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The Healthy, Hunger-Free Kids Act and High School Obesity

Derek Grills
Walden University

Walden University

College of Social and Behavioral Sciences

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Derek Grills

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Dr. Hilda Shepeard, Committee Chairperson,
Public Policy and Administration Faculty

Dr. Mi Young Lee, Committee Member,
Public Policy and Administration Faculty

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Public Policy and Administration Faculty

Chief Academic Officer
Eric Riedel, Ph.D.

Walden University
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Abstract

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Dissertation Submitted in Partial Fulfillment

Of the Requirements for the Degree of

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Abstract

United States high school student obesity rates have doubled in the past 30 years to 13%, threatening the health of millions of adolescents. To mitigate the epidemic, Congress passed the Healthy, Hunger-Free Kids Act (HHFKA) in 2010, which mandated significant changes to school nutrition and physical education. From a public policy perspective, the HHFKA changed school nutrition and exercise policy to affect obesity rates by changing intake and energy expenditure at school, though no study using national-level data examined this relationship. As such, the purpose of the study was to examine whether HHFKA policy compliance had a statistically significant effect on high school obesity rates. The theoretical framework for this study was the energy imbalance theory (EIT), as developed by James Hill, Holly Wyatt, and John Peters. The research questions focused on the relationship of HHFKA nutrition changes and childhood obesity rates. The study used Pearson's Product-moment correlation to test for a simple correlation between Compliance Scores and High School obesity rates. Findings revealed no statistically significant correlation between state high school student obesity rates and HHFKA compliance scores. Future research is needed to validate the findings after more time has passed with the HHFKA mandates in effect. The implications for social change include informing the debate over the efficacy of implementing the HHFKA as currently written to mitigate childhood obesity.

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Dedication

Although earning a Doctorate degree is an awesome personal triumph, my children, Jourdan, Jalen, Jaide, Jaida, and Jewel, have made it one of the most worthwhile accomplishments I could have ever achieved. I started this quest because I wanted to show the world I was an exceptional person. I persevered through some of the most difficult personal problems and finished only because of my desire to inspire and impart in my children the confidence to do great things with their lives. I pray you are proud of your Daddy and are encouraged to strive even higher.

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Chapter 1: Introduction to the Study

Introduction

High school student obesity rates in the United States rose to epidemic proportions between 1980 and 2011 (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010; Center for Disease Control [CDC], 2013). High School obesity rates more than doubled from 5% in 1980 to 13% in 2011 (Anderson & Butcher, 2006; CDC, 2013). In an effort to mitigate the epidemic, Congress passed federal school nutrition legislation called the *Healthy, Hunger-Free Kids Act* (HHFKA) in 2010 (Federal Register, 2010). The HHFKA significantly changed existing policy and created mandates for improving school nutrition and exercise programs. The potential for using national school nutritional policy to positively impact high school obesity is great. The National School Lunch Program provides subsidized or free lunches to over 31 million schoolchildren each day attending more than 100,000 public and private schools (United States Department of Agriculture [USDA], 2011).

The HHFKA represents the first time the federal government has intervened in school nutrition policy to influence childhood obesity rates. Pursuant to the HHFKA, the USDA published the 2010 USDA Guidelines for Americans that created school nutrition mandates (USDA, 2010a). This study tested for an association between compliance with HHFKA regulations and high school obesity rates after controlling for median income and population density (rurality). The study was needed because no broad-based studies exist on the efficacy of using public policy to change high school obesity rates. The study contributes to the body of knowledge on obesity interventions at time when obesity is an

epidemic. Chapter 1 defines the scope of the obesity epidemic, introduces energy balance theory as a theoretical framework for understanding obesity interventions, and summarizes the study methodology. Chapter 1 provides context for the study and introduces the problem statement, research questions, theoretical framework, significance, methodology, research design, assumptions, delimitations, and limitations.

Background

Childhood obesity is a complex phenomenon. United States obesity rates dramatically increased nationwide despite the widespread recognition of the health risks and related costs., Data from large-scale epidemiological studies have indicated that obesity increases cardiovascular disease and diabetes, and reduces life expectancy (Baker, Olsen & Sorensen, 2007; Burns, Letuchy & Witt, 2009; Owens, 2013). There is a significant association between childhood obesity and race, income, home and school environment, region of residence, socioeconomic status, ethnicity, certain states, and regions of the country (CDC, 2013).

Research and theory regarding the causes of obesity suggest that obesity is related to multiple interlinking factors (Skelton, Buehler, Irby & Grzywacz, 2010). Childhood obesity was associated with biological factors such as genetics and metabolism (CDC, 2013); psychological factors such as mood, self-efficacy, coping and problem solving skills; and environmental factors such as the increase in high calorie, low cost vegetable oils and socio-economic status (Skelton et al., 2010). Furthermore, links between these factors were investigated. For instance, research found an association between increased stress levels and impaired metabolic functioning (Institute of Medicine [IOM], 2014).

Research on interventions to reduce childhood obesity was divided into three categories: (a) individual behavioral (*psyche-based*), (b) parenting styles and family dynamics (*family-based*), and (c) sociological (*community-based*), including schools. A majority of the research utilized multifactor interventions in a school setting, including changes in food intake, physical activity, sedentary behaviors, or combinations of these (Gonzalez-Suarez, Worley, Grimmer-Somers, & Dones 2009; Katz, O'Connell, Njike, Yeh, & Nawazet, 2009; Sobol-Goldberg, S., Rabinowitz, J., & Gross, R., 2013). Treatment protocols included menu changes, physical education, skills building, behavior modification, extracurricular activities, incentive schemes, and modification of the overall food environment. Much of the research on school age obesity treatment included parental involvement (Katz et al., 2009).

Gonzales-Suarez et al. (2009) conducted a meta-analysis of 26 quantitative studies to evaluate the efficacy of school-based intervention programs on childhood obesity. No significant reduction in childhood obesity was detected two years after the interventions. The Gonzalez-Suarez et al. (2009) research design included only controlled experiments, however a large number of confounding variables could not be controlled, such as involvement of parents, school environment and culture, and after-school compliance. Brown and Summerbell (2009) conducted a meta-analysis of 38 studies to evaluate the effectiveness of school-based intervention programs on childhood obesity in terms of BMI, absolute body weight, skin-fold thickness, and percentage of overweight. The study concluded that school-based interventions to improve diet and increase physical activity were inconsistent and short-term.

None of the studies included by Gonzalez-Suarez et al. (2009) and Brown and Summerbell (2009) were large-scale, longitudinal studies. There was a gap in the literature on the effectiveness of school-based nutrition programs to reduce childhood obesity. This nationwide study was needed to evaluate the effectiveness of using school nutrition policy to address the childhood obesity.

Problem Statement

The tripling of high school obesity rates threatens the health and welfare of U.S. children and portends a future healthcare liability (Anderson & Butcher, 2006; CDC, 2013). High school obesity has a negative effect on morbidity and mortality in adult life (Ogden et al., 2010) and 70% of obese high school students have one or more risk factors for cardiovascular disease (CDC, 2013). The CDC, public policy makers, doctors, and parents are vigorously searching for effective interventions to reduce obesity rates.

Obesity is a complex, multifaceted phenomenon with genetic, community, family, and individual components (Burns et al., 2009; Owens, 2013). Obesity researchers have found that ethnicity, race, SES, gender, and region of residence are associated with obesity rates (Gonzales-Suarez et al., 2009). Causes of obesity included genetics, energy imbalance, metabolic abnormalities, diet, and physical activity level. A large number of small-scale, school-based obesity studies were conducted using increased exercise, and improved dietary behaviors as interventions (Sobol-Goldberg, et al., 2013). The study addressed a gap in the literature regarding the efficacy of using state and federal school nutrition policy to affect high school obesity.

Purpose of the Study

The purpose of this quantitative study was to examine the relationship between compliance with HHFKA regulations and state-level high school obesity rates. The HHFKA represented the first attempt by the federal government to intervene legislatively to address the growing obesity epidemic in the United States. The study was timely due to the nationwide changes in school cafeteria menus during the 2013 - 2014 school year and the widespread protest against those changes. The study used state school nutrition policies in effect in 2007, measured their compliance with the HHFKA, and tested for a correlation between compliance and state obesity rates. The supposition was that obesity is a complex phenomenon and that changes in school cafeteria menus alone are unlikely to affect high school obesity rates.

The study correlated state high school obesity rates with state policy compliance with the HHFKA (compliance scores). The study dependent variable was state obesity rates and the independent variable was compliance scores, as calculated by the researcher. Covariates were median income and state population density, which were shown in previous research to be predictive of obesity rates (Zhang, Zeng, Zhang, & Wang, 2011).

Research Question and Hypothesis

RQ1: After controlling for median income and region of rural or urban residence, is there an association between state high school student obesity rates and compliance score?

$H_{1o:}$ There is no statistically significant correlation between state high school student obesity rates and Compliance Scores, after controlling for median income and degree of urbanization.

$H_{1a:}$ There is a statistically significant correlation between state high school student obesity rates and Compliance Scores, after controlling for median income and degree of urbanization.

Theoretical Framework

The study used Energy Imbalance Theory (EIT) as the theoretical framework for understanding the phenomenon of obesity. Energy Imbalance Theory posits that childhood and adult obesity is explained by a long-term, chronic imbalance between individual energy intake and expenditure (Hill, Holly, Wyatt, & Peters, 2012). Human energy intake comes from consuming protein, carbohydrates, fat, and alcohol. Humans expend energy doing physical activity and in maintaining basic metabolic functions (i.e. energy expended absorbing and metabolizing food). This study aimed to isolate the effect of changing school lunch nutrition, or energy intake, and high school obesity rates. A detailed examination of EIT and its potential to understand federal intervention in school nutrition policy is conducted in Chapter 2.

Conceptual Framework

Obesity is a complex phenomenon. The rapid increase in U.S. obesity was attributed to several emergent trends (Adair, Popkin, & Ng, 2012; Gonzales-Suarez et al., 2009). First, changes in edible oil production led to cheap vegetable oils that were used in inexpensive, fast food, which enabled low-income individuals to consume vastly more energy at a very low cost. Second, technology reduced work-related energy expended both labor-intensive and administrative occupations. Third, changes in transportation, leisure, and home production (cooking, cleaning, childcare, etc.) also reduced physical activity (Adair et al., 2012). These factors combined to create an energy imbalance in favor of too much energy storage (Gonzales-Suarez et al., 2009). As a result, obesity interventions were focused on increasing physical activity and modifying the quality and quantity of energy to reduce intake (Shek, 2004).

The explicit goal of the HHFKA was to improve student nutrition and increase physical activity to reduce nationwide childhood obesity rates (USDA, 2010). The study aimed to test the efficacy of using federal public policy to reduce childhood obesity using the EIT model. The supposition is that those states with school nutrition policy consistent with 2010 USDA Guidelines (USDA, 2010), which mandates lower energy intake and greater physical activity, have lower high school obesity rates. The research approach was to test for differences in high school obesity rates after states adopted the 2010 USDA Guidelines.

Nature of the Study

The study used a quantitative methodology to address the research questions. In a quantitative study, the hypotheses are either accepted or rejected based upon observable results. There are many advantages to using a quantitative methodology: (a) there is a clear identification of independent and dependent variables, (b) the research problem can be clearly stated, and (c) there is the ability to achieve high levels of reliability because of the controlled observations and the reduction in researcher bias (Leedy & Ormrod, 2012). A causal research design and quantitative method are appropriate for examining the research questions because the dependent and independent variables involve continuous numeric data closely linked in time.

The study variables were compliance scores, degree of urbanization, high school obesity rates, and median incomes. Compliance Scores were the actual number of nutritional elements required by HHFKA present in each state's nutrition policy (NASBE, 2013). Compliance Scores were developed using the State School Health Policy Database of the National Association of School Boards of Education (NASBE) (NASBE, 2013). For the purposes of this study, degree of urbanization was the percentage of the total state population that lives in urban areas, as defined by the Census Bureau (Census Bureau, 2012). State high school obesity rates for 2011 were collected from the Center for Disease Control website (CDC, 2012) and state median income and rurality were collected from the Census Bureau website (Census Bureau, 2012).

Definitions

Compliance score: is the number of nutritional elements from the 2010 USDA Guidelines present in 2007 state nutrition policy. Compliance score is the dependent variable.

Degree of Urbanization: Degree of urbanization is defined as the percentage of the total state population that lives in urban areas, using the Census Bureau definition of urban (Census Bureau, 2012). Degree of urbanization is a mediating independent variable.

High School Obesity Rate: High school obesity rate is the proportion of obese high school students, by state, reported by the Center for Disease Control (CDC, 2012). High school obesity rate is the independent variable.

Median Income: Median income is the amount reported by the Census Bureau for each state (Census Bureau, 2012). Median income is a mediating independent variable.

Assumptions

The primary study assumptions were that state nutrition policy changes reflecting 2010 USDA Guidelines translate rapidly and accurately into actual changes in school cafeteria breakfast and lunch menu choices. The study used a *ceteris paribus* assumption for all unmeasured variables to isolate variance attributable to the independent variables. It was assumed that there were no implementation delays at the school district level and no variation in the degree of actual compliance. Potential variance from implementation delays and regulation interpretation by individual school districts are topics for future research.

Scope and Delimitations

The study tested for an association between compliance with HHFKA school nutrition policy and high school obesity rates. Compliance scores, or degree of state policy compliance with 2010 USDA Guidelines, were reflected in state policy compliance. The compliance scores were based only on an analysis of state nutrition policy, not school district policy, or actual school menu practices. The study was limited to policy analysis, not actual menu nutrition compliance. The reason 2010 USDA Guideline compliance was chosen was because school districts were required to meet those requirements to receive their share of $11.7 billion of annual School Lunch Program (USDA, 2012) subsidies. The magnitude of the economic incentive favored compliance at the school district level and, as such, made it reasonable to assume school districts would implement the guidelines.

The scope of the study was nationwide, which is consistent with the nationwide impact of the 2010 USDA Guideline changes. The entire population of states nutrition policies were tested using a standardized scoring system and the CDC definition of obesity. The study findings might not be generalizable to other age groups, cultures, or populations with differing ethnic composition (Leedy & Ormrod, 2012).

Limitations

The study was limited to one independent variable and two potential covariates. Obesity is a complex phenomenon and studies have found SES, genetics, race, and a number of psychosocial variables to be associated with obesity (Gonzales-Suarez et al., 2009). Differences between states of these potential covariates had the potential to

confound the findings. Research showed considerable variation in nutritional content between schools within a single district, and between school districts. Potential variance in high school obesity rates not accounted for by the independent variables might limit the validity of the results.

There was no potential for participant bias, and researcher bias was limited by the use of factual data provided by reliable third parties, all of which are government instrumentalities. The study's nationwide scope and reliance on government data was designed to maximize the usefulness of the findings.

Significance of the Study

The study aimed to evaluate the efficacy of the federal regulatory scheme to address high school student obesity at a time when there are significant concerns about the 2010 USDA Guidelines. The research results provided insights into the effectiveness of using a federal school nutrition policy to effect obesity rates throughout all states. The research was significant because it informed public policy makers at a time when high school students were reducing their reliance on food provided under the 2010 USDA Guidelines, and certain school districts were opting out of the guidelines and foregoing federal subsidies because certain students were not willing to eat the food prescribed by the legislation. The research suggested changes in nutrition policy for high school students who had more flexibility than grade school students to eat outside food.

Summary

High school student obesity has become an epidemic over the past three decades. The U.S. high school student obesity rate of 13% threatened adolescents' health and welfare, and portends rising healthcare costs (CDC, 2012). Congress passed the HHFKA to reduce high school obesity by mandating improved student nutrition and increased physical activity (USDA, 2010). The HHFKA represents the first time the federal government has attempted to use school nutrition policy to affect obesity rates.

Obesity is a complex phenomenon with many potential causes and interventions. Energy Imbalance Theory attributes the increase in obesity to a reduction in physical activity and an increase in human energy intake (Hill et al. 2012). This quantitative study tested for an association between compliance with state and federal nutrition regulations and high school obesity rates, after accounting for the covariates of income and place of residence. All 50 states were examined for compliance with the 2010 USDA Guidelines and a correlation study was conducted to test the relationship with high school obesity. Chapter 2 examines obesity research and theory, the legislative history of state and federal nutrition regulation, and the efficacy of obesity interventions.

Chapter 2: Literature Review

Introduction

United States high school student obesity is an epidemic, reaching 13% in 2011 (Malik, Pan, Willett & Hu, 2013; CDC, 2013). High school obesity has a profoundly negative effect on childhood health and welfare as well as adult morbidity and mortality rates. Seventy percent of high school students diagnosed as obese have one or more risk factors for cardiovascular disease (CDC, 2013). Congress passed the HHFKA in 2010 to address the childhood obesity epidemic legislatively. Healthy, Hunger-Free Kids Act increased minimum nutritional requirements for breakfast and lunch programs required to qualify for federal funding under the National School Lunch Programs (SLP) (USDA, 2011). There is a gap in the literature reviewed for this study, on the relationship between comprehensive school nutrition reform and high school obesity rates.

The purpose of this quantitative study was to examine the relationship between compliance with HHFKA regulations and state-level high school obesity rates. The research was significant because it examined the association between federal school nutrition regulation and high school student obesity rates at a time while controversy existed regarding implementation of the 2010 USDA Guidelines (CBS, 2014). The controversy surrounded high school student complaints about the type and amount of food available for breakfast and lunch under the 2010 USDA Guidelines (CBS, 2014). The debate about the efficacy of the 2010 Guidelines was exacerbated by the lack of any large-scale, longitudinal studies on the use of school nutrition policy to affect childhood obesity rates. Existing studies on the use of school nutrition to affect obesity showed

mixed results and none found a significant treatment effect lasting two years (Brown & Summerbell, 2009; Gonzalez-Suarez et al., 2009). The study findings informed inform public policy makers at a time when some high school administrators are ignoring the 2010 USDA Guidelines because students are refusing to eat the food.

Childhood obesity threatens the health of America's children and is a significant driver in escalating healthcare costs (CDC, 2013: Malik et al., 2013; Thorpe, 2009). The federal government passed the HHFKA to address the epidemic, representing an enormous intervention affecting school meals for more than 45 million students each day (USDA, 2011). The potential for using national school nutritional policy to address the obesity epidemic is significant because of the large number of student meals served each day under the SLP. However, research on the efficacy of using school nutrition policies to address obesity problems is mixed (Brown & Summerbell, 2009). The literature suggests school based interventions showed no improvement in obesity rates or students who are overweight after two years (Brown & Summerbell, 2009). This research found the most promising school nutrition intervention was the reduction of sugar-sweetened drinks (James, Thomas & Kerr, 2007).

Chapter 2 reviews the literature on i) high school obesity, ii) government intervention in nutrition, iii) federal, state, and local legislation and policy, iv) school nutrition policy frameworks, and v) the historical effectiveness of school nutrition policy to frame the analysis of the 2010 Healthy, Hunger-Free Kids Act (HHFKA). This literature review traces the history of government intervention in nutrition, describes the state and local regulatory environment affecting federal law, and evaluates theoretical

frameworks for nutrition policy. The goal of this study was to examine the association between state school nutrition policy and high school obesity rates. Chapter 2 is organized as follows: literature search strategy, the theoretical foundation, conceptual framework, literature related to key variables and concepts, and a summary and conclusion.

Literature Search Strategy

The following online databases were searched: Academic Search Premier, EBSCOhost, ERIC, Google Scholar, ProQuest, and JSTOR. The following school nutrition-related websites were searched: Action for Healthy Kids (AFHK), Center for Disease Control and Prevention (CDC), Center for Science in the Public Interest (CSPI), National Alliance for Nutrition and Activity (NANA), National Association of School Board Executives, Robert Wood Johnson Foundation (RWJF), School Nutrition Association (SNA), Trust for America's Health (TAH), and United States Department of Agriculture (USDA). Google search engine was used in all cases except when individual sites or databases required the use of their internal search engine.

The development of keywords and key search terms was an iterative process. Initially, databases and websites were searched using the following keywords: *childhood obesity, childhood obesity research, causes of childhood obesity, efficacy of school nutrition intervention, federal nutrition laws and regulations, federal nutrition policy, high school obesity, history of federal nutrition regulation, National School Lunch Program, state nutrition policy, states' rights, school nutrition policy, and USDA school*

nutrition policy. Additional keywords and key search terms used later in the process are listed in Appendix A.

The literature review included peer-reviewed journal articles, books, dissertations, state and federal statutes, policies, and regulations, and related research. The period reviewed was from 1990 to 2014, but drew on some earlier works in government regulatory history, nutrition history, and nutrition theory. A total of 121 separate works were reviewed, of which 76 were specifically referenced and 17 provided context. Approximately 67 % of the studies were quantitative and the remaining 33% were qualitative or theory. The research articles chosen for reference addressed childhood obesity, obesity intervention studies, history of government nutrition regulation, nutrition theory, and USDA regulation of school nutrition policy.

The 2010 USDA guidelines represent the first time in the nation's history that federal school nutrition legislation was used to influence childhood obesity. As such, there is direct research on the relationship between federal school nutrition policy and childhood obesity. Small scale, localized qualitative and quantitative research on school-based nutrition intervention was summarized and analyzed in this literature review. In the absence of recent large-scale research on the relationship between school-based nutrition and obesity rates, this researcher chose to approach the analysis in two ways. First, the current and historical federal and state interventions in school nutrition were examined to provide context for the changes promulgated pursuant to the 2010 USDA Guidelines. Second, an exhaustive examination was made of the research on school-based interventions to effect change in obese and overweight schoolchildren.

Theoretical Framework

Energy Imbalance Theory

Energy Imbalance Theory (EIT) suggests that obesity is caused by a chronic imbalance between energy intake and expenditure, over a period of years. The relationship between energy intake, physical activity, and weight were first observed by Mayer, Purnima, and Mitra (1956). Mayer and his colleagues hypothesized that human physiology evolved during conditions wherein competitive advantage was conferred to individuals for achieving energy balance at a relatively high, and sustained, level of energy expenditure. The point at which human energy intake and expenditure achieved balance occurred at high (but not excessive) levels of physical activity. Mayer observed that energy intake seemed to be more consistently matched to energy expenditure for those people who maintained relatively high levels of physical activity (Hill et al., 2012)

Propositions, hypotheses, and assumptions. The basic components of energy balance include energy intake (food), energy expenditure (physical movement), and energy storage. Given these assumptions, body weight changes occur when energy intake and energy expenditure are not equal over some period of time. Human energy intake comes in the form of protein, carbohydrates, fat, and alcohol. Humans expend energy to maintain basic metabolic functions, which represents the quantity of energy expended while the body is at rest, to fuel basic metabolic functions (i.e. the energy expended absorbing and metabolizing food), and through physical activity. Resting Metabolic Rate is a function of body mass, particularly the amount of muscle mass. The amount of energy expended for the thermic effect of food is a function of total food consumed and

averages 8% to 10% of total energy intake. The quantity of energy expended by physical activity equals the quantity of physical activity per unit of time multiplied by the energy cost of that activity and the duration (Hill et al., 2012).

While there is a basic understanding of the physiological mechanisms involved in achieving energy balance, research found the physiological control systems involved to be quite complex (Lutes et al., 2012). Physical regulatory systems evaluate bodyweight signals, energy stores, physical activity levels, and expected needs based on external temperature and make changes to the amount of energy stored or expended as a counter-weight if it senses an imbalance. The existence of a physiological regulatory system is self-evident; absent such a system, body weight would be subject to wild short-term swings. The stability of body weight from day to day is consistent with a physiological control system governing energy balance (Hall et al. 2011).

The systems that regulate body weight modify metabolism to protect stored energy and create relative long-term stability in body weight (Lutes et al., 2012). Hall et al. (2011) found that the amount of energy necessary to lose one pound increases as body mass decreases. In a sample of college students Hall et al. (2011) found that the standard 1 lb. of weight loss from each 3,500 kcal of negative energy balance did not hold as body mass decreased body metabolism adjusts to the loss in body mass by slowing down to restore equilibrium.

Because metabolism declines with loss of body mass (i.e. one component of energy balance affects another), energy requirements are greatly reduced after significant intentional weight loss. Metabolism, or RMR, can decrease 35% for a 10% weight loss

and 50% for a 20% weight loss. Therefore, rapid intentional weight loss requires substantial and permanent behavioral change to maintain the loss. The dismal statistics for individuals seeking long-term weight loss maintenance suggest that most people cannot sustain the degree of behavior change necessary to keep weight off (Hill et al., 2012).

Literature and research-based analysis. There is considerable debate in the literature regarding the role that changes in physical activity play in the childhood obesity epidemic (Swinburn, Sacks, & Ravussin, 2009). The timing of the rapid worldwide increase in food availability and marketing coincides well with the dramatic increase in body weight (CDC, 2012). Some research supports this view. The quantity of leisure-time physical activity has not changed significantly, nor have measures of total energy expenditure during the time period in which obesity rates increased (CDC, 2012). Critics have suggested that the CDC (2012) analysis fails to account for the dramatic decrease in activity due to rapid urbanization and industrialization during the first half of the 20th century and immediately before the rapid increase in childhood obesity. The decline in daily activity attributed to the advent of mechanized transportation, machinery to do previously manual labor, and created the necessary conditions for a rapid increase of obesity caused by an increase in food availability. In this view, it is not surprising that total energy expenditure decreased in the early part of the century (Swinburn et al., 2009).

Poor nutrition and physical inactivity are the leading causes of obesity and represent the best opportunities for prevention and treatment (CDC, 2012c). Excessive

fast food, fewer homemade meals, and increased soda pop consumption are the key factors contributing to childhood obesity. According to Shek (2004), individual weight gain results from an imbalance between energy intake and energy expenditure. Obesity occurs when the imbalance remains unchecked for a sustained period of time, frequently decades. While the relationship seems obvious, there are important subtleties (IOM, 2014). First, research suggested that calorie intake and energy expenditure are linked, a change in one tends to produce compensatory changes in the other. The compensatory effect is important to understand in terms of designing interventions, it suggests that a reduction in calorie intake does not necessarily lead to a reduction in obesity. Second, due to the difficulty of accurately measuring energy expenditure, especially in children, the relationship between dietary intake and energy expenditure (non-resting energy expenditure) has not been demonstrated (IOM, 2014). Therefore, the relationship between childhood obesity, diet, and exercise remains poorly understood. Since a persistent energy imbalance is the endpoint in a process, interventions should consider all biological and environmental factors that create an energy imbalance (IOM, 2014).

Approximately 5% of all obesity cases are attributable to genetics, specifically, identifiable hormonal, syndromic, neurological, or single gene defects. Researchers have suggested a significant genetic predisposition to obesity (Reilly, Ness, & Sheriff, 2007). Twin studies have shown a high correlation of BMI in identical twins, in cases where the siblings were reared apart. Certain prenatal exposures were also associated with childhood obesity, such as maternal obesity, maternal gestational diabetes, and birth weight. (Reilly et al., 2007). While the evidence for genetic factors play a role in

childhood obesity, it is clear that genetics are not responsible for the recent exponential growth in obesity prevalence. After all, the human genome has not changed much in the past 30 years. As a result, the focus of recent research is on interventions that concentrate on behavioral, environmental, and societal factors. While genetics play a role in childhood obesity, the gene pool does not change rapidly enough to account for the global prevalence of overweight children. Much of the research reviewed for this study sought to understand treatable causes for childhood obesity by investigating the intersection of environment and behavior.

Energy intake. Excessive intake of energy nutrients was associated with an increase of body fat depending on several factors, one of these factors being age. (Wilborn et al., 2005). The common wisdom that a calorie is a calorie, and the composition of nutrients being consumed had no effect on weight gain or loss, was as been proven false. For example, a meal high in fat calories stimulates fat storage rather than making nutrients available for consumption by activity. In addition, the physiological process of depositing the fat into storage has a very low metabolic cost of 0% to 2% of calories deposited, whereas the thermic effect for carbohydrates and protein is 6–8% and 25–30%, respectively (Wilborn et al., 2005). As such, protein requires the greatest metabolic cost to be converted to, and stored as, fat. It follows that a diet high in fat, holding calories constant, is associated with increasing both body weight and fat deposits.

Significant research was conducted on the effects of the type of nutrients consumed at identical energy intake levels and body weight. For example, Labayen, Diez,

and Gonzalez (2003) studied the effects of a high protein hypo-caloric diet versus a high carbohydrate hypo-caloric diet in terms of subsequent weight loss. The authors concluded that the replacement of carbohydrates with protein accelerated weight loss through fat oxidation. Similar results were found when obese participants consumed either an *ad libitum* high protein or high carbohydrate diet with fat intake kept constant in both groups. Other researchers reported similar results regarding the efficacy and safety of a high protein diet (Wilborn et al., 2005).

Research was conducted on the volume of energy intake per meal, satiation, and subsequent energy intake. Hall et al. (2011) found that low-energy-dense foods like fruits and vegetables increased satiety while simultaneously reducing energy intake. The study suggested that diets emphasizing fruits and vegetables were more effective as a weight loss strategy than fat reduction diets, or decreased portion size diets. Epstein, Gordy, and Raynor (2009) found that obese individuals that increased the proportion of fruit and vegetable intake lost significantly more weight than individuals on low fat/low sugar diets.

Energy expenditure. The components of energy expenditure are metabolic rate, the thermic effect of food, and physical activity. Physical activity is further divided into two distinct sub-classes: (1) activity-related thermogenesis (volitional exercise); and (2) non-activity related exercise thermogenesis (activity not related "sporting-like" exercise) (Hill et al., 2012). Activity thermogenesis accounts for between 15% and 50% depending on the overall level of sedentary activity. Castaneda, Jurgens, and Wiedmer (2009) reported a close correlation between minimal amounts of spontaneous physical activity

and the accumulation of fat for both adults and children. Epidemiological studies found a significant relationship between physical activity and weight (Hall et al., 2011). In addition, a meta-analysis demonstrated that aerobic exercise was an effective method to reduce body fat and increase lean muscle mass.

Physical activity changes body composition and promotes weight loss. Sedentary lifestyle is the single best predictor of childhood obesity. A study conducted by Hill et al. (2012) found that individuals who engaged in at least 30 minutes of physical activity at least four days per week were less likely to be obese and had a myriad of other health benefits as well. In a monozygotic twin study, Swinburn, Sacks and Ravussin (2009) reported significant differences in BMI between sedentary and active twins, suggesting that activity level is a more important determinant in body composition than genetics. Increasing physical activity and total energy expenditure was shown to prevent and treat obesity. Hill et al. (2012) found that 29% of all adults do not devote any time towards leisure time physical activity.

Rationale for Use of Energy Imbalance Theory

The 2010 USDA Guidelines significantly changed the energy intake and energy expenditure for nearly all U.S schoolchildren and represented a unique opportunity to examine the relationship between childhood obesity rates and the EIT (Federal Register, 2010). While obesity is a complex multifaceted disease, the federal government intervention is only changing energy intake and level of required physical activity at school, both addressed by the EIT. This was the first time the federal government used its authority under the Student Lunch Program to affect childhood obesity rates.

While there is considerable research on EIT, there was no research on the relationship between school nutrition policy and childhood obesity rates. For the first time, Congress is utilizing federal school nutrition policy to affect childhood obesity rates. The 2010 USDA Guidelines applied mandates to both energy intake and energy expenditure. Energy intake is affected by a reduction in the total calorie count for breakfast and lunch, and nutrient composition is changing in favor of fruits and vegetables (Ello-Martin, Ledikwe, & Rolls, 2005). Energy expenditure is affected by a mandate to increase the amount of time each child is required to exercise and/or engage in vigorous physical activity. Taken together, the USDA mandates were an attempt to change the energy balance for schoolchildren, a clear experiment using the EIT.

The 2010 USDA Guidelines represented significant changes to nutrition and exercise mandates for all schools receiving money under the School Lunch Program, which is effectively 100% of all US High Schools and Grade Schools. The result was a large-scale longitudinal study using at least 37 million schoolchildren as participants (USDA, 2012). This study may be the first of many with the aim of measuring the effect of the HHFKA on childhood obesity rates.

The research question for the study was: After controlling median income and region of residence (rural or urban), are high school student obesity rates associated with compliance with the 2010 USDA Guidelines? The choice of the EIT was based on the research question; the core of the 2010 USDA Guidelines is a decrease in energy intake and an increase in energy expenditure. The study extended the EIT from experiments with relatively small samples to a nationwide study of schoolchildren in all 50 states.

While this study came relatively early in the history of the 2010 USDA Guidelines, there was sufficient history to begin to see changes, if any, resulting from the changes. This set of facts presented a unique opportunity to test the EIT on the entire population, rather than a sample.

Conceptual Framework

There were two separate concepts, or phenomena, related to this study. First, the phenomenon of childhood obesity, its causes, prevalence, and factors associated with the diagnosis were examined. Second, the history, experience, efficacy, and mechanisms for federal intervention in school nutrition were examined. The following sections examine childhood obesity and federal government involvement in school nutrition as it relates to the changes promulgated by the HHFKA and the 2010 USDA Guidelines. Childhood obesity is defined, and its health consequences, prevalence, costs to society, and risk factors are discussed (CDC, 2012). After that, the roles of the federal government, state government, and the school, in implementing federal school nutrition legislation and policy, are examined. The 2010 USDA guidelines represented the first time in the nation's history that federal school nutrition legislation was used to influence childhood obesity. Because this was the first time the federal government was using school nutrition policy to influence childhood obesity there was no direct research to compare and contrast to this study. As such, the structure of the Conceptual Framework section discusses childhood obesity first and federal nutrition policy second.

Childhood Obesity

The term obesity is defined as the excess accumulation of body fat, which places an individual at increased health risk (CDC, 2012). The CDC defines obesity using the Body Mass Index (BMI). Body Mass Index is a ratio of weight and height, and is used to calculate the fat composition in one's body. Once the BMI is calculated, the result is compared to the BMI-age percentile lines for the appropriate age and sex combination, an example of which is shown in Figure 1. The CDC considers a high school student to be obese if their BMI is at, or above, the 95th percentile (CDC, 2012).

Health consequences of childhood obesity. Obese high school children are at risk for severe physical and emotional malformations. Physical conditions include type 2 diabetes, heart disease, hypertension, and various related diseases. Obese children are frequently the target of bullying and name calling which sometimes leads to serious psychosocial disorders. Thorpe (2009) called obesity the greatest health risk facing high school age children in the past 100 years. For the first time in U.S. history, a child's life span is expected to be shorter than their parents (CDC, 2012).

Significant epidemiological evidence exists for the association between overweight and obesity, and cardiovascular risk factors in childhood and later in adulthood (Baker et al., 2007; Burns et al., 2009; Owens, 2013). A sample of 9,167 children ages 5 to 17 were examined in seven cross-sectional studies conducted by the Bogalusa Heart Study. The study found significant odds ratios for hypertension, and raised serum lipids were reported in both 5-10 year old and 11-17 year old obese children, and approximately 60% of the obese children had at least one cardiovascular risk factor (Owens, 2013).

Two large, long-term cohort studies provided significant evidence for the association between childhood obesity and adult cardiovascular morbidity and mortality (Baker et al., 2007; Burns et al., 2009). The Harvard Growth Study followed up a cohort of 508 adolescents for 55 years and found an increased risk of cardiovascular mortality in men who had been overweight as adolescents, but not for women (Burns et al., 2009). The retrospective cohort study of 276 Danish children aged 7-13 reported an increased risk of both fatal and non-fatal cardiovascular events in adulthood with increasing BMI. The results were found to be consistent across the entire BMI distribution. Based on the sample size and duration of the studies, there are significant health risks for obese children. There are societal costs in addition to individual cost of childhood obesity (Burns et al., 2009).

The relationship between obesity, metabolic syndrome, and Type II diabetes has been well characterized in adult populations (Thorpe, 2009). Adults with metabolic syndrome have a fivefold increased risk of developing Type II diabetes. Obesity and metabolic syndrome are also risk factors for developing childhood Type II diabetes. The dramatic rise in prevalence of overweight and obesity in children seen in the last 3 decades has been accompanied by the emergence of childhood Type II diabetes. In the United States, Type II diabetes in now thought to account for around 30-45% of pediatric diabetes, whereas historically, this proportion was only 5%. The proportion of children with Type II diabetes who are overweight or obese is approximately 90%, compared to 25% of those with Type I diabetes (Strange, 2010).

Factors effecting childhood obesity. Childhood obesity has been associated with biological factors such as genetics and metabolism (CDC, 2012); psychological factors including mood, self-efficacy, coping and problem solving skills; and environmental factors for example, the impact of the food industry, and placement of local food stores within neighborhoods and socio-economic status (Wilborn et al., 2005). Furthermore, links between these factors have also been investigated. For instance, research found an association between increased stress levels and impaired metabolic functioning (Wilborn et al., 2005). Together this indicates the level of complexity involved and the potential for nutrition policy to affect obesity rates.

Geographic disparities in high school obesity rates. The prevalence of high school obesity in the United States varies substantially across geographic regions and between individual states. As shown in Figure 1, the highest prevalence of obesity for high school students in 2011 was the South central region at 15%+, while the Mountain states reported the lowest obesity rates. High school students in Kentucky, North Carolina, Texas, Tennessee, and West Virginia (17% +) had double the obesity rate of Colorado high school students (CDC, 2013).

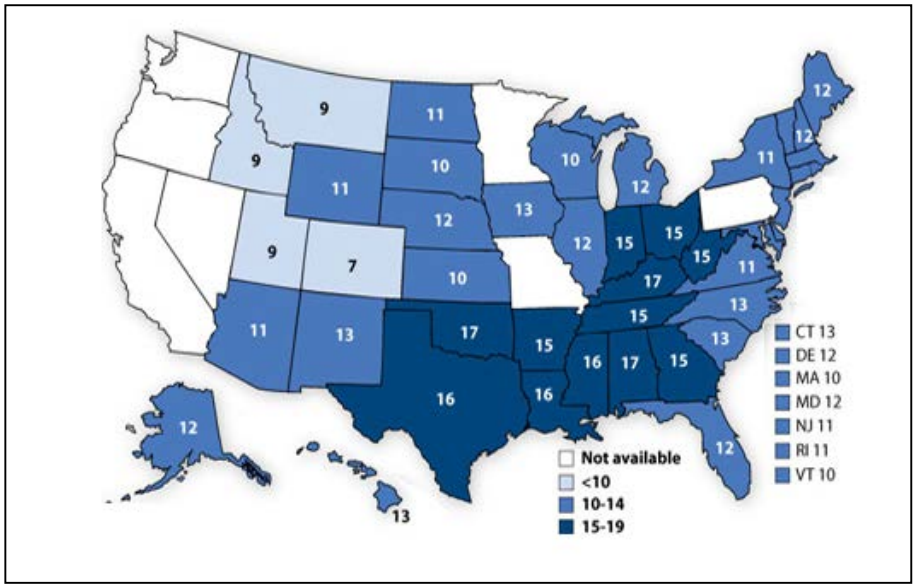

Figure 1: 2011 High school student obesity rates by state (CDC, 2013).

The potential for using national school nutritional policy to impact childhood obesity is substantial because children spend a significant proportion of their time in school. According to 2009 Census Data, the National School Lunch Program subsidizes 31.5 million of the 48.5 million children attending school in Grades K–12 (Census Bureau 2012). As a result, national school lunch policies impact all schools' nutrition policies by linking NSLP subsidies with the 2010 USDA Guidelines (USDA, 2010).

Demographic risk factors. Figure 3 reports the prevalence of obesity among adults aged 20 years and over, by poverty income ratio, sex, and race and ethnicity as of 2008. The analysis uses three ranges of poverty income ratio (PIR) to segment the population. The highest income group was defined as household income ≥ 350% of the poverty level income; the middle income group was defined as household income ≥130% and less than 350% of the poverty level income; the lowest income group was defined as

household income < 130% of the poverty level income. Approximately 35.7% of all U.S. adults were obese. The obesity rate among all women was 42.6% versus 34.1% for all men. The obesity rate was 31.0% for the high PIR group, 36.8% for the medium PIR group 36.8%, and 35.6% for the low PIR group. Obesity prevalence among all African Americans was 43.7% and 51.3% for all African American women. Obesity rates among all Mexican Americans were 37.7% and 41.6% for Mexican American women. The highest obesity rates were reported for African American women for all PIR groups (CDC, 2013).

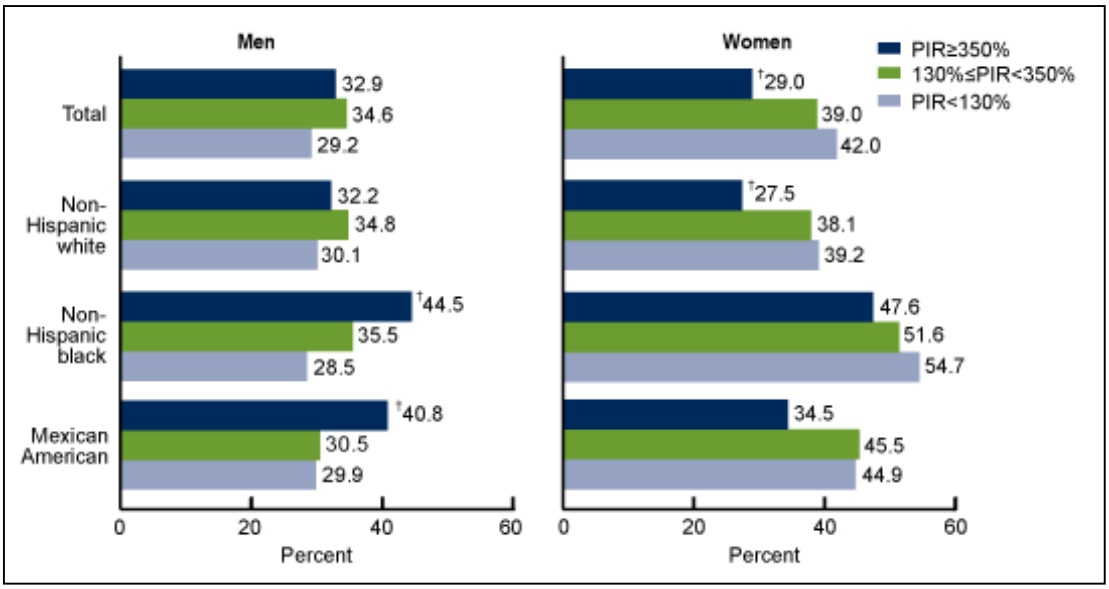

Figure 2. Obesity prevalence rates by income, race and ethnicity (CDC, 2013)

Surgeon General David Satcher stated that the obesity crisis calls upon individuals, families, communities, schools, worksites, organizations, and the media to work together to build solutions to bring better health to everyone in this country (USDHHS, 2001). Surgeon General Satcher added that:

> Dealing with overweight and obesity is a personal responsibility as well as a community responsibility. A lack of safe places for children to play and adults to walk, jog, or cycle is a community responsibility. If school lunchrooms do not offer healthy and appealing foods, that is a community responsibility. When we do not require daily physical education in our schools, it is a community failure. (USDHHS, 2001, p. xiii)

These words provided the context for federal intervention to reduce childhood obesity using the 2010 USDA Guidelines and subsequent threat to withhold NSLP funding for failure to adopt those guidelines. However, there was significant controversy surrounding the use of federal school lunch policy to affect obesity and children's eating habits (CDC, 2006, SNA, 2010).

For example, the school lunch boxes at West Hoke Elementary School in Raeford, North Carolina were subject to daily inspection by teachers and state inspectors (Civitas Institute, 2014). A government inspector determined a kindergarten student's homemade lunch did not meet nutrition requirements. While the 4 year-old was permitted to eat her home lunch, the girl was forced to take a helping of chicken nuggets, milk, a fruit, and a vegetable as a supplement. The family's school account was charged for the meal. The incident raised the fundamental question of who has the responsibility to make nutritional decisions for the nation's children (Perryman, 2011).

Subject to some basic moral boundaries, parents have the exclusive right to raise their children as they wish, and the responsibility to protect their children from harm

(Perryman, 2011). The ethical dilemma occurs when a child becomes obese. Does the government have the right to intervene and make nutrition choices for those children? Mermin and Graff (2009) state that obesity is a disease and therefore a public health issue. As such, the government has the authority to use their police power to promulgate laws and regulations to counter obesity. On the other hand, civil libertarians take issue with state police power trumping parental rights (Perryman, 2011; Ryan et al., 2007). Where does the right to intervene end and parental rights begin? What about children that are not obese, where does the governments' right to regulate their nutrition emanate from? Moreover, does the government even have a right to inspect the lunch box of a healthy, normal kindergarten girl? (Perryman, 2011).

Obesity treatment modalities. There are no large-scale, longitudinal precedents for the use of school nutrition policy to prevent or treat obesity in the literature (Perryman, 2011). There are many existing obesity treatment modalities in the literature; nearly all focus on individualized treatment based on: gender, degree of obesity, individual health risks, psycho-behavioral and metabolic characteristics, and the efficacy of previous weight loss attempts (Hainer, Toplak, & Mitrakou, (2008). While there are many choices for achieving a modest, short-term weight loss, long-term weight management is plagued with a lack of compliance, failures, and high dropout rates. Effective long-term obesity reduction involves daily physical activity, cognitive behavioral lifestyle modification, and frequently anti-obesity drugs. In an increasing number of cases, bariatric surgery is the only effective strategy for obesity. Bariatric surgery has proven to be effective for permanent, long-term obesity reductions and

overall mortality improvements of 25–50%. Obesity treatment should be individually tailored and the following factors should be taken into account: sex, the degree of obesity, individual health risks, psycho-behavioral and metabolic characteristics, and the outcome of previous weight loss attempts. In the future, an evaluation of hormonal and genetic determinants of weight loss could also contribute to a better choice of individual therapy for a particular obese patient. A multilevel obesity management network of mutually collaborating facilities should be established to provide individually tailored treatment.

Federal Government Intervention in School Nutrition

For the purposes of this study, government intervention refers to the following laws and regulations. It is necessary to understand the history and operation of federal and state law to examine the mechanisms for the federal government intervention in what is a local decision, the school lunch menu. Through the passage of the HHFKA and subsequent publishing of the 2010 USDA Guidelines, the federal government is intervening in school nutrition to affect childhood obesity. Public policy intervention in school nutrition dates back nearly 100 years. Until 2010, all previous government intervention in school-based nutrition was designed to provide food to impoverished children and address a lack of nutrition. The 2010 USDA Guidelines was the first effort to reduce the number of calories and shift consumption toward fruit and vegetables while reducing fat content. The history is provided here as context for the USDA 2010 intervention aimed at reducing obesity.

Proper nutrition promotes the optimal growth and development of children and supports the goal of reducing overweight and obese children (USDA, 2010). Schools are

well positioned to promote healthy eating habits and promote physical activity to address the obesity epidemic (USDA, 2012). Congress passed the HHFKA and the USDA published the 2010 USDA Guidelines to improve the nutrition of food served in schools. These actions further regulated the distribution of $11.1 billion of state subsidies under the SLP. The rules extend beyond the confines of the cafeteria to vending machines, snack bars, school stores, and other venues that offer food and beverages to students. In addition, the new guidelines cover nutrition education and physical activity as part of a comprehensive obesity solution (USDA, 2012). School nutrition policy is a states right that led to a wide variety of nutrition policies in schools between states. Some states already met the 2010 USDA Guidelines for an extended period of time before passage 2014.

History. The National School Lunch Act (NSLA) of 1946 provided states with commodity and cash support so that they, in turn, can provide nutritious school lunches to children, free, or at a reduced cost. The purpose of the NSLA is twofold: (1) to provide nutritious meals to schoolchildren and (2) to support America's agriculture markets by donating surplus commodities for school lunches. There are three legislative acts that gave the USDA authority to purchase commodities for the school lunch program: (1) Section 6 of the Richard B. Russell National School Lunch Act, (2) Section 32 of the Agriculture Act of 1935, and (3) Section 416 of the Agricultural Act of 1949. All three Acts give the USDA control over nutrition. Pursuant to the legislative acts, schools used two groups of commodities in their meal programs: Group A Commodities include perishables: beef, pork, fish, poultry, egg products, fruits and vegetables. Group B

Commodities include nonperishables: cereals, grains, peanut products, dairy products, and oils. An agency of the USDA may purchase items from these groups to limit surplus and stabilize prices (USDA, 2012). In addition to commodities, the USDA provided states with a cash reimbursement based on the number of lunches served and family need (USDA, 2012). Today, because of USDA involvement, "Over 31 million school children receive a nutritious school lunch each school day in over 100,000 participating public and private nonprofit schools and institutions" (USDA, 2007, p. 2).

The language of the Dietary Guidelines continued to morph through the 1980's and early 1990's until the publication of the 1992 Food Guide Pyramid. This guide introduced seven groups in a hierarchical graphic, a pyramid, with the least servings; i.e., foods to be used sparingly – fats, oils, and sweets -- at the top and the most servings (6-11 daily) --bread, cereal, rice, and pasta -- at the bottom, or foundation, of the pyramid. Since the publication of the Food Pyramid in 1992, the serving sizes of all seven groups have not changed except that the daily meat group servings went from 2-3 servings of 5-7 ounces to 2-3 servings of 4-9 ounces. The "meat group" includes meat, poultry, fish, dry beans, eggs, and nuts.

In 1994, Congress passed the Healthy Meals for Healthy Americans Act (HMHAA). This Act required all meals under the NSLP and SBP to meet the HMHAA Dietary Guidelines (DGA) (USDA, 2007). After the passing of the Healthy Meals Act, the USDA published a manual, *The Road to SMI Success*. The purpose of this manual was "to help foodservice directors, supervisors, and managers successfully implement the

USDA's School Meals Initiative for Healthy Children (SMI) regulations within the scope of daily practice" (USDA, 2007, p. 1).

None of the history of government legislation or the creation of the 2010 USDA Guidelines is associated with any theory of childhood obesity. Every five years experts study the DGA and issue a report. The DGA is technical, scientific, and written for policymakers, nutrition educators, nutritionists, and healthcare providers. It contains a vast amount of information not intended for the general public to comprehend; rather, "The intent of the Dietary Guidelines is to summarize and synthesize knowledge regarding individual nutrients and food components into recommendations for a pattern of eating that can be adopted by the public" (USDA, 2007, p. vi).

State's role. While school nutrition regulation is considered a states' right, in order to receive part of the $11.1 billion of federal subsidies, each state had to adopt the 2011 NSLP guidelines. Under the HHFKA, the USDA published nutrition guidelines, 2010 USDA Guidelines, which constitute federal nutrition policy. The federal requirements NSLP guidelines include: 1) nutrition guidelines, 2) physical activity, 3) a plan to implement the policy, and 4) must involve parents, students, the school board, school staff, and the community. The 2010 USDA Guidelines do not "tell schools what foods to serve, nor does it spell out how much physical activity students must receive" (Buchanan, 2005, p. 5), however the USDA withholds NSLP subsidies for failure to comply with the guidelines. As a result, each state must create its own nutrition policy legislation.

Some states have taken seriously the need to develop state nutrition policy beyond the minimum federal requirements; other states have adopted, practically verbatim, the federal language into their own policy. Arizona banned the sale of junk food and soda machines at the elementary and middle school level in 2004, Oklahoma prohibited serving foods of minimal nutritional value in elementary schools. It also required elementary students to have at least 60 minutes of physical activity weekly. North Carolina requires K-8 students to have 30 minutes of physical activity each day (Buchanan, 2005). The Connecticut House and Senate passed legislation removing sodas and junk food completely from all schools and requiring 20 minutes of daily physical activity for all students (Buchanan, 2005).

Key Variables and Concepts

The literature on childhood obesity suggests that race, income, home and school environment, region of residence, socio-economic status, and ethnicity have a significant effect on obesity rates (CDC, 2012). For instance, Katz et al. (2006) found that rural children in North Carolina were 54.7% more likely to be overweight or obese then urban children. While there are a large number of studies on local school-based obesity interventions (CDC, 2012; Katz, et al., 2009), there is a gap in the literature on the impact of *community-level* obesity intervention. The purpose of this quantitative study was to examine the relationship between compliance with HHFKA regulations and state-level high school obesity rates. The study used a quantitative methodology to address the research question.

Dependent Variable – Childhood Obesity Rate

The CDC defines childhood obesity as a BMI at or above the 95th percentile for children of the same age and sex. For the purposes of this study, CDC reported childhood obesity rates were used.

Independent Variable – Compliance Score

The following section defines, in detail, the 2010 USDA Guidelines that aim to reduce energy intake and increase energy expenditure. The Methodology requires each state in the sample reviewed for the degree to which their school nutrition policies meet the 2010 USDA Guidelines. The independent variable, State Compliance, represents the extent to which a state nutrition policy is consistent with the 2010 USDA Guidelines.

The 2010 USDA Guidelines represent an unprecedented, nationwide experiment in the use of school nutrition policy to reduce childhood obesity rates. For the purposes of this study, the changes from the 2005 USDA Guidelines to the 2010 USDA Guidelines are a "treatment" which has been unevenly implemented across the U.S., thereby creating an opportunity to test for an association between the degree of compliance with the 2010 USDA Guidelines and local high school obesity rates. Each state must pass legislation and regulations to implement the 2010 USDA, while they can add or accelerate policies or practices they deem appropriate and in their best interest to promote student nutrition. This state-level latitude created significant differences between states in the actual school nutrition policies, which are significant. The impact of the changes to school nutrition policy mandated by the 2010 USDA guidelines are filtered through the myriad state and local nutrition policies (i.e., 50 states, plus all public school districts within those states;

New Jersey, for example, has over 600 school districts). The state-level discretion created large variances in school nutrition policy. For instance, Arizona implemented substantially all of the 2010 USDA Guideline changes as early as 2005.

The 2010 USDA Guidelines for school breakfast and lunch programs were phased in over time and were required to be 100% operative for the school year ending in 2014. The energy intake requirements are as follows:

1. Control total calorie intake to manage body weight.
2. Reduce daily sodium intake to less than 2,300 milligrams.
3. Consume less than 10 percent of daily calories from saturated fatty acids by replacing them with monounsaturated and polyunsaturated fatty acids.
4. Consume less than 300 mg per day of dietary cholesterol.
5. Keep trans fatty acid consumption as low as possible by limiting foods that contain synthetic sources of trans fats, such as partially hydrogenated oils, and by limiting other solid fats.
6. Reduce the intake of calories from solid fats and added sugars.

Energy expenditure. *A Call to Action* (USDHHS, 2001) defines schools as the role of the school in the crusade against overweight and obesity. It outlines a specific, detailed strategy that schools can utilize in promoting health and physical activity, including the following:

1. Educate school administrators, teachers, educators, school service personnel, and coaches about the importance of school physical activity and healthy nutritional habits.

2. Conduct community outreach to raise awareness of the importance of being good role models for children in terms of diet and exercise.
3. Raise awareness of school administrators, teachers, educators, school service personnel, and coaches about the importance of body size acceptance and the dangers of unhealthy dieting practices and the potential for emotional problems of in overweight children (p. 19).

Although physical education is a requirement in all 50 states, the amount of time spent and the quality of the program varies from state to state. The National Association for Sport and Physical Education (NASPE), a leading organization of physical health, recommends at least two and a half hours a week of physical education for middle and high school students. Physical activity (PA) refers to opportunities for children to be active, separate from state mandated physical education (PE) requirements. NASPE also suggests at least an hour of physical activity per day while avoiding prolonged periods of inactivity. The amount of physical activity time varies from state to state and it is one of the elements of State Compliance Score.

Energy intake. The process for creating the nutritional requirements for the 2010 USDA Guidelines took nearly a decade and involved many large, powerful groups including the Action for Healthy Kids (AFHK), National Alliance for Nutrition and Activity (NANA), and the School Nutrition Association (SNA). AFHK is "the nation's leading non-profit and largest volunteer network fighting childhood obesity and undernourishment by working with schools to improve nutrition and physical activity

(PA) to help our kids eat right, be active every day, and be ready to learn" (USDA, 2010c). Created in 2002, this organization has over 11,000 members.

AFHK's Wellness Policy Fundamentals provided a framework for the 2010 USDA Guidelines (AFHK, 2014). It included six policy components that are reflective of the federal mandates. A study was conducted by the AFHK on the then school nutrition policies. The study found more than 256 separate policies from 49 states. The assessment included a sample meant to reflect the underlying 11,000 school districts. The study found the number and complexity of school nutrition policies made analysis of their efficacy in reducing obesity untenable. The AFHK called for a single, national school nutrition standard using the AFHK Wellness Policy Fundamentals as the foundation.

The National Alliance for Nutrition and Activity (NANA) is made up of more than 300 organizations, including steering committee members such as the American Cancer Society, the American Diabetes Association, and the National Association for Sport and Physical Education (NANA, 2013). NANA developed a 26-page document entitled *Model Local School Wellness Policies on Physical Activity and Nutrition* (NANA, 2013, p. 342). This document is by far the most comprehensive nutrition policy resource predating the 2010 USDA Guidelines.

The School Nutrition Association is "a national, nonprofit professional organization representing more than 55,000 members who provide high-quality, low-cost meals to students across the country" (SNA, 2013). SNA is a recognized authority on school nutrition since its inception in 1946. The SNA conducted two studies. *A*

Foundation for the Future: Analysis of Local Nutrition Policies from the 100 Largest School Districts (*Future*), and *A Foundation for the Future II: Analysis of Local Nutrition Policies from 140 School Districts in 49 States* (*Future II*) were accessed via SNA's website and used in this research. *Future* (October 2006) analyzed local nutrition policies from the 100 largest school districts in the United States. *Future II* (December 2008) analyzed local nutrition policies from a sample of 140 school districts in the United States representing seven regions. Both studies supported a change in the nutritional composition of meals but did not call for a reduction in the number of calories. The study suggested that the obese were in the minority and changes to calorie counts for all students was counterproductive and antithetical to providing nutrition to students that cannot afford to buy their own food.

Childhood Obesity Intervention Research

Obesity is a complex phenomenon, affected by clusters of factors at the *community, family, and individual* levels. The purpose of this research was to isolate the association between a *community-based* nutrition intervention program and state-level high school obesity rates. Given the volume of research on obesity treatment, the scope of this review is limited to summarizing, analyzing, and synthesizing recent research on the efficacy of school-based treatments of childhood obesity.

Widespread increases in obesity despite the universal recognition of the individual and societal costs suggests that obesity is influenced by multiple interlinking factors, and not moderated by knowledge of the consequences (Skelton, Buehler, Irby & Grzywacz, 2012) . Systems include: i) individual behaviors (*psyche-based*), ii) parenting styles and

family dynamics (*family-based*), iii) community and demographic factors (*community-based*), including school. This view was supported by the bio-psychosocial perspective of illness that posits that numerous psychological and sociological factors subjectively influence obesity, and that it is reductionist to assume that health and illness are only affected by objectively verified, biomedical factors (Stange, 2010). As children grow up their food intake becomes more reliant on external cues, such as the amount and type of food presented. Since children spend so much of their time in schools, much of the obesity intervention research is based in schools. Research on the causes and potential interventions for childhood obesity examined the following: i) individual behavioral change, ii) family, and iii) sociological/school-based interventions.

Family Systems Theory (FST) is a framework for understanding how family relationships affect individual behavior, and in this case, childhood obesity (Pocock, Trivedi, Wills, Bunn, Magnusson, 2010; Klein & White, 2008). Skelton et al. (2012) conducted a comprehensive review of the literature on family theories and pediatric obesity research and treatment. The search yielded 76 relevant abstracts of which 17 were thoroughly reviewed and the findings reported. FST was used as a framework in four reviews/commentaries on childhood obesity, and one article used FST to intervene in childhood obesity (Kitzman-Ulrich et al., 2009). FST principles were combined with Social Cognitive Theory for the treatment. A sample of 42 female adolescents aged 12 to 15 years completed a 16-week randomized controlled trial comparing three groups: multifamily therapy plus psycho-education (n = 15), psycho-education-only (n = 16), or wait list (control; n = 11) group. Adolescents in the family-based psycho-education only

group demonstrated a greater decrease in energy intake compared to the multifamily therapy plus family-based psycho-education and control groups ($P < 0.01$). The findings from this study provided preliminary support for a family-based psycho-educational weight-loss program that integrated family variables to reduce energy intake in overweight (>95th percentile) adolescent girls. However, no significant effects were found for body mass index. Limitations to Kitzman-Ulrich et al. (2009) included the following: i) while significant decrease in energy intake was observed, no change in BMI were observed, ii) power to detect effects was limited due to the small sample size, and iii) the 24-hour dietary recall method was used and is subject to significant inaccuracy. The Kitzman-Ulrich et al. (2009) study was included here to illustrate relative lack of research quality regarding systems theory to treat obesity. There were no large-scale longitudinal studies on any obesity intervention available in the literature. The federal government's decision to use a school nutrition-based obesity intervention would be strengthened and would gain increased support if it was based on proven long-term research.

Legislative-Based Interventions

Alderman, Smith, Fried, and Daynard (2007) suggested a sociological approach to obesity intervention at the *community-level*, meaning the examination and manipulation of social issues and regulations to effect obesity rates. Their sociological approach does not reject autonomous behavior; rather it examines individual behavior in social context and suggests regulatory intervention for obesity, including federal regulation of school nutrition. Using the law to create a social context and social capacity for health is more

effective than focusing on the attainment of actual health for individuals supports a social epidemiologic view (Alderman et al., 2007). Alderman et al. (2007) found that legislation to reduce childhood obesity addressed society's risk factors, as opposed to individual behavior. They suggested the regulatory scheme should "shift focus away from individual risk factors and seek the situational and environmental influences that create an environment conducive to health" (Alderman et al., 2007, p.102). Alderman et al. (2012) stated, "To be as effective as possible as a policy tool, the law should focus not only on frequently illusory individual choices, but also on population-wide change and environmental conditions that affect individual decisions" (p. 90-91). Regulatory schemes seek to control weight and obesity by focusing on individual choices about diet and exercise.

Schwartz and Brownell (2007) also suggested that *community-level* legislative and regulatory action is the appropriate intervention to reduce childhood obesity. Schwartz and Brownell (2007) proposed changing the frame from which the public perceives obesity as an individual problem to that of a societal, public health catastrophe. They use the term "toxic environment" in that it refers to "several layers of the world around us that interact with key elements of our biology" (Schwartz & Brownell, 2007, p. 79). Schwartz and Brownell (2007) suggested that when emphasis is diverted from personal responsibility for obesity and redirected to obesity as a public health issue, then legislation and regulation should be more effective in combating juvenile obesity. Schwartz and Brownell (2007) used adding fluoride to America's drinking water as an example: from a medical approach, the increase in children's cavities would have been an

individual problem. Seek dental care and take fluoride to fix it. However, the public health approach had the government put fluoride in all our water. This health intervention did not require a behavior change or group modification, it was silent and led to a profound transformation in public health (Schwartz & Brownell, 2007).

Regulation at the federal level can decrease the advertising of unhealthy foods to children. This is similar to laws restricting tobacco and alcohol advertising. Some proposals included restricting the frequency and content of unhealthy food advertisements during child programming as well as having equal representation of good nutrition and physical activity advertisements, alternatively, balancing unhealthy food ads against nutritious food and physical activity ads. Regulation also included "the print media, the Internet, in-store promotional campaigns, and product tie-ins to children's television programs" (Mermin & Graff, 2009, p. 2603). Public health officials were specifically targeting obesity reduction. Many public health activists support federal and state governments' involvement in fighting the obesity epidemic, but there is also opposition. Food industries are concerned about their profits, and consumer groups are concerned about their civil rights (Mermin & Graff, 2009).

Many agree that obesity is a public health issue, therefore clearing the way for state governments to use their police power "to develop and enact measures to counter obesity" (Mermin & Graff, 2009, p. 1800). The federal government control over food extends to school nutrition through the SLP, however, their jurisdiction stops at meals. A la carte foods and other competitive food sales, as well as physical education and activity, are not under the federal laws. Therefore, even though the federal government's

involvement is limited in these areas, it can lay the tracks on which the states, exercising police power, can ride.

Individual states have police power specifically as it pertains to public health, welfare, and safety (Mermin & Graff, 2009). It gives states more freedom from constitutional barriers and more regulatory power when it comes to public health and the ability to issue laws and regulations that address public health issues. Civil libertarians take issue with state police power over individual food choice. While state, "Use of the law generally is a long supported and effective practice to advance public health (Ryan et al., 2007), the controversy remains, without agreement on where the right to intervene ends and parental rights begin.

The Healthy, Hunger-Free Kids Act implementation caused immense controversy. HHFKA school lunch implementation resulted in more than 1 million students choosing not to eat school meals each day (GAO, 2013). Those paying full price for lunch declined 10% in 2013 to the lowest level in more than a decade. Those that bought the newly mandated menu items were throwing the fruits and vegetables away. The GAO reported that 40% of the fruits and 75% of the vegetables were thrown away (GAO, 2013). In light of the controversy surrounding the HHFKA, the House of Representatives passed a bill that would postpone some implementation of significant parts of the HHFKA pending further investigation. At this writing, no change to the HHFKA has been made by Congress. The debate underscores the need for this study, which addresses the question, "Will HHFKA compliance actually reduce obesity rates?"

School-based Interventions

A study by Gonzales-Suarez et al. (2009) evaluated school-based interventions using the following treatments: i) increased exercise, ii) improved dietary behaviors, or iii) combinations of the two approaches (Gonzales-Suarez et al., 2009). Treatment protocols included classroom lessons emphasizing reductions in high fat, sugary foods; increases in the number of daily servings of fruits and vegetables; and increasing physical activity to improve health. In most cases, physical education classes included an increase for time spent in moderate-to-vigorous physical activity. Most of the studies used multiple intervention strategies and several included modifications in the availability of healthy foods in school cafeterias. The increased allocation of time to rigorous exercise was consistent with the 2010 USDA Guidelines; however, the majority of food interventions were classroom education based rather than changes to fruit and vegetable availability in school cafeterias, limiting the applicability to the present study.

Compulsorily education and the attendant administrative structure make school age children an ideal population for testing these interventions (Katz et al., 2009). Much of the research utilized multi-factor interventions in a school setting, including changes in food intake, physical activity, sedentary behaviors, or combinations of these (Gonzalez-Suarez et al., 2009; Katz, et al., 2009; Sobol-Goldberg et al., 2013). Many combinations of the following potential interventions were studied in schools: menu changes, physical education, skills building, behavior modification, extracurricular activities, incentive schemes, and modification of the overall food environment. Research on school age

obesity interventions frequently included an element of parental involvement (Katz et al., 2009).

A substantial hurdle in evaluating obesity intervention efficacy is that of measurement. Isolating the effects of an intervention, which occurred over a long period of time and have complex interactions, made outcome evaluation problematic (Malik et al., 2013). Treatment effects might be subtle and diffuse, and difficult to isolate, particularly in the case of obesity where there are certainly multiple causations. As a result, research on obesity interventions tends to modify behavior within a well-circumscribed sample over a short timeframe, rather than a large-scale, longitudinal study. The number of quantitative, peer-reviewed research articles on school-based childhood obesity intervention in the past 5 years exceeded 115. The following research review focused on quantitative, randomized controlled trials (RCT) and clinically controlled studies to limit the size of the review.

Gonzalez-Suarez et al. (2009) conducted a meta-analysis of 26 studies to evaluate the effectiveness of school-based intervention programs on childhood obesity in terms of BMI, percentage of body fat, waist girth, triceps, skinfold, and waist–hip ratio. For the purposes of the study, short-term outcomes were measured immediately after completion of the intervention, while long-term outcomes were measured at least 6 months after intervention program completion. The duration of the implementation of the intervention programs varied, from less than 6 months to greater than 2 years. Only those RCTs and clinical controlled trials that had high methodological critical appraisal scores, i.e. greater than 60% of criteria met, as measured by the Critical Appraisal of Evidence Effectiveness

tool from the Joanna Briggs Institute. The use of RCVTS and clinical controlled trials, multiple raters, a large sample size, and long-term studies makes the Gonzalez-Suarez (2009) study robust.

Gonzalez-Suarez et al. (2009) found that, in the short-term, school-based interventions were effective in decreasing percentage of body fat and waist girth but not in reducing BMI in treatment groups in comparison to control groups. However, no significant reductions in any observed variable were detected in the long-term. The effectiveness of a school-based intervention program could be influenced by many factors. The Gonzalez-Suarez et al. (2009) research design addressed program duration, and included only controlled experiments, factors such as the age of participants, involvement of parents, school environment/culture, and compliance with the intervention cannot be readily controlled.

Brown and Summerbell (2009) conducted a meta-analysis of 38 studies to evaluate the effectiveness of school-based intervention programs on childhood obesity in terms of BMI, absolute body weight, skin-fold thickness, and percentage of overweight. Studies with school-aged children ages 5 to 18 were included. A study was included only if the research design was a RCT or controlled clinical trial of a lifestyle intervention, school-based, and treatment duration was at least 12 weeks. Study inclusion criteria were identical to the NICE obesity guidance (NICE, 2013), with the following exception: only studies with weight outcomes were included. Study duration of the 38 studies ranged from 12 weeks to 22 years. Twenty-two studies had follow-up of less than 1 year, four studies had follow-up between 3 and 5 years and two studies had follow-up periods of 10

and 20 years. The use of RCT and clinical controlled trials, school-based treatment protocols, and large sample sizes made the Brown and Summerbell (2009) robust and highly relevant to the present study.

Brown and Summerbell (2009) found insufficient evidence to assess the effectiveness of dietary interventions to prevent obesity in schoolchildren, or to compare the relative effectiveness of diet alone compared to PA alone interventions. One of three (33%) diet studies alone, five of 15 (33%) PA studies, and nine of 20 (45%) combined diet and PA studies demonstrated significant differences between intervention and control for BMI. The study concluded that school-based interventions to increase PA and improve diet may help children to maintain a healthy weight, but the results are inconsistent and short-term. The large sample size for both the Brown and Summerbell (2009) study and the underlying primary research lends considerable reliability and validity to the results.

Adolescents Committed to Improvement of Nutrition and Physical Activity (ACTION) conducted a study to the determine feasibility of using a school-based health center (SBHC) weight management program to reduce BMI. Sixty participant-caregiver dyads in two urban New Mexico SBHCs were randomized to deliver ACTION or standard care. The treatment consisted of eight visits of motivational interviewing, and multimedia presentations to improve diet decisions and physical activity behaviors (Kong et al., 2013). The study found that ACTION trials of moderate to high intensity (>25 hours) which included adolescent peer participants were more effective than low-intensity interventions. While the sample was small, the study showed improvements for

both boys and girls that were still significant after six months. The large number of caregiver hours required for the treatment is a limitation to the treatments cost effectiveness in real world applications.

Katz et al. (2009) reported that school-based interventions with significant parental involvement were more effective, however this finding was inconsistent as well. Several reviews explored the relative effectiveness of interventions aimed at diet, physical activity, or a combination of the two, with no clear answers. Katz et al. (2009) concluded that school-based intervention programs were the most promising if they combined dietary and physical activity elements. In contrast, Brown and Summerbell (2009) found that studies emphasizing physical activity alone were more likely to report a significant impact on BMI than any other combination of interventions.

Summary

High school obesity rates are at epidemic levels with profoundly negative implications for long-term health and healthcare costs. The federal government intervened to reduce childhood obesity by passing the HHFKA in 2010 that creates nutrition and physical activity mandates for school districts. Pursuant to the HHFKA, the USDA created the 2010 USDA Guidelines meant to increase physical activity, reduce calories consumed at school meals, and convert certain calories from fat content to fruits and vegetables. The 2010 USDA Guidelines represented the first federal intervention in school nutrition policy to affect childhood obesity. As a result, more than 37 schoolchildren were participants in a nationwide study to determine the effect on childhood obesity of the policy changes.

There was considerable debate in the literature regarding the causes of the childhood obesity epidemic that began in the 1980s in the United States. Obesity is a complex phenomenon, affected by clusters of factors at the community, family, and individual levels. Research has shown that obesity is associated with ethnicity, race, SES, gender and region of residence. Causes cited in the literature include genetics, energy imbalance, metabolic abnormalities, diet, and physical activity level. The efficacy of using federal intervention in school meal planning is not known, there is no precedent for using school nutrition policy to affect childhood weight or obesity (CDC, 2006; Perryman, 2011).

There is a gap in the literature regarding the relationship between school meal policy and childhood obesity rates. The purpose of this quantitative study was to examine the relationship between compliance with HHFKA regulations and state-level high school obesity rates. This study was the first, of what will likely be many attempts to measure the impact of the HHFKA to reduce childhood obesity rates.

Chapter 3 Methodology describes the research design, sample, statistical tests, and data analysis plan to address the research questions. State compliance with 2010 USDA guidelines, described in detail in this Chapter, were assessed by comparing the requirements in the regulations to the actual state school lunch policy. An ANOVA study was conducted to test for an association between State Policy Compliance and childhood obesity rates after accounting for known factors, such as SES and race.

Chapter 3: Research Method

Introduction

The purpose of this quantitative study was to examine the association between school nutrition policy compliance and federal school nutrition regulations and high school obesity rates. The research was significant because it examined the association between federal school nutrition regulation and high school student obesity rates at a time while controversy exists regarding implementation of the 2010 USDA Guidelines (CBS, 2014). The controversy surrounds high school student complaints about the type and amount of food available for breakfast and lunch under the new guidelines (CBS, 2014). The research was significant because it informed public policy makers at a time when some high school administrators were choosing to ignore the 2010 USDA Guidelines due to complaints from students and parents.

This chapter presents a description of the study design, sample powering, and data analysis. It also includes the rationale for the specific research design, methodology, and the data collection procedure. The study only used existing data collected from published governmental sources. Chapter 3 includes no mention of study participants, ethical considerations, recruitment, instrumentation, treatment, or archival data sources due to the absence of study participants.

Research Design and Rationale

The dependent variable was state obesity rate and the independent variable was Compliance Scores, as calculated by the researcher. Covariates were median income and region type. This quantitative study used a causal research design. The methodology

aimed to measure state compliance with the 2010 USDA Guidelines for school meal nutrition and test for an association between Compliance Score and high school obesity rates. The causal research design is appropriate when variation in one phenomenon, in this case Compliance Scores, leads to or results in, on average, variation in another phenomenon, high school obesity rates. The causal research design can be used when an empirical association exists between variables and there is an appropriate, and reasonable, relationship in time. The causal research design for this study increased the probability of generating reliable and valid results (Leedy & Ormrod, 2012). There was no known resource or time constraint associated with the selection of a causal research design. No attempt was be made to affect the behaviors of any individual or entity therefore the research is of a non-experimental nature.

A causal research design using quantitative methodology was an appropriate choice for this study to advance knowledge. Both the dependent and independent variables were continuous and reliable sources and were available from which to collect data. In the case of causal quantitative studies, hypotheses were either accepted or rejected using inferential statistics and based on observable behavior (Liu & Ju, 2010). According to Leedy and Ormrod (2012), there were many advantages to using a quantitative methodology: 1) there is a clear identification of independent and dependent variables, 2) the research problem can be clearly stated and hypotheses tested, and 3) high levels of reliability are available relative to other methods.

Population

The target population for this study was all 50 U.S. states with 15.9

million high school students who were subject to state and federal nutrition regulation (IES, 2014). Based on an estimated 13% high school obesity rate, there were approximately 2.1 million obese high school students in 2012 (Malik et al., 2013; CDC, 2013).

Sampling and Sampling Procedure

Based on inclusion of all 50 states in the study sample (see below), there was no sampling strategy, procedure, or frame. Sample size was a function of population, α and β. Sample size for a small population, as is the case when using 50 states, approaches 100% of the population. The formula for powering the sample size is:

$$n = \frac{X^2 * N * P * (1-P)}{(ME^2 * (N-1)) + (X^2 * P * (1-P))}$$

Where:

n = Sample size
X^2 = Chi-square for the specified confidence interval at 1 *df*
N = Population size
P = Population proportion
ME = desired Margin of Error

Assuming α = .05 and $p = 0.05$, the calculated sample size is 44 (Faul, Erdfelder, Buchner & Lang, 2009). Based on the proximity of the calculated sample size to the total population, the study sample included the entire population.

Procedures for Data Collection

State Compliance Scores data was collected from the State School Health Policy Database compiled by the National Association of State Boards of Education (NASBE, 2013). The NASBE data was checked against state government websites for reliability.

The reliability and reputability of the Compliance Scores data source is addressed by the following description taken from the NASBE website:

> The NASBE State School Health Policy Database is a comprehensive set of laws and policies from 50 states on more than 40 school health topics. Originally begun in 1998, and maintained with support from the Centers for Disease Control and Prevention (CDC), the policy database is designed to supplement information contained in CDC's School Health Policies and Programs Study. (NASBE, 2013).

The Census Bureau and Center for Disease Control websites provided state median income, state high school obesity rate, and degree of urbanization (Census Bureau, 2012; CDC, 2012).

Operationalization of Variables

Definitions.

Compliance Score: Compliance Scores represent the number of the 17 potential 2010 USDA Guideline nutritional elements present in state nutrition policy.

Degree of urbanization: For the purposes of this study, degree of urbanization is defined as the percentage of the total state population that lives in urban areas, as defined by the Census Bureau (Census Bureau, 2012).

High school obesity rate: High school obesity was the rate reported by the Center for Disease Control for 2011 (CDC, 2012).

Median income: Median income was the amount reported by the Census Bureau for each state in 2011 (Census Bureau, 2012).

Table 1

Variables, Scales of Measurement, Variable Type, and Operationalization

Variable	Scales of Measurement	Variable Type	Source
High School Obesity Rate	Continuous	Dependent Variable	Center for Disease Control (2012)
Compliance Score	Interval	Independent Variable	State School Health Policy Database (2012)
Median Income	Continuous	Mediating Independent Variable	Census Bureau (2012)
Degree of Urbanization	Continuous	Mediating Independent Variable	Census Bureau (2012)

Compliance Scores were calculated in the following manner. Each state's school nutrition policy in 2007 was compared to the 2010 USDA Guidelines for breakfast and lunch. State policy was examined for compliance with each of the 17 nutritional categories in the 2010 USDA Guidelines. The breakfast categories are: 1) calories, 2) fluid milk, 3) fruits, 4) grains, 5) meats/meat alternatives, 6) saturated fat, 7) sodium, and 8) trans-fat. The school lunch categories are: 1) calories, 2) fluid milk, 3) fruit, 4) grains, 5) meats/meat alternative, 6) saturated fat, 7) sodium, 8) trans-fat, and 9) vegetables, for lunch. Each time the state's nutrition policy met or exceeded the 2010 USDA Guidelines, one point was awarded, for a maximum potential Compliance Score of 17. For example, if the state's breakfast calorie policy required the same or less number of calories as the 2010 USDA Guidelines, one point was awarded. The categories were equally weighted, with one point awarded for each item. Appendix A contains the scoring sheet to be used

to score each state's compliance. Appendix B presents an example of the spreadsheet format used to capture compliance data and generate Compliance Scores.

Data Analysis Plan

Descriptive and inferential statistics were calculated using the Statistical Package for the Social Sciences (SPSS). High school obesity rate data was downloaded directly from the U.S. CDC website to an Excel spreadsheet and a scatterplot generated to identify outliers, and bad or missing data (Rousseeuw & Leroy, 2003). Median income and degree of urbanization data was downloaded from the Census Bureau website to an Excel spreadsheet and a scatterplot was generated to identify outliers, and bad or missing data. Compliance Score data was captured using the scoring sheet in Appendix A and transferred to an excel spreadsheet for analysis. Dependent and independent variable Excel spreadsheet data was transferred to SPPS for analysis.

Research Question. After controlling for median income and region of residence (rural or urban), is there an association between state high school student obesity rates and Compliance Score?

Hypothesis:

H_{1o}: There is no statistically significant correlation between state high school student obesity rates and Compliance Scores, after controlling for median income and degree of urbanization.

H_{1a}: There is a statistically significant correlation between state high school student obesity rates and Compliance Scores, after controlling for median income and degree of urbanization.

H_1 was tested using ANCOVA analysis. Covariates of median income and degree of urbanization were chosen based on previous research that consistently found that each was significantly predictive of childhood obesity rates (Zhang et al., 2011). The purpose of this analysis was to isolate the effect of state nutrition policy on state high school student obesity rates. The results were interpreted using the output from SPSS, which reported ANCOVA results to accept or reject the null hypothesis.

Threats to Validity

External validity refers to the generalizability of findings to other settings or populations. While no threats to external validity were noted, the results might not be generalizable to other age groups, cultures, or populations with differing ethnic composition (Leedy & Ormrod, 2012).

The following two potential threats to internal validity are noteworthy:

1. History: a significant amount of time will have passed between the measurement of state compliance score and high school obesity rates. Any number of factors could have confounded the relationship between state nutrition policy and high school obesity rates.
2. Statistical regression: since the study aimed to measure differences in similar populations, compensating factors and the passage of time might eliminate those differences.

Childhood obesity is a well-recognized and thoroughly vetted construct, which removes any threat to construct validity. The use of standard statistical procedures on 100% of the target population reduces threats to statistical conclusion validity but does

not eliminate all threats. The primary threat to statistical conclusion validity is the potential for an unmeasured covariate with greater explanatory value the independent variable.

Summary

This study used a causal research design and a quantitative methodology. The causal research design was appropriate for this study given the potential for an empirical relationship between variables and the reasonable relationship in time. The study aims to test for an association between state nutrition policy compliance and state high school obesity rates. The study used descriptive statistics and the ANCOVA inferential statistic to describe the findings and test the hypothesis. Chapter 4 presents the findings, characterizes the study sample, and discuss methodological issues arising during the research process.

Chapter 4: Results

Introduction

The purpose of this quantitative study was to examine the relationship between compliance with the *Healthy, Hunger-Free Kids Act* of 2010 (HHFKA) regulations and state-level high school obesity rates. The HHFKA was passed to address the growing U.S. obesity epidemic (Federal Register, 2010). The HHFKA implementation under the 2010 USDA Guidelines mandating nationwide changes in school cafeteria menus during the 2013 - 2014 school year was met with significant resistance (CBS, 2014). No large-scale study on the relationship between school nutrition regulations andSu high school obesity rates was conducted before enactment of the HHFKA to establish the efficacy of the then proposed school menu changes. This study aimed to examine the relationship between state high school obesity rates and state policy compliance with 2010 USDA Guidelines prior to their enactment. The hypothesis was that U.S. states with at least some 2010 USDA Guideline compliance in 2007 would report lower high school obesity rates by 2013, after controlling for median income and region of residence (rural or urban), known covariates of high school obesity rates.

Chapter 4 includes a discussion of research design issues, data collection methods, and study findings. Descriptive and demographic statistics are presented for all 50 states taken together, and separately for two samples, one with positive Compliance Scores, and the second with zero Compliance Scores. Statistical analyses, hypothesis tests, and results are detailed and discussed. Study findings are summarized and Chapter 5: Conclusions and Recommendations is introduced.

Data Collection

The study sample included 15.9 million high school students subject to federal, state and local nutrition regulation (IES, 2014), of which 2.0 million met the definition for obesity (CDC, 2014). Study data was collected for each of the 50 United States for Compliance Scores, high school obesity rates, median income, and rurality. State rurality and median income data was collected from the 2013 U.S. Census Bureau tables (Census Bureau, 2014). High school obesity data was drawn from two sources. The 2013 Youth Risk Behavior Survey (YRBS) was used for the 42 states that responded to the survey (CDC, 2014), and data for the remaining eight states (California, Colorado, Indiana, Iowa, Minnesota, Pennsylvania, Oregon, and Washington) was drawn from the Robert Wood Johnson Foundation (RWJF) report on *The State of Obesity: Better Policies for a Healthier America 2014 (*RWJF, 2014). Based on these sources for state high school obesity rates, the nationwide high school obesity rate was 12.5% in 2013. By state detail for all study variables is included in Appendix D.

State Compliance Scores data was collected during November and December 2014 from the State School Health Policy Database compiled by the National Association of State Boards of Education (NASBE, 2013). The 2010 USDA Guidelines were compared to each state's school nutrition policy for eight breakfast and nine lunch components (Appendix B). While the 2010 USDA Standards for vegetable descriptive indicators included separate categories for dark green vegetables, orange vegetables, legumes, and starchy vegetables, this study combined the vegetable-related indicators into a single category called vegetables. Data was available for all 50 states and was

scored as compliant or non-compliant for each of the 17 nutritional components. When insufficient information was available in the state policy database to determine compliance, the category was coded as non-compliant.

Results

As shown in Table 2, the mean nationwide high school obesity rate was 12.5% (*SD* = 2.4%), mean rurality was 26.4% (SD=14.5%), median income was $50,595 (SD=$7,338), and mean Compliance Score was 2.32 (SD=3.16). For the purposes of this analysis, the 50 states were divided into two samples, those with some level of compliance (Semi-complaint) with 2010 USDA Guidelines, and states with no compliance (Non-compliant). The mean high school obesity rate for the Semi-compliant states was 13.2% (SD=2.3%) compared to 11.9% (SD=2.5%) for Non-compliant states, although not a significant difference at $p \leq 0.10$. The mean population residing in rural areas for the Semi-compliant states was 28.1% (SD=15.1%) compared to 25.0% (SD=13.7%) for Non-compliant states, although not a significant difference at $p \leq 0.10$. The Semi-compliant states mean obesity rate was higher than the Non-compliant states. Data was collected from the entire population of 50 states, state-level detail for all study variables is included in Appendix D.

Table 2

Mean Obesity Rates and Compliance Scores

	Obesity Rate	% Rural Population	Median Income	Compliance Score	Population
Semi-Compliant States (N=23)					
Mean	13.2%	28.1%	$49,168	5.04	6,153,792
STD	2.3%	15.1%	$6,375	2.80	8,148,043
Non-Compliant States (N=27)					
Mean	11.9%	25.0%	$51,811	0.00	6,170,615
STD	2.5%	13.7%	$8,303	0.00	5,675,254
All 50 States	12.5%	26.4%	$50,595	2.32	6,162,876
STD	2.4%	14.5%	$7,338	3.16	6,911,649

Table 3 lists the 23 Semicompliant states, obesity rates, rural population percentage, median incomes, and compliance percentages.

Table 3

Semicompliant States

State	2013 Obesity Rate	2013 % Rural Population	2013 Median Income	2007 Compliance Score	Compliance %
Alabama	17.1%	41.0%	$ 42,590	2	12%
Alaska	12.4%	34.0%	$ 57,431	2	12%
Arizona	10.7%	10.2%	$ 48,621	4	24%
Arkansas	17.8%	43.8%	$ 41,302	2	12%
California	15.1%	5.0%	$ 53,367	4	24%
Connecticut	12.3%	12.0%	$ 65,415	6	35%
Delaware	14.2%	16.7%	$ 54,660	2	12%
Idaho	9.6%	29.4%	$ 47,459	7	41%
Michigan	13.0%	25.4%	$ 48,879	9	53%
Minnesota	14.0%	26.7%	$ 57,820	3	18%
Mississippi	15.4%	50.7%	$ 41,090	4	24%
Nebraska	12.7%	26.9%	$ 55,616	6	35%
Nevada	11.4%	5.8%	$ 47,043	4	24%
New York	10.6%	12.1%	$ 50,636	6	35%
North Carolina	12.5%	33.9%	$ 45,206	7	41%
Oregon	9.9%	19.0%	$ 51,526	2	12%
Pennsylvania	13.5%	21.3%	$ 49,910	2	12%
Rhode Island	10.7%	9.3%	$ 49,033	11	65%
South Carolina	13.9%	33.7%	$ 40,084	4	24%
South Dakota	11.9%	43.3%	$ 47,223	4	24%
Tennessee	16.9%	33.6%	$ 42,279	8	47%
Vermont	13.2%	61.1%	$ 51,862	6	35%
West Virginia	15.6%	51.3%	$ 41,821	11	65%
Washington	13.1%	28.1%	$ 49,467	5	30%

Table 4 summarizes nationwide compliance rates for 2010 USDA Grades 9-12 Breakfast component compliance. Individual component compliance rates ranged from 6% to 28% with a mean compliance rate for Breakfast equal to 14.0%. Fluid milk and saturated fat had the highest compliance at 28% and 26%, respectively. Breakfast components with the lowest compliance rates were calories, fruit, grains, protein, and sodium at 8% or less. Examples from statutory language that was compliant for fluid milk included the following: Idaho and Mississippi offered only fat-free (skim) or 1% fat content milk for all meals. On the other hand, Pennsylvania was non-compliant in the fluid milk requirement because the language used states that at least 75% of milk offered must be 2% fat or less. Pennsylvania was also non-compliant because the serving size for all grade levels must be 8 oz. or less and Pennsylvania permits a 12 oz. serving size in middle and high school.

Table 4

Nationwide Grades 9-12 Breakfast Compliance

Category	# States Compliant	% Compliant
Calories	3	6%
Fluid Milk	14	28%
Fruit	4	8%
Grains	4	8%
Protein	4	8%
Saturated Fat	13	26%
Sodium	4	8%
Trans-fat	9	18%
Total		14%

Table 5 summarizes nationwide compliance rates for 2010 USDA Grades 9-12 Lunch component compliance. Individual component compliance rates ranged from 6% to 26% with a mean compliance rate for Lunch equal to 14.0%. Fluid milk and saturated fat had the highest compliance rate at 26%. Lunch components with the lowest compliance rates were calories, fruit, grains, protein, and sodium at 8% or less. Examples from statutory language that was compliant for fluid milk included the following: Examples of statutory language for Lunch policy included: Washington State was non-compliant in sodium because the sodium limit was significantly higher than guidelines at 1100 mg.

Table 5

Nationwide Grades 9-12 Lunch Compliance

Category	# States Compliant	% Compliant
Calories	3	6
Fluid Milk	13	26%
Fruit	4	8%
Grains	4	8%
Protein	4	8%
Saturated Fat	13	26%
Sodium	4	8%
Trans-fat	9	18%
Vegetables	7	14%
Total		14%

Hypothesis 1

Test for skewness and kurtosis revealed that the study data and residual errors were normally distributed, thereby meeting the necessary assumption of use of Pearson and ANCOVA statistics.

There was no statistically significant correlation between state high school student obesity rates and Compliance Scores, after controlling for median income and degree of urbanization. The first step in testing Hypothesis 1 was to verify that rurality and median income are covariates (Leedy & Ormrod, 2012). Table 6 shows Pearson correlation statistics between each study variable. There were significant correlations between the dependent variable, high school obesity rate, and study covariates of rurality (r = .404)

and median income (r = -.454). As shown in previous studies, obesity was negatively correlated with median incomes and positively correlated with population density. Since the absolute value of the correlation between high school obesity and both rurality and median income was between $r \geq .30$ and $r \leq .90$, both rurality and median incomes were covariates and should be accounted for in the main analysis (Leedy & Ormrod, 2012). Table 6 also shows no significant correlation between high school obesity rates and Compliance Score (r = .156) for the sample of 50 U.S. states.

Table 6

Study Variable Pearson Correlation Matrix

Variable		Obesity	Rurality	Median Income
Obesity	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	50		
Rurality	Pearson Correlation	.404**		
	Sig. (2-tailed)	.004		
	N	50		
Median Income	Pearson Correlation	-.454**	-.455**	
	Sig. (2-tailed)	.001	.001	
	N	50	50	
Compliance	Pearson Correlation	.156	.107	-.192
Score	Sig. (2-tailed)	.279	.458	.181
	N	50	50	50

** Correlation significant at $p \leq 0.01$ (2 tailed).

Table 7 reports the results of the ANCOVA statistics to test Hypothesis 1. There was no significant effect of Compliance Score on high school obesity after controlling for the effects of median income and rurality, $F(3, 46) = 1.522$, $p > .05$. There was no

statistically significant correlation between state high school student obesity rates and Compliance Scores, after controlling for median income and degree of urbanization, the null hypothesis cannot be rejected.

Table 7

Effect of Compliance Score on obesity after Controlling for Median Income and Rurality

Dependent Variable (Obesity)	F	Sig.
Median Income	9.951	.000***
Rurality	5.623	.021*
Compliance Score	1.522	.739

Note. ***$p < .01$, *$p < .05$.

Summary

The purpose of this quantitative study was to examine the relationship between compliance with the *Healthy, Hunger-Free Kids Act* of 2010 (HHFKA) regulations and state-level high school obesity rates. Compliance Score data were calculated by comparing the each state's school nutrition policy to the 2010 USDA Guidelines for school meals. As shown in Table 2, the mean nationwide high school obesity rate was 12.5% (SD=2.4%), mean rurality was 26.4% (SD=14.5%), median income was $50,595 (SD=$7,338), and mean Compliance Score was 2.32 (SD=3.16). The 50 states were divided into two samples, those with some level of compliance (Semi-complaint) with 2010 USDA Guidelines, and states with no compliance (Non-compliant). The mean high school obesity rate for the Semi-compliant states was 13.2% (SD=2.3%) compared to 11.9% (SD=2.5%) for Non-compliant states, although not a significant difference at $p \leq 0.10$. The mean population residing in rural areas for the Semi-compliant states was

28.1% (SD=15.1%) compared to 25.0% (SD=13.7%) for Non-compliant states, although not a significant difference at $p \leq 0.10$. The Semi-compliant states mean obesity rate was higher than the Non-compliant states.

As shown in Table 6, there was no significant correlation between high school obesity rates and Compliance Scores (r = .156). There were significant correlations between high school obesity rates and study covariates of rurality (r = .404), and median income (r = -.454). In accordance with previous studies, obesity was negatively correlated with median incomes and positively correlated with population density, and were treated ass covariates. As shown in Table 7, the null Hypothesis 1 was accepted there was no statistically significant correlation between state high school student obesity rates and Compliance Scores, after controlling for median income and degree of urbanization. Chapter 5 includes a discussion of the findings, conclusions, and recommendations for future research.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this quantitative study was to examine the relationship between compliance with the *Healthy, Hunger-Free Kids Act* of 2010 (HHFKA) regulations and state-level high school obesity rates. The HHFKA and the subsequent 2010 USDA Guidelines represented an attempt to intervene legislatively at the federal level to reduce nationwide childhood obesity rates. The legislation was passed in response to high school student obesity rates in the U.S. that had tripled to 12.8% between 1980 and 2011 (CDC, 2013; Ogden et al., 2010). The HHFKA was passed despite the lack of a single large-scale, longitudinal study on the effect of school nutrition policy on childhood obesity (Brown & Summerbell, 2009; Gonzalez-Suarez et al., 2009). This study was particularly timely due to the widespread criticism during the 2014-2015 school year regarding the 2010 USDA Guidelines and the significant number of school districts that opted-out of compliance.

State-level data was collected and analyzed for all 50 states on high school obesity rates, Compliance Scores, state median income, and the proportion of citizens living in rural areas. Compliance Scores for each state were calculated by comparing 2007 state nutrition policy to the 2010 USDA Guidelines. The supposition was that obesity is a complex phenomenon and that changes in school cafeteria menus alone are unlikely to affect high school obesity rates.

The key finding was the absence of a significant relationship between high school obesity rates and compliance with the 2010 USDA Guidelines. States with the highest

high school obesity rates tended to have higher Compliance Scores, which may have been a function of the early recognition by those states that high school obesity rates warranted changes to high school nutrition policy. Earlier researcher's report of a significant relationship between high school obesity, state median income, and rurality was confirmed.

Interpretation of Findings

No Significant Correlation between Compliance and Obesity

As shown in Table 7, there was no significant effect of Compliance Score on high school obesity after controlling for the effects of median income and rurality. While there are no large-scale or longitudinal precedents for the use of school nutrition policy to prevent or treat obesity in the literature (Perryman, 2011), the research on obesity treatment modalities focuses primarily on individualized treatment regimens based on gender, degree of obesity, individual health risks, psycho-behavioral and metabolic characteristics, and the efficacy of previous weight loss attempts (Hainer et al., 2008). The literature on school-based nutritional programs and exercise was mixed, but generally resulted in modest, short-term weight loss and little or no long-term weight management benefit. The literature suggests that successful long-term obesity reduction involves daily physical activity, cognitive behavioral lifestyle modification, and frequently anti-obesity drugs.

Long-term, widespread increases in high school obesity rates, despite the devastating individual and societal healthcare costs, suggests that obesity is caused by multiple interrelated factors and is not subject to influence by knowledge of

consequences (Skelton, et al., 2012) . Research suggests that a well-balanced diet rich in fruit and vegetables is the healthiest lifestyle in terms of obesity. The fact that the National School Lunch Program (NSLP) provides 33% of the nutritional needs for 28 million school children of low income families makes it an attractive point for federal intervention. Despite these seemingly related observations, there was no evidence in the literature, nor in this study, that modifying the amount and types of food provided by NLSP would have any effect on high school obesity rates. This finding is important in light of the complaints by school boards that children were throwing away the fruit and vegetables served in the school cafeteria. Using the NSLP to reduce obesity may have the perverse effect of children consuming less nutrition than recommended due to increases in fruit and vegetables that are not consumed.

Obesity Rate Correlated with Median Income and Rurality

As shown in Table 6, obesity rate was positively correlated (r=.404) with proportion of citizens living in rural areas and the finding was significant at $p \leq 0.01$ (2 tailed). As such, as the proportion of the state population living in rural areas increases so does state high school obesity rate. As shown in Table 6, obesity rate was negatively correlated (r= -.454) with median income and the finding was significant at $p \leq 0.01$ (2 tailed). As such, as median income increases the state high school obesity rate decreases. Both of these findings are consistent with findings from Gonzalez-Suarez et al. (2009), and Brown and Summerbell (2009).

As shown in Table 7, median income and rurality both significantly affected high school obesity based on using the ANCOVA statistic. Since median income was

negatively correlated with rurality, this finding demonstrates that rurality contributes to high school obesity rates even after controlling for median income. Research on the marginal contribution of rurality after accounting for median income was mixed (Gonzalez-Suarez et al., 2009). This nation-wide study confirmed median income and rurality as covariates that independently contributed to high school obesity rates.

Semi-compliant States had Higher Obesity Rates

As shown in Table 3, twenty-three Semi-compliant states adopted an average of 30% of the 2010 USDA Guidelines as of 2007, however the obesity rate for the Semi-compliant states was 13.2% compared to 12.9% for the 27 states with no compliance at all. The finding that Semi-compliant states have 11% higher high school obesity rates was unexpected. This nationwide study used state-level data from all 50 states on high school obesity rates, compliance with federal nutrition regulations, state median income, and the proportion of each state's residents living in rural communities. The 50 states were divided into two samples, those with some level of compliance (Semi-complaint) with 2010 USDA Guidelines, and states with no compliance (Non-compliant). The difference has three potential explanations. First, the Semi-compliant sample median income was $2,643 lower than the Non-compliant sample. Since lower median income was shown in both previous studies and in this study to be associated with greater high school obesity rates, some portion of the difference is reasonably attributable to the difference in sample median income. Second, the Semi-compliant sample proportion of citizens living in rural areas was 3.1% higher than the Non-compliant sample. Since a higher proportion of rural citizenry was associated with greater high school obesity rates

in both previous studies and in this study, some portion of the difference is reasonably attributable to the difference in the sample mean proportion of rural citizenry. Third, since semi-compliant states have relatively higher high school obesity rates, it may be that those 23 states initiated changes to school nutrition policy earlier.

Limitations of the Study

Obesity is a complex phenomenon and researchers found SES, genetics, race, and a number of psychosocial variables to be associated with obesity (Brown & Summerbell, 2009; Gonzales-Suarez et al. 2009). This study aimed to isolate the effect of changing federal school nutrition policy and high school obesity rates by including median income and degree of rurality as covariates. Several factors serve to limit the generalizability of the results. First, unmeasured covariates such as race, SES, or psychosocial factors could have confound the results. Second, the study used state-level data for all study variables. Given the considerable variation in study variables and interpretation of the 2010 USDA Guidelines between schools within a single district, and between school districts, the use of state-level data may have obfuscated underlying patterns. Third, only 23 of the 50 states were at least partially compliant and their average compliance was less than 33%. The limited incidence and duration of compliance may have hidden a compliance effect that would have been apparent using a longer time period for the Compliance Scores. Fourth, some potential for researcher bias existed. Between state variance in terms of nomenclature in nutrition, regulations and policy added a level of subjectivity into the Compliance Score calculation that was not anticipated before the research began. There is no potential for participant bias, and researcher bias is limited by the use of factual data

provided by reliable third parties, all of which are government instrumentalities. The study's nationwide scope and reliance on government data was designed to maximize the usefulness of the findings.

Recommendations

School boards are in the process of implementing the 2010 USDA Guidelines as stipulated by the HHFKA in order to receive federal reimbursement for school meals under the NSLP. By school year 2015-2016, it is expected that nearly all public schools will find ways to bring breakfast and lunch programs into compliance. However, some districts are opting-out. A recent article in *Education Week* reported that two New York school districts, the 4,200-student Niskayuna Central School District and the 1,200-student Voorheesville district, are foregoing NSLP monies and opted-out of the mandated nutrition changes (Shah, 2014). Both districts implemented the 2010 USDA Guidelines and found that the students were discarding substantial amounts of food.

I recommend both large-scale and small scale longitudinal studies be conducted on the efficacy of using federal and state mandates to effect high school obesity rates. The opt-out by certain school districts mentioned above creates a control sample of school districts for comparison to school districts that comply with the 2010 USDA Guidelines. The research should be done annually using school district-level data on high school obesity, compliance, median income, and rurality. Data on the change in obesity rate by school district over time lends itself to a test-retest mean difference methodology using opt-out school districts as the control group. The validity and reliability of the study will improve with each successive year of data until the question regarding the

efficacy of federal mandate to effect high school obesity is resolved. Once that time interval and sample sizes are sufficient, perhaps certain school districts would be willing to modify the meal pattern to test other combinations of nutrition if the 2010 USDA Guidelines do not significantly reduce high school obesity. I also recommend conducting the study using individual school districts using known community covariates which are identified as significant influencers in those areas. In my opinion, each community, district, and state can have different levels of impact for various covariates.

Implications & Conclusions

High school obesity rates pose a serious threat to the health and well-being of America's children. Obesity is a complex phenomenon and the causes for its tripling in the past 30 years are poorly understood. The HHFKA was passed before completion of any large-scale, longitudinal studies on the efficacy of school nutrition policy to affect high school obesity. While there are significant limitations to this study, the absence of a significant improvement in high school obesity rates between 2007 and 2012 for states with at least some compliance suggests the limitations of using federal policy affect high school obesity rates. The fact that a significant number of school boards have affirmatively opted-out of the HHFKA mandates highlights the risks of using a one-size-fit all federal approach to a complex phenomenon. Recent pronouncements from the Obama administration signal changes to the HHFKA in response to those criticisms. The absence of scientific evidence that the HHFKA has any effect on childhood obesity rates leaves administrators without a basis for deciding which, if any, regulations should be

kept or discarded. Sweeping federal changes to something as critical as children's food should be done based on large-scale, longitudinal studies.

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Appendix A: Additional Key Search Terms

Key Search Terms / Keywords
Competitive foods
Community based obesity interventions
Comprehensive school health
Establishment of nutritional breakfast and lunch
Federal nutrition guidelines
Nutrition education
Nutrition guidelines
Nutritional standards for school nutrition program
Obesity interventions
School-based interventions
School breakfast
School food programs
School health promotion
School Lunch Program
School lunch program reimbursements
School wellness policies taskforce
Standards for food sold on school premises
USDA guidelines 2005
USDA guidelines 2010
Vending machines in schools

Appendix B: Compliance Scoring Sheet

2010 USDA Guidelines - Grades 9 - 12

State Name_____

Data Source(s)_____

Breakfast Item (weekly amounts)	C = Compliant	Lunch Item (weekly amounts)	C = Compliant
Calories (525 ± 75)		Calories (800 ± 50)	
Fluid Milk (5 cups)		Fluid Milk (5 cups)	
Fruit (5 cups)		Fruit (5 cups)	
Grains (9-10 oz.)		Grains (9-10 oz.)	
Protein (7-10 oz.)		Protein (10-12 oz.)	
Saturated Fat (10%)		Saturated Fat (10%)	
Sodium (≤ 740 mcg)		Sodium (≤ 740 mcg)	
Trans-fat (0)		Trans-fat (0)	
		Vegetables (5 cups)	
Sub-Score =			
Total Score =			

Appendix C: Compliance Score Tracking Spreadsheet

			BREAKFAST Grades 9-12			LUNCH Grades 9-12		
State	Policy	Meal_Pattern	Status			Status		
AL	Y	Fruit	N	Non-Compliant		N	Non-Compliant	
AL	Y	Vegetables				N	Non-Compliant	
AL	Y	Vegetables_DarkGreen				N	Non-Compliant	
AL	Y	Vegetables_Oranges				N	Non-Compliant	
AL	Y	Vegetables_Legumes				N	Non-Compliant	
AL	Y	Vegetables_Starchy				N	Non-Compliant	
AL	Y	Vegetables_Other				N	Non-Compliant	
AL	Y	Grains	N	Non-Compliant		N	Non-Compliant	
AL	Y	Meats	N	Non-Compliant		N	Non-Compliant	
AL	Y	Fluid Milk	C	Compliant		C	Compliant	
AL	Y	Calories	N	Non-Compliant		N	Non-Compliant	
AL	Y	Saturated_Fat	C	Compliant		C	Compliant	
AL	Y	Sodium	N	Non-Compliant		N	Non-Compliant	
AL	Y	Trans_fat	C	Compliant		C	Compliant	
AL		Compliance Sub-scores	3			3		
AL		Compliance Score	**6**					

Appendix D: Study Variables by State

State	2013 Obesity Rate (1)	2013 % Rural Population (2)	2013 Median Income (3)	2007 Compliance Score	2013 Population (2)
Alabama	17.1%	41.0%	$42,590	2	4,779,736
Alaska	12.4%	34.0%	$57,431	2	710,231
Arizona	10.7%	10.2%	$48,621	4	6,392,017
Arkansas	17.8%	43.8%	$41,302	2	2,915,918
California (4)	15.1%	5.0%	$53,367	4	37,253,956
Colorado (4)	7.0%	13.8%	$58,629	-	5,029,196
Connecticut	12.3%	12.0%	$65,415	6	3,574,097
Delaware	14.2%	16.7%	$54,660	2	897,934
Florida	11.6%	8.8%	$45,105	-	18,801,310
Georgia	12.7%	24.9%	$45,973	-	9,687,653
Hawaii	13.4%	8.1%	$59,047	-	1,360,301
Idaho	9.6%	29.4%	$47,459	7	1,567,582
Illinois	11.5%	11.5%	$50,637	-	12,830,632
Indiana (4)	15.0%	27.6%	$44,445	-	6,483,802
Iowa (4)	13.0%	36.0%	$50,219	-	3,046,355
Kansas	12.6%	25.8%	$46,147	-	2,853,118
Kentucky	18.0%	41.6%	$39,856	-	4,339,367
Maine	11.6%	61.3%	$40,658	-	1,328,361
Louisiana	13.5%	26.8%	$49,693	-	4,533,372
Maryland	11.0%	12.8%	$68,876	-	5,773,552
Massachusetts	10.2%	8.0%	$63,313	-	6,547,629
Michigan	13.0%	25.4%	$48,879	9	9,883,640
Minnesota (4)	14.0%	26.7%	$57,820	3	5,303,925
Mississippi	15.4%	50.7%	$41,090	4	2,967,297
Missouri	14.9%	29.6%	$45,774	-	5,988,927
Montana	9.4%	44.1%	$40,277	-	989,415
Nebraska	12.7%	26.9%	$55,616	6	1,826,341
Nevada	11.4%	5.8%	$47,043	4	2,700,551
New Hampshire	11.2%	39.7%	$65,880	-	1,316,470
New Jersey	8.7%	5.3%	$62,338	-	8,791,894
New Mexico	12.6%	22.6%	$41,982	-	2,059,179
New York	10.6%	12.1%	$50,636	6	19,378,102
North Carolina	12.5%	33.9%	$45,206	7	9,535,483
North Dakota	13.5%	40.1%	$56,361	-	672,591
Ohio	13.0%	22.1%	$44,648	-	11,536,504
Oklahoma	11.8%	33.8%	$48,455	-	3,751,351
Oregon (4)	9.9%	19.0%	$51,526	2	3,831,074
Pennsylvania (4)	13.5%	21.3%	$49,910	2	12,702,379
Rhode Island	10.7%	9.3%	$49,033	11	1,052,567
South Carolina	13.9%	33.7%	$40,084	4	4,625,364

South Dakota	11.9%	43.3%	$47,223	4	814,180
Tennessee	16.9%	33.6%	$42,279	8	6,346,105
Texas	15.7%	15.3%	$49,047	-	25,145,561

Appendix D: Study Variables by State (cont'd)

State	2013 Obesity Rate (1)	2013 % Rural Population (2)	2013 Median Income (3)	2007 Compliance Score	2013 Population (2)
Utah	6.4%	9.4%	$55,493	-	2,763,885
Vermont	13.2%	61.1%	$51,862	6	625,741
Virginia	12.0%	24.5%	$62,616	-	8,001,024
Washington (4)	10.0%	16.0%	$56,850	-	6,724,540
West Virginia	15.6%	51.3%	$41,821	11	1,852,994
Wisconsin	11.6%	29.8%	$52,058	-	5,686,986
Wyoming	10.7%	35.2%	$54,509	-	563,626
Median	12.6%	26.3%	$49,370	0.00	4,436,370
Mean	12.5%	26.4%	$50,595	2.32	6,162,876
Population-Weighted Mean	12.9%				
STD	2.5%	14.6%	$7,522		6,848,235

Notes: (1) High School Obesity Rates (CDC, 2014).
(2) U.S. Census Bureau (Census Bureau, 2014).
(3) U.S. Census Bureau (Census Bureau, 2014a).
(4) Robert Wood Johnson Foundation: The State of Obesity 2014 (RWJF, 2014).