rates there is a .724 point increase in food-type policy strictness. For every one percent increase in free and reduced price participation, a .286 point increase in food-type policy strictness is estimated. This result is moderately significant ($p<.10$). Each one percent increase in percent of the state adults over 25 that have a high school diploma there is an estimated .286 point decrease in food-type policy strictness. Percent black and percent Hispanic or Latino both show an estimated decrease in food-type policy strictness for every one percent increase in the control variable (-.372 and -.120, respectively). The estimate for percent black is a confident estimate ($p<.05$). Model 3 accounts for 22.8 percent of the variation in state food-type policy strictness.

Model 4 is the full model, which includes all control variables from both groups (*state politics* and *state student demographics*). In this model, each one percent increase in average obesity rate estimates a .586 point increase in food-type policy strictness. There is less estimated change for the *state politics* variables, with political affiliation estimating only a .437 point increase, and per capita spending estimating a .670 point decrease in food-type policy strictness. Likewise, most of the *state student demographics* variables estimate a smaller change in food-type policy strictness. Free and reduced price participation estimates a .257 point increase in food-type policy strictness for every one percent increase in state participation. For every one percent increase in the state population over 25 with a high school diploma, there is an estimated .214 point decrease in food-type policy strictness. As seen in model 3, both percent black and percent Hispanic or Latino estimate a decrease in food-type policy strictness for every one percent increase (-.321 and -.127, respectively), but only the percent black estimate is significant ($p<.05$). This model accounts for 24.9 percent of the variation in food-type policy strictness.

Table 2. Linear Regression of State Implementation of Food Environment Policies in Schools on State-Level Obesity, State Politics, and State Student Demographic Variables

	Model 1		**Model 2**		**Model 3**		**Model 4**	
Average Obesity Rates	0.648	*	0.604	#	1.196	*	1.089	*
	(0.309)		(0.313)		(0.504)		(0.540)	
State Politics								
Political Affiliation			1.339				0.997	
			(1.281)				(1.346)	
Per Capita Spending			-0.777				-0.339	
			(0.517)				(0.557)	
State Student Demographics								
Free and Reduced Price Participation					0.166		0.168	
					(0.158)		(0.166)	
Percent over 25 with a High School Diploma					-0.35		-0.286	
					(0.393)		(0.413)	
Percent Black					-0.358	*	-0.330	*
					(0.115)		(0.126)	
Percent Hispanic or Latino					-0.191		-0.213	
					(0.163)		(0.17)	
Intercept	-0.572		4.177		-7.591		-5.803	
	(7.776)		(8.752)		(10.884)		(12.208)	
r squared	0.084		0.135		0.253		0.265	
F statistic	4.398		2.347		2.979		2.116	

*p<.05
#p<.10

Table 2 reports results from the models estimating strictness of policies regarding school food environment. Model 1 shows the relationship between food environment policy strictness and average state obesity rates, where for every one percent increase in obesity rate, there is an estimated .648 point increase in food environment policy strictness. This estimate is likely significant ($p<.05$). The r-square estimates that this model accounts for 8.4 percent of the variation in food environment policy strictness.

Model 2 examines the relationship between average obesity rates and food environment policy strictness while controlling for *state politics*. For every one percent increase in average obesity rate, there is an estimated .604 point increase in food environment policy strictness. This estimate is moderately confident ($p<.10$). As in table 1, political affiliation estimates an increase in strictness (1.339), while per capita spending estimates a .777 point decrease. This model accounts for 13.5 percent of the variation to be explained.

The third model controls for *state student demographics* while examining the relationship between average obesity rates and food environment policy strictness. For every one percent increase in average obesity rate, there is a confidently estimated 1.196 point increase in food environment policy strictness ($p<.05$). Free and reduced price participation estimates a .166 point increase in food environment policy strictness for each one percent increase in state participation. For every one percent increase in percent of the population over 25 with a high school diploma, there is an estimated .35 point decrease in food environment policy strictness. Percent black and percent Hispanic or Latino both estimate a decrease in food environment policy strictness. For each one percent increase in percent Black, there is a confidently estimated .358 point decrease in food environment policy strictness ($p<.05$). Each one percent increase in percent Hispanic or

Latino estimates a .191 point decrease in food environment policy strictness. Model 3 accounts for 25.3 percent of the variation found in food environment policy strictness.

Model 4 includes all control variables when examining the relationship between average obesity rates and school food environment policy strictness. For every one percent increase in obesity rate, there is an estimated 1.089 point increase in food environment policy strictness. This estimate is significant ($p<.05$). The *state politics* estimate less change than in model 2. Political affiliation estimates a .997 point increase in food environment policy strictness for every one point increase in affiliation. Every $1,000 increase in per capita spending estimates a .339 point decrease in food environment policy strictness. The *state student demographics* estimates are very similar to those in model 3. Free and reduced price participation shows a .168 point increase in food environment policy strictness for every one percent increase in participation. Every one percent increase in adults over 25 with a high school diploma estimates a .286 point decrease in food environment policy strictness. Percent Black and percent Hispanic or Latino both show a decrease in food environment policy strictness (-.330, -.213), but only the percent Black estimate is significant ($p<.05$). This final model accounts for 26.5 percent of the variation in food environment policy strictness.

I tested whether a three-year change in the state obesity rate influenced the strictness of both food type and food environment policies, but the results were not statistically significant than zero and had little influence on the remainder of the model. Results are available in the appendix.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

The results indicate some relationship between state school nutrition policies and state average obesity rates. The obesity rate averages show a statistically significant correlation with food environment policy strictness, supporting the hypothesis that states with higher obesity rates will have stricter school nutrition policies. The relationship is stronger for food environment policies than food-type policies, the latter of which provides little evidence of associations. Model 4, the full model for each dependent variable, accounts for about one fourth of the variation in food-type and food environment policy strictness (24.9 percent and 26.5 percent, respectively). The two different policy groups (food-type and food environment) have a correlation coefficient of .753, indicating a strong positive linear relationship. As the value of one gets higher, so does the value of the other.

The most unique facet of this study is this division and scaling of state school nutrition policies. In dividing the policies into separate categories, the results show the variation in types of policies between states, with food environment policies having much greater variation than food-type policies, which tend to fall in the same median range of 18 (equivalent to the standards set by the federal National School Lunch Policy guidelines). It is this division that provides the most interesting results for analysis.

The federal guidelines for food-type policies are much more detailed than for food environment, contributing to the difference between the policy categories. There are specific, quantitative guidelines for most of the food-type policy standards at the federal level such as fruits, vegetables, and grains. States must comply with these standards to receive the federal funding for their lunch program. Because of the strictness at the federal level, states tend to score a median of 18 for food-type policies, equivalent to the federal standards. The other common result for food-type policy is a zero score, or having no set standards for school lunches. These states likely do not participate in the federal program, or allow the local level to decide standards on their own. This relinquishing of control to the local level goes against Coleman's idea of macro level structure effects on individual behavior.

Food environment policies are much more varied than food-type policies. This is likely because they are less regulated at the federal level. Some of the standards in this category are only mentioned at the federal level, with no guidelines for what standards should be implemented. States have much more freedom in this category to make stricter school nutrition policies, the best example being competitive food policies. This is a topic of great importance that has been receiving increasing media attention. Many states have begun implementing stricter competitive food guidelines as a means of combatting obesity and appeasing public desire for increased health in schools, like Alabama, Connecticut, and Kentucky in this research. This is shown in the nationwide (but not national) move toward banning vending machines with junk food or soda, or limiting the times in which they are functional to after school hours. These results indicate that the food environment policy score may be a better indicator of change due to state obesity rate than food-type policy strictness as it has more freedom for variation at the state level.

Two examples in the data that support the original hypothesis are the states of Mississippi and Colorado. Mississippi has the highest average obesity rate in the dataset, at 32.9 percent. Mississippi also has the highest food environment policy score (26 of 40). In contrast, Colorado has one of the lowest average obesity rates at 19.7 percent. Colorado's overall policy score (both food-type and food environment together) is only 13 of 76. These examples support the hypothesis that states with higher average obesity rates will have stricter state school nutrition policies as a means of combatting their heightened rate of obesity.

Other interesting results include the effect of race and state politics on state school nutrition policy strictness. There is a decrease in policy strictness as the percent of minorities (percent black and percent Hispanic or Latino) in the population increased. Farley (1977) and Williams and Collins (2001) found that racial residential segregation was common among the largest cities in the United States. Minority populations such as black and Hispanic or Latino are more prevalent in urban areas due to factors like the increased presence of affordable housing and welfare programs compared to suburban areas where the population is more Caucasian. Racial segregation leads to more polarization within the state, and therefore, a less strict policy on the state level. It is difficult to get the required consensus to pass stricter legislation at the state level. Saporito and Sohoni (2006) found a similar relationship for schools. They showed that whites are more able to choose schools outside of their neighborhood through choice schools or private schools. The community, then, cares less about the state legislation because they have more choice in local policy. This difference highlights an area of Coleman's theory that needs some refinement, as he does not address the issue of context or local control in his theories. For Coleman, macro structures have the greatest influence on individual behavior. The results here show that there is more local than federal control. While the federal and state level policies are still important, there is room for great variation at the local level when states have less strict policies.

In both the regression of food-type and food environment policies, the outcomes for political affiliation and per capita spending are notable. As states become more Democratic, the strictness of policies increases. Conversely, as spending increases the policy strictness decreases

Democratic states likely have stricter policies because of the more prominent commitment in the party to social welfare programs such as the National School Lunch Program, Supplemental Nutrition Assistance Program, and other programs that are funded on the federal level. There is less need in Democratic states for state level spending because of this dependence on federal spending. The Lewin Group (2004) also found that states with less overall income spent less money per capita on social welfare programs than those with higher incomes, finding that personal income affects health program funding more than state fiscal capacity. This means that less fiscally stable states, those more likely to be obese, are less likely to spend state money on social welfare programs related to health because the funding comes from personal income or federal spending.

This study was conducted with some limitations. The sample of 50 states is small for a regression analysis. Future research should use obesity rate data from multiple years as a means of increasing the sample size. The scale used in this study was created by the researcher, but a uniform scale would make future research more reliable. Future research should include more control variables that more accurately represent the data set. Future research should also include the presence and effect of physical activity in schools.

Obesity is a solvable problem, and the schools are an appropriate place to begin this battle. By regulating nutrition in schools, state policies can help to lower the rates of obesity in children and adolescents, leading to a lowered rate of obesity in future American adults. This issue is important because of the wider health implications of unhealthy diets and obesity. While the national standards serve as an adequate minimum requirement, those states that go beyond the lowest standard will see the greatest decline in rates of obesity among their youth.

APPENDIX A

Table 3. Division and Scale of Dependent Variables

Food-type(0-36)	Food Environment (0-40)
Fruits (0-4)	Offer vs. Serve (0-4)
Vegetables (0-4)	Vending Machines (0-4)
Grains (0-4)	Food as Reward (0-4)
Meat/Meat Substititues (0-4)	Time of Lunch (0-4)
Milk (0-4)	Time to Eat (0-4)
Calories (0-4)	Tracking (0-4)
Saturated/trans fats (0-4)	Advisory Committees (0-4)
Sodium (0-4)	Timelines (0-4)
Fried Foods (0-4)	Enrollment (0-4)
	Age Breakdown (0-4)

APPENDIX B

Table 4. Breakdown of State-Level Results for Dependent Variables

State Scoring Results: Food Type					
Fruits 0-12 1-4 2-28 3-4 4-2	Vegetables 0-12 1-4 2-28 3-4 4-2	Grains 0-13 1-5 2-30 3-1 4-1	Meat/Meat Substitutes 0-13 1-3 2-33 3-1 4-0	Milk 0-11 1-5 2-30 3-3 4-1	Calories 0-12 1-3 2-32 3-3 4-0
Total fat and calories from saturated fats 0-12 1-4 2-32 3-2 4-1	Maximum sodium levels 0-13 1-5 2-28 3-2 4-2	Fried Foods 0-14 1-3 2-28 3-2 4-3			
State Scoring Results: Food Environment					
Offer vs. serve 0-16 1-4 2-29 3-1 4-0	Time to Eat 0-12 1-4 2-32 3-2 4-0	Tracking 0-15 1-2 2-26 3-5 4-2	Food as Reward 0-19 1-3 2-27 3-0 4-1	Vending Machines 0-6 1-4 2-21 3-10 4-9	Time of Lunch 0-13 1-4 2-31 3-2 4-0
Advisory Committees 0-10 1-0 2-25 3-10 4-5	Timelines 0-15 1-4 2-27 3-3 4-1	Enrollment 0-11 1-3 2-33 3-3 4-0	Planning lunches using age/grade groups 0-12 1-8 2-29 3-1 4-0		

APPENDIX C

Table 5. Data Descriptives

	Minimum	Maximum	Mean	Standard Deviation
Food-Type Policy	0.000	28.000	13.740	8.351
Environment Policy	0.000	26.000	15.580	7.796
Overweight and Obesity Averages	17.500	33.000	24.924	3.485
Political Affiliation	0.000	2.000	0.780	0.896
Per Capita Spending	3.068	13.741	6.052	2.213
%Free and Reduced Price Participation	36.400	80.000	60.982	10.911
%over 25 with a High School Diploma	20.800	41.600	29.654	4.047
%Black	0.500	67.900	11.992	12.518
%Hispanic or Latino	1.300	46.700	10.870	10.079

APPENDIX D

Table 6. Correlation Matrix

	1	2	3	4	5	6	7	8	9
1. Food-typePolicy	1.000								
2. Environment Policy	0.753**	1.000							
3. Obesity Averages	0.157	0.290*	1.000						
4.Political Affiliation	0.028	0.078	-0.026	1.000					
5. Per Capita Spending	-0.299	-0.205	-0.113	0.307*	1.000				
6. %Free and Reduced Price Participation	0.244	0.182	0.541**	0.125	-0.145	1.000			
7.%over 25 with a High School Diploma	0.012	0.145	0.421**	-0.181	0.057	-0.189	1.000		
8. %Black	-0.212	-0.153	0.534**	-0.055	0.173	0.428**	-0.016	1.000	
9. %Hispanic or Latino	0.175	0.025	-0.052	0.285*	-0.171	0.517**	-0.553	-0.138	1.000

* Correlation is significant at the .01 level
** Correlation is significant at the .05 level

APPENDIX E

Table 7. Linear Regression of State Implementation of Food-Type Policies in Schools on State-Level Average Obesity, Change in Obesity Rates, State Politics, and State Student Demographic Variables

	Model 1	**Model 2**
Average Obesity Rates	-2.000	0.245
	(-2.174)	(16.052)
Obesity Rate 2003	2.734	0.029
	(2.324)	(2.524)
Percentage Point Change	0.676	-0.115
	(1.066)	(1.132)
State Politics		
Political Affiliation		0.49
		(1.505)
Per Capita Spending		-0.68
		(0.618)
State Student Demographics		
Free and Reduced Price Participation		0.265
		(0.189)
Percent over 25 with a High School Diploma		-0.205
		(0.460)
Percent Black		-0.307
		(0.158)
Percent Hispanic or Latino		-0.129
		(0.188)
Intercept	13.577	0.245
	(10.431)	(16.052)
r squared	0.073	0.250
F statistic	1.201	1.442

*p<.05
#p<.10

APPENDIX F

Table 8. Linear Regression of State Implementation of Food Environment Policies in Schools on State-Level Average Obesity, Change in Obesity Rates, State Politics, and State Student Demographic Variables

	Model 1		**Model 2**
Average Obesity Rates	-2.996		1.089
	(1.918)		(0.540)
Obesity Rate in 2003	4.084	#	2.403
	(2.050)		(2.307)
Percentage Point Change	1.312		0.925
	(0.940)		(1.035)
State Politics			
Political Affiliation			1.030
			(1.376)
Per Capita Spending			-0.340
			(0.565)
State Student Demographics			
Free and Reduced Price Participation			0.147
			(0.173)
Percent over 25 with a High School Diploma			-0.253
			(0.420)
Percent Black			-0.281
			(0.144)
Percent Hispanic or Latino			-0.220
			(0.172)
Intercept	10.454		1.043
	(9.204)		(14.673)
r squared	0.171		0.285
F statistic	3.174		1.730

*p<.05
#p<.10

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