AN ANALYSIS OF NUTRITION POLICY AND ADOLESCENT OBESITY

by

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ABSTRACT OF DISSERTATION

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Abstract

This study is designed to assess the effectiveness of state laws enacted with the purpose of improving nutrition among youth and reducing obesity rates. The analysis includes a qualitative review of the political process of introducing nutrition legislation in two case study states, Massachusetts and North Carolina.

As youth obesity rates have tripled, states across the U.S. have begun enacting legislation designed to target this health issue. Categories of legislative approaches include structural (such as nutrition advisory councils), physical (including regulations on competitive foods), communication (including nutrition education), and surveillance policies (BMI measurement). The analysis compares the laws passed in 17 states between 2001-2011 with Youth Risk Behavior (YRBS) data to determine whether certain types of laws improve nutrition behaviors such as fruit and vegetable consumption, and ultimately decrease BMI. Results suggest that structural policies may be associated with lower BMI scores among youth, however other types of policies may influence nutrition behaviors. Demographic variables including race, education, poverty, and unemployment were also assessed to determine how they affect the analysis. As states struggle to adequately address obesity among youth, schools offer an important intervention target. An evaluation of legislative options can help to prioritize limited resources towards the most effective approaches.

Finally, qualitative data suggest that a number of themes are important to the political process surrounding nutrition policy. Stakeholders in North Carolina and Massachusetts, despite operating in very different health and political environments, shared certain characteristics in terms of political barriers and sources of legislative support. Building multidisciplinary coalitions,
ensuring adequate funding, and designing an evaluation system are all integral to enacting and implementing effective legislation.
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Introduction

This study is designed to assess the effectiveness of state laws enacted with the primary aim of improving nutrition among youth and reducing obesity rates. As youth obesity rates have tripled (CDC 2011), states across the U.S. have begun to craft and in some cases enact legislation to target this mounting public health concern. Currently, geographic disparities exist in both the domains in which nutrition legislation is enacted, and the rates of obesity among youth (Taber 2011). Obesity disparities are explained in part by state-level factors, such as poverty, as well as individual-level factors, including race and household economic status (Singh 2008).

States have the authority to pass nutrition legislation, and while policy is implemented at the school district level, states will often incentivize districts to follow policies, such as attaching compliance rules to state funding (Levi 2011). This analysis focused on state laws directed at nutrition in schools. Among adolescents, the school food environment is significant, as it has been found to facilitate and reinforce healthy eating behaviors (CDC 2011). As such, state governments have begun using their regulatory authority to attempt to re-shape the food environment in schools, and legislation enacted so far has produced mixed results (Palmer 2011). While law is a critical tool in the fight against obesity, a systematic evaluation is necessary to determine which interventions are effective, and what should be changed (Chriqui 2011).

Obesity and Youth

Obesity and the health conditions associated with it are a substantial problem among youth in the United States. Overweight children and adolescents are more likely to be at risk for cardiovascular disease, including high blood pressure, high cholesterol, and type 2 diabetes; these youth are also more likely to remain obese into adulthood. The problem has grown so acute that
some have suggested that, for the first time in two centuries, this generation of children and adolescents may actually live shorter life spans than their parents (Olshansky 2005).

While the concept of obesity has varied somewhat over time, in the United States, the method currently used to define obesity in youth is through measurement of body mass index, or BMI (Montoya 2011). This metric is recommended as a screening tool by both the Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics (CDC 2011). The BMI measurement is a standard formula accounting for height and weight (weight in kilograms/height in meters squared), plotted on age-for-growth charts to obtain a percentile ranking. Adolescents with BMI between the 85th and 95th percentiles for age and sex are considered overweight, while those with BMI above the 95th percentile are considered obese.

BMI is used as a population measure and more precise methods of measuring adiposity exist. However, comparison of BMI with magnetic resonance imaging (MRI) and age-adjusted fat mass found that BMI threshold is a useful tool for determining rates of overweight and obesity among youth (Harrington 2012).

According to the CDC, an estimated 17% of American children and adolescents aged two to 19 years are obese (CDC 2011). The data are particularly concerning when assessing trends. Between 1976 and 2008, the prevalence of obesity increased from 5.0% to 18.1% among adolescents aged 12 to 19 years. An analysis of four nationally representative datasets (National Health and Nutrition Examination Survey (NHANES), National Longitudinal Study of Adolescent Health, National Health Interview Survey, and National Longitudinal Surveys of Youth) examined trends in body mass index (BMI) during the transition from adolescence into young adulthood (Lee 2011). The analysis showed that BMI increased sharply among adolescents in the 1990s, and the pattern was most dramatic among females and blacks. The
increasing BMI in this age group is particularly significant because obesity during this critical period increases the likelihood of becoming an obese adult, and being burdened with associated social, economic, and health consequences (Lee 2011).

Below, Figure 1 illustrates the trends in obesity over time by age category. While youth of all ages have demonstrated increasing prevalence of obesity since the 1960’s, the increase is sharpest among adolescents aged twelve to nineteen years. Eighteen percent of this population is considered obese.
A recent analysis of NHANES data showed no statistically significant trends in BMI in boys and girls between 1999 and 2008. However, an increase in the highest BMI level (≥97 percentile) in 6 to 19 year old boys was observed during the same timeframe (Ogden 2010). The authors note that these stable (or, among the heaviest boys, increasing) rates of obesity occurred despite an increase in promising, funded research on interventions related to school food, taxes, food marketing, and the physical environment.

**Problem/Consequences**

Adverse health outcomes that result from overweight and obesity among youth include type 2 diabetes, obstructive sleep apnea, hypertension (high blood pressure), dyslipidemia (high cholesterol), and metabolic syndrome (Daniels 2005). In addition to significant health consequences that persist into adulthood, research shows that obese youth have suffered an increasing prevalence of chronic disease.
Between the years 1988 and 2006, as obesity trends among youth worsened, data indicate that youth suffered increased rates of asthma, other physical conditions, and behavior/learning problems (Cleave 2010). The trends emphasize racial and ethnic disparities as well, as black and Hispanic youth faced greater odds of being diagnosed with a chronic condition. Besides the substantial consequences to physical health, obese adolescents also face psychosocial risks. Due to early and systematic social discrimination, obese children may experience psychological stress and low self-esteem, which may eventually hinder social and academic functioning and persist into adulthood (CDC 2011).

**Literature**

**Legislation and public health**

Law is a vital tool in promoting public health, and specifically in addressing obesity. Gostin and Pomeranz describe the importance of applying a legal framework to this complex issue, “…law and policymakers and public health practitioners have many domains to address and consider when developing, implementing, and evaluating obesity prevention and control strategies and interventions.” (Gostin 2009) Laws should be designed to create healthier environments, and Gostin and Pomeranz specifically emphasize a state’s authority to regulate and restrict competitive foods in schools, prohibit permissive practices and include meaningful monitoring and enforcement provisions in schools’ wellness policies.

Research demonstrates that environment has an important influence on food choices, and individual change is more likely to be sustained if the environment supports healthy food options (Larson 2009). A review of legislative evaluations also suggests that particular policy interventions, applied in settings like schools, may have a stronger influence on individual behavior (Matson-Koffman 2005). The thirty-year increase in obesity prevalence among
adolescents is a reflection of changes in the food environment, which emphasizes the need to target school foods, and to identify and modify the environmental influences that are currently promoting an energy surplus (Story 2009).

Despite the promising influence of law, the science of environmental and policy effects on nutrition and eating behavior is still a developing field (Story 2008). The Institute of Medicine (IOM), in its 2005 report *Preventing Childhood Obesity: Health in the Balance*, concluded that policy and environmental interventions are both the most potentially powerful, yet least well understood, strategies for addressing obesity among youth (Koplan 2005). As state legislators have begun to focus on the issue of youth obesity, creating an environment where healthy food choices are available has been a high priority.

Trends in legislation indicate that states are focusing increasing attention toward enacting laws related to obesity prevention (Winterfeld 2010). Early evaluations of these legislative efforts indicate that results can be achieved even within relatively short time frames. An analysis of state competitive food laws in 40 states classified school regulations into three categories for strength and comprehensiveness (strong, weak, or no competitive food laws) between 2003 and 2006 (Taber 2012). Results showed students exposed to strong laws at baseline gained an average of 0.25 fewer BMI units and were less likely to remain overweight or obese over time than students in states with no laws. This analysis is unique in its longitudinal design, and provides early evidence that strong school food regulations may influence the weight status of youth.

**Context: national and state**

Federal school nutrition standards are governed by Public Law 111-296, the Healthy, Hunger-Free Kids Act, enacted in 2010 (Congress 2010). This legislation outlines minimum
nutrition standards for federally reimbursable meals provided as part of the National School Breakfast and National School Lunch programs. The guidelines outlined in the law apply only to those meals; the federal government does not regulate competitive foods sold in schools, and other cafeteria, a la carte, vending, bake sale or classroom offerings are not required to adhere to the guidelines.

In 2005, the IOM determined that youth obesity should be considered a national priority, and recommended coordinated leadership at both the federal and state levels of government (Koplan 2005). The report tasked state governments with increasing resources and strengthening policies that promote opportunities for physical activity and healthy eating in communities, neighborhoods, and schools. Obesity prevention efforts should be particularly focused on high-risk groups (Koplan 2005). Government policy, particularly in the context of youth obesity, can be evaluated as natural experiments. This information can serve as an important link between researchers and political decision-makers, and promote evidence-based policy development (Ramanathan 2008).

In 2011, the USDA issued a rule that required state and local cooperation with evaluations of the nutrition assistance programs nondiscretionary provisions of the Healthy, Hunger-Free Kids Act (USDA 2011). The law stipulates that programs authorized under the National School Lunch Act and Child Nutrition Programs must cooperate with federal evaluations and studies, but does not describe whether nutrition is assessed. Further, the regulations pertain only to funds directed towards the federal programs, and does not address foods sold in competition with National School Lunch program options. In 2013, The Department of Health and Human Services issued a funding announcement to study school nutrition and physical activity policies, including the specific purpose of studying implementation of existing policies within schools.
The USDA requested that the IOM revise the school nutrition standards in 2009, using the 2005 *Dietary Guidelines for Americans* as a basis for evaluation. The resulting report recommended eight updates to the nutrition standards in the National School Lunch and National School Breakfast programs (Council 2010). Recommendations included 1) The USDA Food and Nutrition Service (FNS) should adopt nutrient targets as the scientific basis for setting standards for menu planning for school meals, but should not adopt a nutrient-based standard meal planning and monitoring; 2) To align schools with the *Dietary Guidelines for Americans* and improve healthfulness of school meals, FNS should adopt standards for menu planning that increase the amounts of fruits, vegetables, and whole grains; increase the focus on reducing the amount of saturated fat and sodium provided; and set a minimum and maximum level of calories; 3) To achieve a reasonable balance between reducing the amount of waste and preserving the nutritional integrity of school meals, the FNS, in conjunction with state and local educational agencies and students, should weight the strengths and limitations of the committee’s two options (offer food vs. serve food) when setting standards for meals as selected by a student; 4) The FNS, working together with state agencies, professional organizations, and industry, should provide extensive support to enable food service operators to adapt to the many changes required by the revised Meal Requirements; 5) USDA should work cooperatively with Health and Human Services, the food industry, professional organizations, state agencies, advocacy groups, and parents to develop strategies and incentives to reduce the sodium content of prepared foods and to increase the availability of whole-grain rich products while maintaining acceptable palatability, cost, and safety; 6) The Food and Drug Administration (FDA) should take action to require labeling for the whole grain content of food products; 7) Relevant agencies in USDA and other federal departments should provide support for the conduct of studies to evaluate the revised
Requirements for the School Breakfast Program and the National School Lunch Program; 8) The committee recommends that agencies of USDA, of other federal departments, and relevant foundations fund research studies on topics related to the implementation of the new Meal Requirements, children’s acceptance of and participation in school meals, and children’s health. The report concludes by noting that improvements in program regulations based on these recommendations will depend on effective implementation, and requires participation from stakeholders at the local, state, and national levels, including those in food production.

Preliminary reports suggest that student lunch intake did not meet the IOM recommendations subsequent to the 2009 report. An analysis of middle schools in Texas noted that servings of fruit, vegetables, and whole grains were all below the IOM standards, and interventions that include all stakeholders will be necessary to improve student food and beverage selections (Cullen 2011). An analysis of 33 public schools in Louisiana found that 70% of student food selections exceeded the IOM recommendations for saturated fat, and 74% exceeded upper limit guidelines for calories (Martin 2010). A CDC analysis of state policies as of October 2010 determined that no state regulations fully aligned with all IOM standards (CDC 2012). When divided into quartiles, with 4th quartile scores being complete alignment with the standards, most states scored low (2nd or 3rd quartile), and only 2 states, Hawaii and West Virginia, scored in the 4th quartile.

The National Governors Association (NGA) has also recognized the important role of states in identifying and implementing policies designed to improve nutrition and reduce childhood obesity. A report highlighting best practices reviewed dozens of strategies that governors have implemented in states across the US, which function within the parameters of current federal policies (Mulheron 2009). The NGA recommends a coordinated, multi-sector
approach to comprehensively address youth obesity. These policies have been implemented in four key settings: childcare venues, schools, communities, and healthcare. While the guidance document reviews examples in each setting, no evidence is provided to clarify the relative effectiveness of each measure, or how comparatively difficult implementation may be.

The child obesity guidance document (Mulheron 2009) is available on the NGA Center for Best Practices website, where children’s health and obesity prevention are cited as a current population health “issue.” However, the 2009 document is the most recent resource available. Within this resource, only three pages are devoted to information regarding specifically nutrition in schools.

The NGA Key Committee Issues includes a section on School Meals. This issue area is focused on federal reimbursement of school meals, and includes a 2010 letter regarding the Healthy, Hunger-Free Kids Act. Governors Bill Ritter, Jr., (former Colorado governor) and Jodi Rell (former Connecticut governor) addressed a letter to Senate Majority Leader Harry Reid, Minority Leader Mitch McConnell, Committee on Agriculture, Nutrition, and Forestry Chairman Blanche Lincoln and ranking member Saxby Chambliss. The letter expressed concerns over provisions in the bill, including certification of students eligible for reimbursable meals, school meal program inspections, and federally mandated school meal pricing. The NGA does not specifically address obesity or nutrition, and no memos or letters are published since 2010.

In addition to regulating school nutrition and vending machines, states have worked to promote farmer’s markets and local food, taxed sodas and snacks—in some cases using revenues for nutrition and health education initiatives in schools, and placed nutrition information on products and menus (Dodson 2009).
In an effort to improve surveillance and inform policy, many states have followed Arkansas’s 2003 bill and proposed or enacted legislation requiring measurement of BMI among school children (Longjohn 2010). A variety of approaches have been implemented in response to federal directives to create “local wellness policies” by June 2006, which have often revolved around nutritional guidelines for foods offered in schools. When Belansky, et. al. coded these policies for strength and comprehensiveness, they found that few evidence-based practices had been implemented (2010).

There is a lack of clear guidance on which approaches are most effective in improving youth’s nutrition environment. While policy can be a potentially powerful response to the childhood obesity epidemic, effective strategies are not well understood. In the absence of clear federal guidelines on how to address issues like competitive foods in schools, states have begun legislative efforts designed to regulate the influence of the food industry on children (Fleischhacker 2007).

Data from the National Survey of Children’s Health (NSCH) suggest that highly variable disparities in overweight and obesity exist within and among states (Bethell 2010). State differences in socioeconomic status, school outcomes, neighborhoods, type of health insurance, and quality of care may be important factors in accounting for these differences. The policy environment varies between states as well. A review of state-level youth obesity prevention legislation introduced between 2003 and 2005 found some states were much more likely to introduce and enact legislation than others (Boehmer 2007). The authors suggested that state-level political, economic, and socio-cultural factors may influence legislative priorities within state governments.
Setting: Schools

It is within this context that states have begun experimenting with legislative approaches to reduce youth obesity. Because of the amount of time youth spend in school each day, schools are seen as effective venues to promote and educate children on healthy lifestyles and nutrition (Plaza 2004). Comprehensive nutrition policies (including wellness policies related to competitive foods, nutrition practices and nutrition education) implemented in schools have been shown to significantly reduce the risk of adolescent obesity, although the effectiveness of specific components is less clear (Coffield 2011).

The School Health Policies and Practices Study (SHPPS), most recently conducted in 2006, indicated a disparity in policy approaches to improve school nutrition between states (O'Toole 2007). When the study was undertaken, 32.6% of states required, and 22.4% recommended, prohibiting student access to vending machines. In the same study, over one-third (37.3%) of states had adopted a policy stating that school districts should identify a nutrition coordinator. A few states had requirements or recommendations regarding specific foods outside of the National School Lunch and Breakfast programs that could be offered during lunch or breakfast periods (i.e., types of milk or fruit/vegetable offerings). While the 2006 SHPPS showed a trend toward improved school food offerings from the 2000 assessment, results indicated that foods and beverages high in fat, sodium, and added sugars remained a widespread problem (O'Toole 2007).

While data suggest that school environments can offer poor nutrition, the opportunity for improved access to healthy food and education exists as well. Research has demonstrated that school-based wellness programs can play a vital role in reducing obesity in adolescents. An evaluation of multiple wellness components (including physical activity and education,
competitive food restrictions and nutrition policies and education, portion sizes and standards) found that policy components related to diet were significantly associated with lower BMI (physical activity components were only associated with lower odds of severe obesity) (Coffield 2011). A meta-analysis of 19 studies further emphasized these findings, noting that schools are favorable settings for obesity prevention in youth. Specifically, policy interventions in place for at least one year led to significant change in mean weighted BMI (Gonzalez-Suarez 2009).

A number of examples of comprehensive state laws applied in the school setting exists. An assessment of Chapter 51 legislation passed in Maine designed to ban “foods of minimal nutritional value” (FMNV) in public high schools found that student vending choices improved after implementation (Blum 2011). Despite some positive findings, researchers also determined that school environments were not necessarily supportive of the law, as evidenced in part by advertisements for sugar-sweetened beverages. The Texas School Nutrition Policy was a more comprehensive law passed in 2004, which stipulated specific allowable serving sizes and frequency of servings for high-fat vegetables like french fries, in addition to high-fat and high-sugar snacks and beverages. An evaluation of this policy found that student consumption of vegetables, milk, and nutrients (protein, fiber, vitamins A and C, calcium, and sodium) increased, while consumption of sweetened beverages, snack chips, and percentage of energy from fat decreased (Cullen 2008). The authors remarked that the state policy was effective in making school lunches healthier for students.

States have been enacting multi-component and single-intervention legislation to influence school food environments for years. Reviews of both types of policy efforts have indicated that such approaches have a positive potential for improving youth nutrition behavior, such as increased fruit and vegetable consumption (French 2003). However, the relative
contribution of each policy, and the possible interactions of several measures packaged as part of a comprehensive bill, is not clear. Some of the primary policy targets that comprise the majority of current school-based nutrition legislation are described below.

**Physical environments: Competitive foods**

A common method to improve the school nutrition environment among states has been to target the foods sold in competition with federally reimbursable school lunch and breakfast services. These so-called “competitive foods” are all foods and beverages sold outside the U.S. Department of Agriculture (USDA) programs, and generally are exempt from the federal nutrition standards set by the USDA.

Several states have adopted policies to establish explicit school nutrition standards that limit the number of items sold to students during the school day (Plaza 2004). A review of research on competitive foods found that unhealthy food options are widely available in U.S. public schools, through vending machines, a la carte lines, snack bars, school stores, and food sold for fundraisers. Generally, research suggests that students have better diets when unhealthy foods are not sold through these venues, in competition with federal breakfast and lunch programs (Larson 2010).

Research has also suggested that when competitive foods are available in schools, youth tend to choose foods that are energy-dense and low in nutrients (Fox 2009). This is especially true for youth who do not eat a school lunch. Availability of these low-nutrient, energy dense foods has also been associated with higher BMI scores among youth (Fox 2009). However, recent research has also questioned the strength of the association between competitive food availability in schools and obesity, suggesting that other interventions may be more effective at improving nutrition among youth (Van Hook 2012).
With regard to reducing the availability of “junk foods” in school vending machines and stores, state-level policies have been found to be more effective than those implemented at the district level, although the association was evident in elementary and middle schools rather than high schools (Kubik 2010).

Legislation designed to require nutrition guidelines in venues such as school beverage machines has shown decreased consumption of some sugar-sweetened beverages (Terry-McElrath 2011). A review of high school implementation of state-mandated nutrition standards found that school districts were better at adhering to competitive beverage standards than to competitive foods (Samuels 2009). A cross-sectional analysis of California high schools, where the nutrition content of competitive foods is regulated, found that students reported consuming less fat, sugar, and total calories at school than students in states with no competitive food standards (Taber 2012). Finally, while recent research has shown an overall encouraging relationship between school food standards and access, contracts with corporate suppliers remain an important barrier to compliance (Terry-McElrath 2011).

**Structural Environment**

The structural environment includes measures such as requiring school nutrition wellness or advisory councils, as well as the appointment of qualified food service directors. These entities are responsible for providing nutritional guidance to schools. An analysis of a nationally representative sample of school districts found that those with health advisory councils tended to have stronger school food policies, however, small- and medium-sized high schools were less likely to require councils (Chriqui 2011).

An evaluation at the school and district level in Minnesota schools found that 53% had district-only wellness councils, 38% had district and school councils, and 9% had none (Kubik
2011). In this assessment, schools with both district and school councils had significantly less access to low-nutrient, energy-dense food and beverages in vending machines compared with schools without councils (Kubik 2011). The findings suggest that nutrition councils can have a positive impact on access to nutritious food in schools.

**Communication Environment: Nutrition education**

Adolescent health, education, and nutrition related professional societies have advocated for comprehensive, school-based nutrition education for years (Rees 1999; Briggs 2010). Nutrition education for students has the potential to be an effective method of addressing youth obesity.

A pilot study of a nutrition education intervention, as part of a regular ninth grade health class, resulted in a modest (though not statistically significant) increase in fruit and vegetable consumption, and a decrease in BMI between intervention and control schools (Craven 2011). Another intervention, implemented in schools located in low-income neighborhoods in New York City, was found to be effective in very different ways. *Choice, Control, and Change*, designed to target behaviors related to reducing obesity risk via a science-based curriculum, was successful in reducing student’s consumption of sweetened drinks, packaged snacks, and fast food portions; however, it was not effective in increasing consumption of fruit, vegetables, or water (Contento 2010).

Nutrition education is a policy area that applies not only to students, but also to staff including school food service professionals. Some legislative approaches include training staff to recognize what constitutes a healthy diet for students. Research suggests that clear nutrition information is not always readily accessible. For example, when food service personnel in one study were asked to identify whole grain products from their labels, focus groups demonstrated a
limited ability and confidence to do so (Chu 2012). However, a study of food service personnel who were provided with a continuing education program regarding whole grain foods showed an increased understanding and likelihood to look for whole grain recipes to use in school meals (Roth-Yousey 2009).

Economic Environment: preferential pricing

Economic incentives include policies designed to make energy-dense or low-nutrient food less financially desirable (i.e., more expensive) relative to healthier food options. There are relatively few studies examining price sensitivity among students and the effect of food choices. However, a systematic review of the existing research found that economic incentives can effectively modify food choices in youth (Jensen 2011). An interesting caveat to such approaches, however, was that pricing interventions were multidimensional; sensitivity to price changes appeared to be related to other factors present in schools, such as access to competitive food in vending machines and the presences of nutrition education that encourages healthy eating.

Surveillance: BMI Screening

An extensive evaluation that assessed current legislation related to BMI measurement in schools, including a review of the extant literature on the intervention method, concluded that the approach remains controversial (Nihiser 2009). Of the thirteen states that conducted BMI measurement in schools, perceptions regarding the utility of the data conflicted between parents and expert organizations. The study concluded that decision-makers should weigh the benefits of BMI data with potential harms prior to committing resources to a BMI measurement program. State considerations should include legal assessments of mandatory participation and how to ensure safety and security of data (Ryan 2009).
Evaluations of the surveillance component of Arkansas’s Act 1220 have been more positive. The innovative legislation mandating BMI measurement in schools, passed in 2003, has been credited with enhancing awareness of the obesity crisis in the state, as well as providing valuable tracking data (Thompson 2009). External evaluations revealed a lack of anticipated negative consequences, such as teasing or excessive concerns about weight or use of diet pills, while providing parents with detailed information about their children’s health (Thompson 2009).

**Significance for law and public policy**

Legislative policy can be assessed from an interdisciplinary, social science perspective. This research is relevant to that framework because the state laws analyzed in this work were developed to address a public health issue. The effectiveness of the public policies that are the focus of this project is assessed through the application of social science methodology and analysis of political barriers.

Both the legal and public policy interests of this project are represented by the state nutrition laws, which are classified and quantified. In addition to analyzing the comprehensiveness of each state’s policy approach to obesity prevention, the analysis assesses the political barriers or climate in select states the affect enactment of certain laws. The information regarding effectiveness of the policies and the state political climate can be applied to other social or public health issues.

The “public” in public policy is a highly relevant component of this analysis, as youth obesity is a significant public health issue. Policy interventions have been in place to curtail the obesity epidemic for years, yet the U.S. lacks clarity on effective methods of addressing the issue.
Additionally, this project seeks to account for regional political differences, which may be an important factor in feasibility of implementation.

**Research Objectives and Hypotheses**

This research aims to combine qualitative and quantitative measures of policy and health outcomes. To explore the relationship between state-level obesity prevention legislation and youth obesity prevalence, the following research questions are assessed:

1. Are some state legislative approaches associated with a reduction in youth obesity prevalence?
   
   Hypothesis: Some laws will have a stronger association with BMI and eating behavior than others. Specifically, certain categories of legislation will be more effective, depending on the context in which the laws are implemented (physical, structural, economic, communication, surveillance).

2. What are the political barriers or conditions associated with introduction or enactment of school nutrition legislation?
   
   Hypothesis: Enactment or failure to enact nutrition-related legislation is influenced by a combination of key stakeholders and resource availability in each state.

These two questions will require a mixed-methods approach, a quantitative analysis of state legislation with comparison to youth obesity prevalence over time; and selection of some states for in-depth case studies, which will include identification of key stakeholders and review of legislative history. The data derived from this analysis should be broadly generalizable across the U.S., as states included in the analysis represent a variety of geographic, political, and health indicators; and data for each selected state involve a statistically representative sample of youth.
Index Studies

This analysis is conducted by developing an index of existing state nutrition laws. Previous research has made use of indices to measure the influence of policies and health outcomes like obesity. One study (Nanney 2010) linked school health policies and youth obesity using the School Health Policies and Programs Study (SHPPS) and the NSCH measures of obesity prevalence. The findings included two factors that are relevant to this research. Schools were more likely to have adopted food service and nutrition policies, compared to policies related to physical activity and education or weight assessment. Additionally, the average number of nutrition policies adopted by each state was correlated with youth obesity prevalence. The authors suggest that the relationship between obesity prevalence and policy comprehensiveness is not linear; it is possible that some states with high prevalence of obesity face political pressures to enact policy.

Various other studies have created indices to measure policy differences across regions. At the international level, the Alcohol Policy Index compared legislation related to alcohol across 30 countries in North America, Asia, Europe, and Australia (Brand 2007). The index generated a score based on policies from five regulatory domains, and revealed wide variation between countries. Regression analysis demonstrated a strong negative correlation between policy scores and alcohol consumption.

In the United States, the comparison of a policy index and health outcome data has been particularly useful in tobacco research. One assessment of tobacco control measures in each state found a statistically significant correlation with adult smoking prevalence and consumption over time (Gilpin 2000). The results indicate that, in the case of tobacco use, strong policy environments can be predictive of a decrease in future smoking rates.
A recent analysis of cost-effective policies for obesity control recommended that governments implement a systems framework to address complementary actions in legislation (Gortmaker 2011). Among the limited but growing body of evidence regarding methods to reduce obesity, the relatively novel systems approach recommends assessment of policies in multiple sectors. An examination of policy models underscores the importance of evaluating coordinated approaches to obesity, rather than measuring policies in isolation (Gortmaker 2011). In the case of adolescent obesity, those sectors could include physical, structural, communication, economic, and surveillance related laws.

**Research Design**

In order to answer both research questions, a mixed method approach was employed. This section describes the quantitative and qualitative methods used in the study.

**Model for standard comparison**

In order to analyze nutrition policies across states, a model of enacted legislation was applied based on a study by Masse, et al. (2007) Using the CDC Database of State Legislative and Regulatory Action to Prevent Obesity and Improve Nutrition and Physical Activity, (Described in more detail below, http://apps.nccd.cdc.gov/DNPALeg/index.asp), all enacted legislations were categorized. Each category was treated as a dichotomous variable, and the presence or absence of the legislation formed the model. Categories were designed based on previous research using the same legislative database. Specifically, Masse et. al. (2007) divided state-level nutrition policies as follows:

1. Physical environment/access (competitive foods, school meals)
2. Structural Environment (food director’s qualifications, school nutrition advisory council)
3. Communication environment (nutrition education, marketing)
4. Economic environment (preferential pricing)
5. Surveillance (BMI)

The model allows for a standard comparison across states and time. The unit of analysis is the state, and the index will be compared with obesity prevalence data, the dependent variable in the assessment, as well as data on selected nutrition behaviors, which include measures of 100% fruit juice, fruit, vegetable, salad, potatoes, carrots, milk, and “other vegetable” consumption.

The Youth Risk Behavior Surveillance System (YRBSS, described in more detail below, http://www.cdc.gov/HealthyYouth/yrbs/), collects data on childhood obesity and overweight in the states. All information from both of these databases is publicly available and current to 2011 (Legislative database) or 2009 (YRBSS). The CDC has collected YRBSS data for alternate years since 1991, and the legislative database includes annual data beginning in 2001. Because the data are collected and provided by the U.S. government, this study will not involve human subject research; all data are anonymous.

Database of State Legislative and Regulatory Action to Prevent Obesity and Improve Nutrition and Physical Activity

The legislative database includes all enacted, pending, vetoed, or dead state bills related to obesity, from each U.S. state. The legislation can be sorted into categories, i.e., bills related to physical activity or nutrition, and further defined by setting, including childcare, community, medical, restaurant/retail, school, and workplace. Legislation included in the database begins in 2001, which allows for comparison over time, and is searchable by state. The system provides
access to the bill number, status of the legislation, a summary of the bill’s intent, and the sponsor. State legislative sites can be accessed directly for more information on specific bill details.

The CDC’s legislative database has been useful for other studies that sought to analyze the comparative effectiveness of public health policies across states. For example, Eyler et al. (2010) looked specifically at the effect of community trails on physical activity by evaluating appropriation and non-appropriation trail bills. The database was helpful in identifying the role of fiscal support as an important element in passing legislation that can improve physical activity access within states.

Initial review of data and policies

YRBSS

The YRBSS monitors health-risk behaviors among youth and young adults, including dietary behaviors and obesity prevalence. The national data are collected every two years and are representative of 9th-12th grade students in public and private U.S. high schools. Data are available at the individual student level.

Data are not available from every state. For example, Minnesota, Oregon, and Washington did not participate in the 2009 survey (see Table 1, below). Additionally, some states did not report a sufficiently high response rate to produce weighted results (In 2009, this included California, Iowa, Nebraska, Ohio, and Virginia).

Each state YRBSS employs a two-stage, cluster sample design. In the first sampling stage, schools are selected with probability proportionate to enrollment size. In the second stage, intact classes of a required subject or intact classes of a required period are eligible to participate
Subsequent to this procedure, samples with an overall response rate of $\geq 60\%$ are weighted.

While the YRBSS can track aggregate changes in youth behavior over time, a new sample of students and schools is drawn each year. Students cannot be tracked over time as no identifying information is collected year-to-year (although it is possible some students could be sampled in multiple years). The survey questionnaires are self-administered and the CDC reports that reliability and validity of the items has been demonstrated (MMWR 2013). See appendix 2 for a review of relevant survey items.

In consultation with study sites, the CDC has made revisions to the survey over time. This practice limited some of the analysis in this research. For example, race and ethnicity codes changed between 2005 and 2007. Due to the differing categories, data in this analysis were collapsed to the less precise grouping of white/non-white.
Table 1: YRBSS Participation

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th>2003</th>
<th>2005</th>
<th>2007</th>
<th>2009</th>
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<td>Alabama</td>
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<tr>
<td>Alaska</td>
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<td>U</td>
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<td>+</td>
</tr>
<tr>
<td>Arizona</td>
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<tr>
<td>Arkansas</td>
<td>+</td>
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<td>+</td>
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<td>California</td>
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<td>-</td>
<td>-</td>
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<td>+</td>
<td>U</td>
<td>+</td>
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<tr>
<td>Connecticut</td>
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<tr>
<td>Delaware</td>
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<td>+</td>
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<tr>
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<td>+</td>
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<td>+</td>
<td>U</td>
<td>U</td>
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<tr>
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<tr>
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<tr>
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<tr>
<td>Vermont</td>
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<tr>
<td>Virginia</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>U</td>
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<tr>
<td>Washington</td>
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<tr>
<td>West Virginia</td>
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<td>Wisconsin</td>
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<td>+</td>
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</tr>
<tr>
<td>Wyoming</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

NOTE: (+) = weighted data, (U)= unweighted data, (-) = no data
As noted in the table above, not every state reported a representative data sample for each year. For this reason, the analysis is limited to those states that reported weighted data for each of the years within the policy timeframe.

Example of total number of enacted child nutrition legislation in select states, by year:

Table 2: State Legislation Example

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MA</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NC</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>WY</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

All data were imported into SPSS version 20 for complex samples. In order to analyze individual-level data, researchers must make a request to the CDC. The CDC provided these data for the states of Arizona, Delaware, Idaho, Maine, Missouri, Montana, North Carolina, North Dakota, South Dakota, Utah, and Vermont. States that provided data after a direct request included Florida, Massachusetts, Michigan, Nevada, Texas, and Rhode Island. Wyoming was unable to provide data due to local access problems.

**Two-level hierarchical logistic regression model**

The relationship between state-level policies, individual-level characteristics, and obesity are assessed using a hierarchical linear model. This model is useful for behavioral and social data, which commonly have a nested structure. (Raudenbush 2004). It is useful for examining between-cluster variance and contextual influences on health (Carle 2009). Here, the contextual influence of interest is the state. The structure is suited for complex samples such as those used in this study.
In this analysis, the sublevels consist of level 1, a model that represents the relationship with individual-level variables, and level 2, a model that captures the relationship with state-level variables. In this case, the dependent variable is youth obesity, as measured by BMI. More proximal nutrition behaviors are assessed as dependent variables in other models. This method of analysis has been useful for similar studies of state-level policies and health outcomes. For example, a legislative scan of bills introduced related to child obesity between 2003 and 2005 in all 50 states found that bill-level factors (procedure, composition, content) were more influential in their effect on policy enactment than state-level factors (sociodemographic, political, economic, and industrial) (Boehmer 2008).

This method was also implemented in a study of neighborhood characteristics and adolescent obesity. In that analysis, the hierarchical structure consisted of individual lifestyle factors (level 1), including demographics, dietary and snacking behaviors, nested within neighborhoods (level 2), which included variables such as unemployment rates, access to energy-dense foods, parks, and crime rates (Lange 2011). While this analysis found little between-neighborhood variation in BMI and health behaviors, the statistical method used provides a good foundation for this project.

The two levels of variables for this analysis are organized according to the following structure (numbers within cells for policy categories are examples):
Table 3: YRBSS data

<table>
<thead>
<tr>
<th>Year</th>
<th>State</th>
<th>100% juice</th>
<th>fruit</th>
<th>salad</th>
<th>potatoes</th>
<th>carrots</th>
<th>other veg</th>
<th>milk</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>AZ</td>
<td>2.94</td>
<td>3.04</td>
<td>2.21</td>
<td>2.03</td>
<td>1.78</td>
<td>2.70</td>
<td>3.29</td>
<td>22.7</td>
</tr>
<tr>
<td>2005</td>
<td>AZ</td>
<td>2.67</td>
<td>2.75</td>
<td>2.05</td>
<td>1.97</td>
<td>1.71</td>
<td>2.52</td>
<td>x</td>
<td>22.7</td>
</tr>
<tr>
<td>2007</td>
<td>AZ</td>
<td>2.71</td>
<td>2.82</td>
<td>2.01</td>
<td>1.90</td>
<td>1.71</td>
<td>2.49</td>
<td>3.02</td>
<td>22.9</td>
</tr>
<tr>
<td>2009</td>
<td>AZ</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>3.22</td>
<td>23.6</td>
<td></td>
</tr>
</tbody>
</table>

(These two data tables were linked by the state ID number for each year)

Table 4: State-level data

<table>
<thead>
<tr>
<th>Year</th>
<th>State</th>
<th>Cat 1</th>
<th>Cat 2</th>
<th>Cat 3</th>
<th>Cat 4</th>
<th>Poverty Rate</th>
<th>Unemployment Rate</th>
<th>Education (% population with bachelor’s degree)</th>
<th>Race (% defined as “white only”)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>AZ</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14.1%</td>
<td>5.7%</td>
<td>26.0%</td>
<td>87.2%</td>
</tr>
<tr>
<td>2005</td>
<td>AZ</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14.8%</td>
<td>4.7%</td>
<td>28.0%</td>
<td>86.6%</td>
</tr>
<tr>
<td>2007</td>
<td>AZ</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14.4%</td>
<td>3.7%</td>
<td>25.3%</td>
<td>85.7%</td>
</tr>
<tr>
<td>2009</td>
<td>AZ</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>19.6%</td>
<td>9.9%</td>
<td>25.6%</td>
<td>84.9%</td>
</tr>
</tbody>
</table>

Here, each category represents the binary variable associated with that policy area. For each policy category, the state is assigned a “1” if a policy exists, and a “0” if not. All relevant policies designed to improve nutrition for children will be represented in only one possible category. Once a category of legislation has been enacted, a “1” will remain in place for the subsequent years for that category (unless there is evidence that the legislation was repealed, which was not applicable for any of the included states). If additional policies are enacted within the same category, the category is still labeled “1”-the model does not account for strength or comprehensiveness of a particular domain. Some studies have accounted for comprehensiveness

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1 These figures are aggregated individual-level YRBSS data
by applying a more detailed scoring system, for example scaled scores. This analysis lacks the ability to distinguish between relatively weak and stronger policies.

Additional state-level variables (poverty, unemployment, education, and race) are included to determine what influence they may have on the outcome variable. Categories for race had to be collapsed into individuals who identified as “white-only” and all other races or combinations, due to a change in how YRBS gathered race data between 2003 and 2009. All state-level data are available from the US Census Bureau (American Community Survey- www.factfinder.census.gov) and are factored into the model. Please see appendix one for a summary of key variables included in the analysis.

**Case studies for in-depth political analysis**

Environmental and policy approaches can be very effective in reducing the burden of chronic disease, including the more specific target of healthy eating. However, in addition to evaluating the effectiveness of the policies that promote healthy eating, it is important to understand the local context in which the intervention is implemented, as well as the politics that support or compete with policy enactment (Brownson 2006).

Furthermore, analysis of state-level school health policies indicates that the relationship between legislation and youth obesity requires a closer look. Specifically, research suggests that states with higher levels of obesity have responded with greater institution of policies (Riss 2012). Variation between states indicates that it is important to understand the sociopolitical context of each location, and how that context plays a role in the uptake and implementation of policies.

For this reason, key stakeholders in selected states were contacted to assess how the local social and political context influenced the nutrition policy index in that state. These states were
selected based on the following criteria: First, at least one piece of major nutrition legislation must have been enacted during the years included in the study period, with a primary sponsor who could be contacted to initiate purposive snowball sampling. Next, states were divided into categories to represent different rates of youth obesity, regions of the United States, and traditionally dominant political parties, and to compare states that enacted legislation more recently with states where policy had been in place for some time. Based on these criteria, Massachusetts, North Carolina, and Montana were selected. The legislation in Montana was the oldest, enacted in 2003, while the Massachusetts law was enacted in 2010.

After the primary sponsor or an associated staff member of the nutrition legislation was contacted, snowball sampling identified subsequent stakeholders. This provided a mix of interviews from both legislative and public health/advocacy backgrounds.

Dodson’s (2009) examination of factors that enabled or impeded state-level child obesity legislation serves as a useful model for the qualitative portion of this assessment. In that study, interviews were conducted with legislators or staffers and included semi-structured, open-ended questions based on a standard script. Responses were later coded for themes. For example, categories associated with the question,

“In your view, what factors support or facilitate the introduction and adoption of childhood obesity prevention legislation?”

included: gaining support or involvement of key players, national media exposure, and political climate. Based on responses and themes derived from the initial interview structure, Dodson determined whether other key stakeholders (for example, other policymakers who promoted or blocked legislation, or highly involved activist groups) should be interviewed as well. Interviews were conducted via these contacts until saturation of information was achieved (Chambliss 2013).
Kingdon describes the political nature of the legislative process, noting key factors that influence policymaking including (but not limited to) pressure from interest groups, election results, public opinion, media, as well as academics and researchers (Kingdon 1995). Brownson et. al. (2010) specifically applied Kingdon’s concepts to childhood obesity, and recognized the importance of these factors in determining how best to translate public health research into sound policy. These are the factors that must be considered when assessing the context in which state policies were or were not successfully enacted.

**Results: Quantitative:**

After classifying each state by the five policy categories (physical environment, structural environment, communication environment, economic environment, and surveillance), only one state (Arizona) had implemented a policy within the economic environment domain. Therefore, this category was eliminated from the model due to lack of variability. An additional rater coded policies independently for one third of the data (all years) for reliability purposes. This rater was familiar with the research and trained on the definitions used to classify the policies. She also reviewed several specific data points for which the classification was more difficult. This rater found agreement on all but three items. These areas were reviewed and, based on our discussion; one policy for one state was revised based on the discrepancy.

Between 2001 and 2009, states enacted the following categories of legislation: 8 Physical; 7 Structural; 5 Communication; 2 Surveillance.

By 2009, only one state (VT) had enacted legislation in each of the four categories, and six states (ID, MA, MO, ND, SD, and UT) had not enacted legislation in any of the categories. An average of 1.3 policy categories had been passed in the 17 states.
Total cases by state and year are depicted below:

Table 5: State case summary

<table>
<thead>
<tr>
<th>State</th>
<th>Year 2003</th>
<th>Year 2005</th>
<th>Year 2007</th>
<th>Year 2009</th>
<th>Total</th>
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<tbody>
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<td>AZ</td>
<td>1978</td>
<td>1952</td>
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<td>1547</td>
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<td>DE</td>
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<td>2627</td>
<td>2407</td>
<td>10799</td>
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Figure 2: State policy categories and BMI

The graph above (figure 2) summarizes the total number of policy categories enacted in each state (black bars), and the average BMI in that state (gray bars) between 2003-2009.

The data were first analyzed to examine individual change with repeated measures. (Heck 2010) This model allows for assessment of the effects of time, as each state was sampled four times between 2003 and 2009.
Table 6: Estimates of Fixed Effects, Individual level, BMI as DV

<table>
<thead>
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<th>Parameter</th>
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<th>p value</th>
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<td>12.959</td>
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<td>0.084</td>
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<tr>
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<td>0.003</td>
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<tr>
<td>2005</td>
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<td>0.516</td>
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<tr>
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<td>1.992</td>
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<td>2009</td>
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</tr>
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<td>27.039</td>
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<td>-0.232</td>
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<td>salad</td>
<td>0.136</td>
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<tr>
<td>potatoes</td>
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<td>0.018</td>
<td>3.419</td>
<td>0.001</td>
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<tr>
<td>carrots</td>
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<td>0.019</td>
<td>-0.878</td>
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</tr>
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</tr>
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</tr>
<tr>
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<td>0.007</td>
<td>-6.125</td>
<td>0.000</td>
</tr>
<tr>
<td>team</td>
<td>-0.323</td>
<td>0.016</td>
<td>-20.534</td>
<td>0.000</td>
</tr>
</tbody>
</table>

a: this parameter is set to 0 because it is redundant

At the individual level, this model included selected nutrition and physical activity variables, as well as state and year. Here, BMI was the dependent variable. Due to missing data on some variables for some years, Massachusetts, Michigan, North Carolina, Nevada, and Vermont were
excluded from the analysis. BMI was lowest in year 2003 \((b=-0.157, p= .003)\) as compared to year 2009. BMI in year 2005 was also lower than 2009, however year 2007 was slightly higher.

Among individual level variables, sex was a significant covariate (boys had a higher BMI, \(b=0.931, p= 0.000\)). Students who ate more salad \((b=0.136, p= 0.000)\) and potatoes \((b=0.061, p=0 .001)\) also had higher BMI. Consumption of fruit, juice, carrots, vegetables, and milk were all associated with lower BMI, but none were statistically significant.

Three variables related to physical activity were included in the model, and all three were statistically significantly associated with BMI. Hours of TV viewing \((b=0.218, p= 0.000)\) was associated with higher, while PE \((b=-0.048, p=0 .000)\) and being on a sports team \((b=-0.323, p= 0.000)\) both were associated with lower BMI.
Table 7: Estimates of Fixed Effects, State level, BMI as DV

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>t</th>
<th>p value</th>
</tr>
</thead>
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<td>1.195</td>
<td>0.012</td>
<td>0.991</td>
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<td>0.053</td>
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<td>0.912</td>
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<td>-2.010</td>
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</table>

a: this parameter is set to 0 because it is redundant

For the next model, individual level data (sex, age, BMI by state and year) were aggregated to create state-level means. State level variables (poverty, percent white, unemployment) and the policy categories are analyzed with BMI as the dependent variable. Here, Massachusetts was
excluded due to missing data on the sex variable. All other states were included. In this model, structural (b=-231, p=0.000) and surveillance (b=-0.223, p=0.001) policies were associated with lower BMI. Age and sex, both were statistically significant (b=0.465, p=0.000 and b=0.774, p=0.000, respectively). Both male sex and older age were associated with higher BMI. As expected, state-level poverty (b=0.060, p=0.001) was associated with higher BMI. Interestingly, however, state-level unemployment (b=-0.037, p=0.044) was also associated with lower BMI. Percent white race in a state did not have a statistically significant effect.
Table 8: State level data, excluding variables with missing data, BMI as DV

<table>
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<tr>
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<th>Estimate</th>
<th>Std. Error</th>
<th>t</th>
<th>p value</th>
</tr>
</thead>
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<td>0.146</td>
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<td>-0.924</td>
<td>0.363</td>
</tr>
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<td>communication</td>
<td>-0.097</td>
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<td>0.774</td>
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<td>0.244</td>
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<td>.</td>
</tr>
</tbody>
</table>

a: this parameter is set to 0 because it is redundant

The above model included only variables for which all 17 states had data. The model assesses the effects of each policy on all available states, as well as the effect on two nutrition behaviors.
(consuming salads and other vegetables), and state-level poverty, percent with a bachelor’s degree, unemployment, and percent white. Including only variables available for all states helps to avoid the problem of adverse effects of non-randomly missing data (Dedrick 2009). BMI was the dependent variable. While structural, communication, and surveillance policies were associated with lower intercepts, none of the variables were significant.

Table 9: Comparison of BMI means by sex

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<th>What is your sex</th>
<th>Mean BMI</th>
<th>N</th>
<th>Std. Deviation</th>
</tr>
</thead>
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<tr>
<td>1-female</td>
<td>22.6</td>
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</tr>
<tr>
<td>2-male</td>
<td>23.4</td>
<td>85,570</td>
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</tr>
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<td>Total</td>
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</tbody>
</table>

Male BMI is almost a full point higher than females, 23.4 vs. 22.6. The differences by sex in these data are consistent with the literature that describes higher BMIs among males (Ogden 2010). In a linear model, sex was found to have a statistically significant interaction with each of the policy categories when BMI is the dependent variable. This suggests that policy categories and behaviors have a differential effect on males vs. females in terms of BMI outcome. Thus, results below are reported separately for males and females.
Table 10a: State level data, Females Only, BMI as DV

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>35.053</td>
<td>10.057</td>
<td>3.485</td>
<td>0.002</td>
</tr>
<tr>
<td>physical</td>
<td>0.372</td>
<td>0.1672</td>
<td>2.227</td>
<td>0.034</td>
</tr>
<tr>
<td>structural</td>
<td>-0.237</td>
<td>0.140</td>
<td>-1.692</td>
<td>0.101</td>
</tr>
<tr>
<td>communication</td>
<td>0.133</td>
<td>0.171</td>
<td>0.779</td>
<td>0.442</td>
</tr>
<tr>
<td>surveillance</td>
<td>-0.234</td>
<td>0.250</td>
<td>-0.936</td>
<td>0.357</td>
</tr>
<tr>
<td>poverty</td>
<td>-0.008</td>
<td>0.033</td>
<td>-0.234</td>
<td>0.817</td>
</tr>
<tr>
<td>bachelors_mean</td>
<td>-0.0194</td>
<td>0.033</td>
<td>-0.580</td>
<td>-0.566</td>
</tr>
<tr>
<td>unemployment_mean</td>
<td>0.015</td>
<td>0.039</td>
<td>0.372</td>
<td>0.713</td>
</tr>
<tr>
<td>TVhours_mean</td>
<td>0.592</td>
<td>0.190</td>
<td>3.109</td>
<td>0.004</td>
</tr>
<tr>
<td>white_mean</td>
<td>-0.158</td>
<td>0.107</td>
<td>-1.474</td>
<td>0.151</td>
</tr>
<tr>
<td>2003</td>
<td>-0.116</td>
<td>0.185</td>
<td>-0.627</td>
<td>0.536</td>
</tr>
<tr>
<td>2005</td>
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<td>0.168</td>
<td>-0.440</td>
<td>0.663</td>
</tr>
<tr>
<td>2007</td>
<td>0.023</td>
<td>0.173</td>
<td>0.134</td>
<td>0.894</td>
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<tr>
<td>2009</td>
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<tr>
<td>AZ</td>
<td>-1.016</td>
<td>0.735</td>
<td>-1.384</td>
<td>0.177</td>
</tr>
<tr>
<td>DE</td>
<td>-2.329</td>
<td>2.071</td>
<td>-1.124</td>
<td>0.270</td>
</tr>
<tr>
<td>FL</td>
<td>-1.759</td>
<td>1.362</td>
<td>-1.292</td>
<td>0.206</td>
</tr>
<tr>
<td>ID</td>
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<td>0.283</td>
<td>2.666</td>
<td>0.012</td>
</tr>
<tr>
<td>ME</td>
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<td>0.475</td>
<td>1.969</td>
<td>0.059</td>
</tr>
<tr>
<td>MI</td>
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<td>1.252</td>
<td>-1.031</td>
<td>0.311</td>
</tr>
<tr>
<td>MO</td>
<td>-0.233</td>
<td>0.848</td>
<td>-0.275</td>
<td>0.786</td>
</tr>
<tr>
<td>MT</td>
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<td>0.343</td>
<td>-0.930</td>
<td>0.360</td>
</tr>
<tr>
<td>NC</td>
<td>-2.449</td>
<td>2.063</td>
<td>-1.187</td>
<td>0.245</td>
</tr>
<tr>
<td>ND</td>
<td>0.418</td>
<td>0.204</td>
<td>2.054</td>
<td>0.049</td>
</tr>
<tr>
<td>NV</td>
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<td>1.432</td>
<td>-1.252</td>
<td>0.220</td>
</tr>
<tr>
<td>RI</td>
<td>-0.182</td>
<td>0.573</td>
<td>-0.318</td>
<td>0.753</td>
</tr>
<tr>
<td>SD</td>
<td>0.022</td>
<td>0.527</td>
<td>0.041</td>
<td>0.967</td>
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<td>1.096</td>
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<td>UT</td>
<td>0a</td>
<td>0</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>

a: this parameter is set to 0 because it is redundant

Among policy categories, only physical policies are associated with a change in BMI for females— in this case, presence of the policy is associated with an increase in BMI (b=0.372, p=.034). Structural and surveillance policies are both associated with lower BMIs, however they are not statistically significant.
Table 10b: State level data, Males Only, BMI as DV

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>t</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>12.444</td>
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<td>1.239</td>
<td>0.225</td>
</tr>
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<td>physical_mean</td>
<td>0.104</td>
<td>0.171</td>
<td>0.607</td>
<td>0.548</td>
</tr>
<tr>
<td>structural_mean</td>
<td>-0.246</td>
<td>0.144</td>
<td>-1.704</td>
<td>0.099</td>
</tr>
<tr>
<td>communication_mean</td>
<td>-0.140</td>
<td>0.174</td>
<td>-0.808</td>
<td>0.426</td>
</tr>
<tr>
<td>surveillance_mean</td>
<td>0.251</td>
<td>0.252</td>
<td>0.998</td>
<td>0.327</td>
</tr>
<tr>
<td>poverty_mean</td>
<td>0.064</td>
<td>0.033</td>
<td>1.925</td>
<td>0.064</td>
</tr>
<tr>
<td>bachelors_mean</td>
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<td>0.034</td>
<td>1.046</td>
<td>0.304</td>
</tr>
<tr>
<td>unemployment_mean</td>
<td>-0.020</td>
<td>0.039</td>
<td>-0.515</td>
<td>0.610</td>
</tr>
<tr>
<td>TVhours_mean</td>
<td>0.495</td>
<td>0.226</td>
<td>2.187</td>
<td>0.037</td>
</tr>
<tr>
<td>white_mean</td>
<td>0.074</td>
<td>0.107</td>
<td>0.689</td>
<td>0.496</td>
</tr>
<tr>
<td>2003</td>
<td>-0.400</td>
<td>0.187</td>
<td>-2.133</td>
<td>0.042</td>
</tr>
<tr>
<td>2005</td>
<td>-0.177</td>
<td>0.171</td>
<td>-1.039</td>
<td>0.307</td>
</tr>
<tr>
<td>2007</td>
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<td>0.177</td>
<td>-0.051</td>
<td>0.959</td>
</tr>
<tr>
<td>2009</td>
<td>0a</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AZ</td>
<td>0.953</td>
<td>0.767</td>
<td>1.243</td>
<td>0.224</td>
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<tr>
<td>DE</td>
<td>2.297</td>
<td>2.128</td>
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<td>0.289</td>
</tr>
<tr>
<td>FL</td>
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<td>1.403</td>
<td>1.251</td>
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<td>0.017</td>
</tr>
<tr>
<td>MI</td>
<td>1.921</td>
<td>1.283</td>
<td>1.497</td>
<td>0.145</td>
</tr>
<tr>
<td>MO</td>
<td>1.806</td>
<td>0.878</td>
<td>2.057</td>
<td>0.049</td>
</tr>
<tr>
<td>MT</td>
<td>0.593</td>
<td>0.361</td>
<td>1.641</td>
<td>0.112</td>
</tr>
<tr>
<td>NC</td>
<td>2.225</td>
<td>2.105</td>
<td>1.057</td>
<td>0.299</td>
</tr>
<tr>
<td>ND</td>
<td>0.956</td>
<td>0.218</td>
<td>4.374</td>
<td>0.000</td>
</tr>
<tr>
<td>NV</td>
<td>1.939</td>
<td>1.466</td>
<td>1.323</td>
<td>0.196</td>
</tr>
<tr>
<td>RI</td>
<td>1.349</td>
<td>0.609</td>
<td>2.216</td>
<td>0.035</td>
</tr>
<tr>
<td>SD</td>
<td>1.261</td>
<td>0.539</td>
<td>2.337</td>
<td>0.027</td>
</tr>
<tr>
<td>TX</td>
<td>1.692</td>
<td>1.139</td>
<td>1.486</td>
<td>0.148</td>
</tr>
<tr>
<td>UT</td>
<td>0a</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a: this parameter is set to 0 because it is redundant

The relationship between policy categories and BMI differs somewhat for males. Here, none of the policies are statistically significant, however structural and communication means are associated with lower BMIs for males. The effect of living in North Dakota was statistically significant for all youth, but the relationship was stronger for males (b=0.419, p=.049 for females, b=0.956, p=.000 for males). A review of national data confirms a strong sex disparity in North
Dakota compared to other states (19% of females in North Dakota are overweight or obese compared to 33% of males, national proportions are 27% and 35%, respectively) (Count 2009). Poverty was associated with higher BMIs in males (though not females) approaching significance $b=0.064$ ($p=.065$). The TV hours variable, an indication of greater sedentary behavior, was associated with higher BMIs for both males and females ($b=0.592$, $p=0.004$ for females, $b=0.494$, $p=0.037$ for males).

Table 11: Correlation matrix, demographic variables

<table>
<thead>
<tr>
<th></th>
<th>Poverty</th>
<th>Bachelors</th>
<th>White</th>
<th>Unemployment</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty</td>
<td>Pearson Correlation 1</td>
<td>-0.303*</td>
<td>-0.267*</td>
<td>.374**</td>
<td>0.234</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.012</td>
<td>0.027</td>
<td>0.002</td>
<td>0.065</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>68</td>
<td>68</td>
<td>68</td>
<td>63</td>
</tr>
<tr>
<td>Bachelors</td>
<td>Pearson Correlation -0.303*</td>
<td>1</td>
<td>0.228</td>
<td>-0.044</td>
<td>0.135</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.012</td>
<td>0.062</td>
<td>0.721</td>
<td>0.292</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>68</td>
<td>68</td>
<td>68</td>
<td>63</td>
</tr>
<tr>
<td>White</td>
<td>Pearson Correlation -0.267*</td>
<td>0.228</td>
<td>1</td>
<td>-0.308*</td>
<td>0.127</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.027</td>
<td>0.062</td>
<td>0.011</td>
<td>0.323</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>68</td>
<td>68</td>
<td>68</td>
<td>63</td>
</tr>
<tr>
<td>Unemployment</td>
<td>Pearson Correlation 0.374**</td>
<td>-0.044</td>
<td>-0.308*</td>
<td>1</td>
<td>0.014</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.002</td>
<td>0.721</td>
<td>0.011</td>
<td>0.912</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>68</td>
<td>68</td>
<td>68</td>
<td>63</td>
</tr>
<tr>
<td>Sex</td>
<td>Pearson Correlation 0.234</td>
<td>0.135</td>
<td>0.127</td>
<td>0.014</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.065</td>
<td>0.292</td>
<td>0.323</td>
<td>0.912</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>63</td>
<td>63</td>
<td>63</td>
<td>63</td>
</tr>
</tbody>
</table>

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

An analysis was conducted to test for collinearity among the demographic variables. State level poverty and unemployment were highly correlated ($p= 0.002$). Poverty was also inversely correlated with education (as expected, states with a higher proportion of bachelor’s-educated
residents also had lower poverty rates) (p=0.012). For this reason, poverty was removed from
subsequent analyses.

Table 12: State level data, milk consumption as DV

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>t</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.172</td>
<td>4.717</td>
<td>0.036</td>
<td>0.971</td>
</tr>
<tr>
<td>physical_mean</td>
<td>-0.079</td>
<td>0.089</td>
<td>-0.892</td>
<td>0.379</td>
</tr>
<tr>
<td>structural_mean</td>
<td>0.054</td>
<td>0.077</td>
<td>0.707</td>
<td>0.485</td>
</tr>
<tr>
<td>communication_mean</td>
<td>-0.124</td>
<td>0.0916</td>
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</tr>
<tr>
<td>surveillance_mean</td>
<td>0.135</td>
<td>0.131</td>
<td>1.034</td>
<td>0.309</td>
</tr>
<tr>
<td>bachelors_mean</td>
<td>0.004</td>
<td>0.017</td>
<td>0.221</td>
<td>0.827</td>
</tr>
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<td>0.024</td>
<td>0.019</td>
<td>1.197</td>
<td>0.240</td>
</tr>
<tr>
<td>TVhours_mean</td>
<td>0.051</td>
<td>0.113</td>
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<td>0.650</td>
</tr>
<tr>
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<td>0.034</td>
<td>0.050</td>
<td>0.672</td>
<td>0.507</td>
</tr>
<tr>
<td>2003</td>
<td>0.158</td>
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<td>0.108</td>
</tr>
<tr>
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<td>0.148</td>
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<td>1.722</td>
<td>0.095</td>
</tr>
<tr>
<td>2007</td>
<td>0.104</td>
<td>0.090</td>
<td>1.153</td>
<td>0.258</td>
</tr>
<tr>
<td>2009</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AZ</td>
<td>-0.358</td>
<td>0.375</td>
<td>-0.953</td>
<td>0.348</td>
</tr>
<tr>
<td>DE</td>
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<td>0.982</td>
<td>0.030</td>
<td>0.976</td>
</tr>
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<td>FL</td>
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<td>0.656</td>
<td>-0.377</td>
<td>0.709</td>
</tr>
<tr>
<td>ID</td>
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<td>-0.486</td>
<td>0.630</td>
</tr>
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<td>-0.545</td>
<td>0.589</td>
</tr>
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<td>0.225</td>
<td>-0.997</td>
<td>0.326</td>
</tr>
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<td>0.597</td>
<td>-0.019</td>
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</tr>
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<td>0.409</td>
<td>-0.370</td>
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</tr>
<tr>
<td>MT</td>
<td>0.160</td>
<td>0.181</td>
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<td>0.381</td>
</tr>
<tr>
<td>NC</td>
<td>-0.166</td>
<td>0.994</td>
<td>-0.167</td>
<td>0.868</td>
</tr>
<tr>
<td>ND</td>
<td>0.315</td>
<td>0.109</td>
<td>2.889</td>
<td>0.007</td>
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<tr>
<td>NV</td>
<td>-0.238</td>
<td>0.674</td>
<td>-0.353</td>
<td>0.726</td>
</tr>
<tr>
<td>RI</td>
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<td>0.285</td>
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</tr>
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<td>SD</td>
<td>0.342</td>
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<td>0.198</td>
</tr>
<tr>
<td>TX</td>
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</tr>
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<td>UT</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

a: this parameter is set to 0 because it is redundant

It is useful to assess more proximal outcomes when evaluating nutrition legislation, as a
reduction in BMI may take several years to be reflected in the data after a law is enacted.
table above (11) includes the same state level data, but with consumption of milk set as the dependent variable. Here, structural and surveillance policies were associated with increased milk consumption (and physical and communication policies with lower milk consumption); however, none were statistically significant. In this model, North Dakota had statistically greater milk consumption (b=0.315, p= 0.007). No other variables were significant.
Table 13: State level data, fruit consumption as DV

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Intercept</th>
<th>Std. Error</th>
<th>t</th>
<th>p value</th>
</tr>
</thead>
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<td>0.521</td>
</tr>
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<td>0.050</td>
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<tr>
<td>structural_mean</td>
<td>0.085</td>
<td>0.098</td>
<td>0.868</td>
<td>0.393</td>
</tr>
<tr>
<td>communication_mean</td>
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<td>0.107</td>
<td>-0.338</td>
<td>0.738</td>
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<td>surveillance_mean</td>
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<td>0.135</td>
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</tr>
<tr>
<td>bachelors_mean</td>
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<td>-0.323</td>
<td>0.749</td>
</tr>
<tr>
<td>unemployment_mean</td>
<td>0.008</td>
<td>0.019</td>
<td>0.432</td>
<td>0.669</td>
</tr>
<tr>
<td>TVhours_mean</td>
<td>0.697</td>
<td>0.115</td>
<td>6.065</td>
<td>0.000</td>
</tr>
<tr>
<td>white_mean</td>
<td>-0.024</td>
<td>0.054</td>
<td>-0.447</td>
<td>0.658</td>
</tr>
<tr>
<td>2003</td>
<td>-0.143</td>
<td>0.096</td>
<td>-1.478</td>
<td>0.151</td>
</tr>
<tr>
<td>2005</td>
<td>-0.173</td>
<td>0.086</td>
<td>-2.002</td>
<td>0.055</td>
</tr>
<tr>
<td>2007</td>
<td>-0.0357</td>
<td>0.094</td>
<td>-0.380</td>
<td>0.707</td>
</tr>
<tr>
<td>2009</td>
<td>0a</td>
<td>0</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>AZ</td>
<td>-0.522</td>
<td>0.393</td>
<td>-1.329</td>
<td>0.195</td>
</tr>
<tr>
<td>DE</td>
<td>-1.236</td>
<td>1.067</td>
<td>-1.158</td>
<td>0.257</td>
</tr>
<tr>
<td>FL</td>
<td>-1.186</td>
<td>0.713</td>
<td>-1.663</td>
<td>0.108</td>
</tr>
<tr>
<td>ID</td>
<td>-0.101</td>
<td>0.145</td>
<td>-0.700</td>
<td>0.490</td>
</tr>
<tr>
<td>ME</td>
<td>-0.138</td>
<td>0.241</td>
<td>-0.573</td>
<td>0.571</td>
</tr>
<tr>
<td>MI</td>
<td>-0.922</td>
<td>0.648</td>
<td>-1.422</td>
<td>0.166</td>
</tr>
<tr>
<td>MO</td>
<td>-0.825</td>
<td>0.446</td>
<td>-1.849</td>
<td>0.075</td>
</tr>
<tr>
<td>MT</td>
<td>-0.184</td>
<td>0.187</td>
<td>-0.980</td>
<td>0.336</td>
</tr>
<tr>
<td>NC</td>
<td>-1.187</td>
<td>1.069</td>
<td>-1.109</td>
<td>0.277</td>
</tr>
<tr>
<td>ND</td>
<td>-0.484</td>
<td>0.111</td>
<td>-4.366</td>
<td>0.000</td>
</tr>
<tr>
<td>NV</td>
<td>-1.183</td>
<td>0.730</td>
<td>-1.620</td>
<td>0.116</td>
</tr>
<tr>
<td>RI</td>
<td>-0.545</td>
<td>0.305</td>
<td>-1.785</td>
<td>0.085</td>
</tr>
<tr>
<td>SD</td>
<td>-0.485</td>
<td>0.277</td>
<td>-1.745</td>
<td>0.092</td>
</tr>
<tr>
<td>TX</td>
<td>-1.102</td>
<td>0.599</td>
<td>-1.841</td>
<td>0.076</td>
</tr>
<tr>
<td>UT</td>
<td>0a</td>
<td>0</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>

a: this parameter is set to 0 because it is redundant

In this model (table 12), consumption of fruit was the dependent variable. The only statistically significant policy category was physical, which was associated with lower fruit consumption (b=-0.186, p= 0.050). Hours of TV watched was associated with increased fruit consumption.
consumption (b=0.697, p= 0.000). Both of these results are surprising and some explanation is offered in the discussion section.

Table 14: State level data, green salad consumption as DV

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Intercept</th>
<th>Std. Error</th>
<th>t</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-6.448</td>
<td>2.398</td>
<td>-2.689</td>
<td>0.012</td>
</tr>
<tr>
<td>physical_mean</td>
<td>-0.109</td>
<td>0.046</td>
<td>-2.404</td>
<td>0.023</td>
</tr>
<tr>
<td>structural_mean</td>
<td>0.103</td>
<td>0.049</td>
<td>2.102</td>
<td>0.044</td>
</tr>
<tr>
<td>communication_mean</td>
<td>-0.128</td>
<td>0.053</td>
<td>-2.401</td>
<td>0.023</td>
</tr>
<tr>
<td>surveillance_mean</td>
<td>0.018</td>
<td>0.068</td>
<td>0.272</td>
<td>0.787</td>
</tr>
<tr>
<td>bachelors_mean</td>
<td>0.004</td>
<td>0.008</td>
<td>0.490</td>
<td>0.627</td>
</tr>
<tr>
<td>unemployment_mean</td>
<td>0.006</td>
<td>0.010</td>
<td>0.597</td>
<td>0.555</td>
</tr>
<tr>
<td>TVhours_mean</td>
<td>-0.053</td>
<td>0.057</td>
<td>-0.918</td>
<td>0.366</td>
</tr>
<tr>
<td>white_mean</td>
<td>0.093</td>
<td>0.026</td>
<td>3.614</td>
<td>0.001</td>
</tr>
<tr>
<td>2003</td>
<td>-0.018</td>
<td>0.049</td>
<td>-0.378</td>
<td>0.708</td>
</tr>
<tr>
<td>2005</td>
<td>-0.030</td>
<td>0.045</td>
<td>-0.682</td>
<td>0.501</td>
</tr>
<tr>
<td>2007</td>
<td>0.022</td>
<td>0.047</td>
<td>0.466</td>
<td>0.644</td>
</tr>
<tr>
<td>2009</td>
<td>0\textsuperscript{a}</td>
<td>0</td>
<td></td>
<td>.</td>
</tr>
<tr>
<td>AZ</td>
<td>0.696</td>
<td>0.188</td>
<td>3.696</td>
<td>0.001</td>
</tr>
<tr>
<td>DE</td>
<td>1.765</td>
<td>0.503</td>
<td>3.510</td>
<td>0.001</td>
</tr>
<tr>
<td>FL</td>
<td>1.300</td>
<td>0.336</td>
<td>3.865</td>
<td>0.001</td>
</tr>
<tr>
<td>ID</td>
<td>-0.123</td>
<td>0.069</td>
<td>-1.774</td>
<td>0.086</td>
</tr>
<tr>
<td>MA</td>
<td>0.599</td>
<td>0.205</td>
<td>2.924</td>
<td>0.007</td>
</tr>
<tr>
<td>ME</td>
<td>-0.093</td>
<td>0.113</td>
<td>-0.826</td>
<td>0.415</td>
</tr>
<tr>
<td>MI</td>
<td>1.081</td>
<td>0.308</td>
<td>3.508</td>
<td>0.001</td>
</tr>
<tr>
<td>MO</td>
<td>0.722</td>
<td>0.211</td>
<td>3.422</td>
<td>0.002</td>
</tr>
<tr>
<td>MT</td>
<td>0.365</td>
<td>0.092</td>
<td>3.959</td>
<td>0.000</td>
</tr>
<tr>
<td>NC</td>
<td>1.620</td>
<td>0.505</td>
<td>3.208</td>
<td>0.003</td>
</tr>
<tr>
<td>ND</td>
<td>-0.020</td>
<td>0.054</td>
<td>-0.375</td>
<td>0.710</td>
</tr>
<tr>
<td>NV</td>
<td>1.068</td>
<td>0.347</td>
<td>3.081</td>
<td>0.004</td>
</tr>
<tr>
<td>RI</td>
<td>0.700</td>
<td>0.146</td>
<td>4.803</td>
<td>0.000</td>
</tr>
<tr>
<td>SD</td>
<td>0.383</td>
<td>0.133</td>
<td>2.889</td>
<td>0.007</td>
</tr>
<tr>
<td>TX</td>
<td>0.982</td>
<td>0.284</td>
<td>3.455</td>
<td>0.002</td>
</tr>
<tr>
<td>UT</td>
<td>0\textsuperscript{a}</td>
<td>0</td>
<td></td>
<td>.</td>
</tr>
</tbody>
</table>

\textsuperscript{a}: this parameter is set to 0 because it is redundant

Green salad is the dependent variable in this model (table 13). Here, physical (b=-0.109 p= 0.023) and communication (b=-0.128 p= 0.023) policies were associated with lower levels of
green salad consumption, and structural policies with higher salad intake ($b=0.103, p=0.044$). Residence in Arizona, Delaware, Florida, Massachusetts, Michigan, Missouri, Montana, North Carolina, Nevada, Rhode Island, South Dakota, and Utah was associated with statistically significant higher intakes. States with a higher proportion of whites were significantly more likely to eat more green salads ($b=0.093, p=0.001$).
Table 15: State level data, other vegetables as DV

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Intercept</th>
<th>Std. Error</th>
<th>t</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-3.614</td>
<td>2.954</td>
<td>-1.223</td>
<td>0.231</td>
</tr>
<tr>
<td>physical_mean</td>
<td>-0.082</td>
<td>0.053</td>
<td>-1.562</td>
<td>0.129</td>
</tr>
<tr>
<td>structural_mean</td>
<td>0.082</td>
<td>0.056</td>
<td>1.449</td>
<td>0.158</td>
</tr>
<tr>
<td>communication_mean</td>
<td>-0.132</td>
<td>0.062</td>
<td>-2.129</td>
<td>0.042</td>
</tr>
<tr>
<td>surveillance_mean</td>
<td>0.014</td>
<td>0.078</td>
<td>0.181</td>
<td>0.858</td>
</tr>
<tr>
<td>bachelors_mean</td>
<td>-0.002</td>
<td>0.009</td>
<td>-0.261</td>
<td>0.796</td>
</tr>
<tr>
<td>unemployment_mean</td>
<td>0.024</td>
<td>0.012</td>
<td>2.045</td>
<td>0.050</td>
</tr>
<tr>
<td>TVhours_mean</td>
<td>-0.201</td>
<td>0.067</td>
<td>-3.019</td>
<td>0.005</td>
</tr>
<tr>
<td>white_mean</td>
<td>0.073</td>
<td>0.032</td>
<td>2.309</td>
<td>0.029</td>
</tr>
<tr>
<td>2003</td>
<td>-0.021</td>
<td>0.058</td>
<td>-0.361</td>
<td>0.721</td>
</tr>
<tr>
<td>2005</td>
<td>-0.004</td>
<td>0.005</td>
<td>-0.082</td>
<td>0.936</td>
</tr>
<tr>
<td>2007</td>
<td>0.036</td>
<td>0.056</td>
<td>0.644</td>
<td>0.525</td>
</tr>
<tr>
<td>2009</td>
<td>0a</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AZ</td>
<td>0.614</td>
<td>0.229</td>
<td>2.683</td>
<td>0.012</td>
</tr>
<tr>
<td>DE</td>
<td>1.746</td>
<td>0.621</td>
<td>2.809</td>
<td>0.009</td>
</tr>
<tr>
<td>FL</td>
<td>1.083</td>
<td>0.415</td>
<td>2.611</td>
<td>0.014</td>
</tr>
<tr>
<td>ID</td>
<td>-0.114</td>
<td>0.084</td>
<td>-1.361</td>
<td>0.184</td>
</tr>
<tr>
<td>MA</td>
<td>0.729</td>
<td>0.246</td>
<td>2.965</td>
<td>0.006</td>
</tr>
<tr>
<td>ME</td>
<td>0.060</td>
<td>0.140</td>
<td>0.429</td>
<td>0.671</td>
</tr>
<tr>
<td>MI</td>
<td>0.886</td>
<td>0.379</td>
<td>2.339</td>
<td>0.027</td>
</tr>
<tr>
<td>MO</td>
<td>0.669</td>
<td>0.259</td>
<td>2.578</td>
<td>0.015</td>
</tr>
<tr>
<td>MT</td>
<td>0.252</td>
<td>0.109</td>
<td>2.325</td>
<td>0.028</td>
</tr>
<tr>
<td>NC</td>
<td>1.532</td>
<td>0.624</td>
<td>2.453</td>
<td>0.021</td>
</tr>
<tr>
<td>ND</td>
<td>0.073</td>
<td>0.064</td>
<td>1.146</td>
<td>0.262</td>
</tr>
<tr>
<td>NV</td>
<td>0.842</td>
<td>0.426</td>
<td>1.974</td>
<td>0.058</td>
</tr>
<tr>
<td>RI</td>
<td>0.556</td>
<td>0.177</td>
<td>3.135</td>
<td>0.004</td>
</tr>
<tr>
<td>SD</td>
<td>0.383</td>
<td>0.161</td>
<td>2.375</td>
<td>0.025</td>
</tr>
<tr>
<td>TX</td>
<td>0.962</td>
<td>0.346</td>
<td>2.777</td>
<td>0.010</td>
</tr>
<tr>
<td>UT</td>
<td>0a</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a: this parameter is set to 0 because it is redundant

The dependent variable in this model (table 14) is the consumption of ‘other vegetables’.

The only statistically significant policy category is communication (b=-0.132, p= 0.042), which was associated with lower intake of other vegetables. Counter to expectations, in states where the
unemployment rate was higher, the consumption of other vegetables also was higher (b=0.024, p=0.050). While the relationship is surprising, the statistical relationship is not strong.

The TV hours variable was inversely associated with other vegetable consumption (b=-0.201, p=0.005), meaning more hours of TV was associated with lower vegetable consumption. Finally, states with a higher proportion of white race had higher consumption of other vegetables (b=0.073, p=0.029).

For each of the models that assessed specific nutrition behaviors as the dependent variable, change over time between 2003 and 2009 did not show statistically significant differences.

**Results: Qualitative:**

Of the three states identified for case studies, responses from the primary sponsors of legislation were available for two (Massachusetts and North Carolina). Multiple attempts to contact the author of the original 2003 Montana law, as well as associated staffers, were unsuccessful. The sponsor of the law is no longer in elected office and could not be reached. For this reason, Montana was subsequently eliminated from the qualitative analysis.

All data for Massachusetts were coded for themes by two raters, and similar categories were used to construct the themes for North Carolina. Qualitative interviews from Massachusetts included two individuals from the legislative perspective, and three from different public health advocacy organizations directly involved in the legislation. Confirmation of themes for each question occurred quickly and responses were fairly consistent. In North Carolina, qualitative results were obtained from two legislative contacts, and three representatives from public health research or advocacy groups. Key themes were consistent across all five contacts.

Below is a summary of the background characteristics and demographics for each state, followed by a review of key themes gleaned from the qualitative interviews.
Massachusetts

Table 16: Massachusetts Summary

<table>
<thead>
<tr>
<th>Year</th>
<th>% Poverty</th>
<th>% Bachelor's or higher</th>
<th>% White only</th>
<th>Annual unemployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>9.5</td>
<td>37.6</td>
<td>87</td>
<td>5.8</td>
</tr>
<tr>
<td>2005</td>
<td>9.7</td>
<td>36.6</td>
<td>86.2</td>
<td>4.8</td>
</tr>
<tr>
<td>2007</td>
<td>11.6</td>
<td>37.9</td>
<td>85.4</td>
<td>4.5</td>
</tr>
<tr>
<td>2009</td>
<td>11.1</td>
<td>38.2</td>
<td>84.6</td>
<td>8.2</td>
</tr>
</tbody>
</table>

As a state, Massachusetts has a profile that is generally healthier than the rest of the U.S. Based on the most recently available YRBS data (2011), adolescents in the U.S. as a whole were less likely to have eaten green salad (38.0% reported not eating salad, 36.1-39.9) compared to those in Massachusetts (33.6%, 30.6-36.8)(CDC 2012). Adolescents in the state were less likely to be overweight (14.6%, 13.2-16.0) compared to the U.S. as a whole (15.2%, 14.4-16.1), and Massachusetts adolescents were less likely to be obese (9.9%, 8.3-11.8) compared to U.S. averages (13.0%, 11.7-14.4)(CDC 2012)

Several stakeholders indicated that the Commonwealth is something of a paradox; while generally considered politically progressive, Massachusetts did not enact major legislation to address nutrition in schools until 2010. Despite this, the groundwork was initially laid several years earlier, in 2003. At that time, then-Representative Peter Koutoujian introduced “An Act to Promote Proper School Nutrition” (H. 4376)(Massachusetts Public Health Association 2011), to require standards for drinks and snacks sold in schools. While two legislative committees approved the bill, Public Health and Health Care Financing, it took several years of legislative changes as well as a change in leadership before the current bill was finally enacted.
The final legislation, Senate bill 2314, was passed with leadership from Sen. Richard Moore, Sen. Susan Fargo, and Rep. Jeffrey Sanchez during the 2009-2010 session (Massachusetts Public Health Association 2011). During the interim years, the bill garnered 87 legislative co-sponsors, and the support of over 150 organizations (Massachusetts Public Health Association 2011). The final bill was passed by 154-4 in the House, and unanimously in the Senate.

The final version encompasses several of the categories in the legislative model; the bill requires the Department of Public Health to work with the Department of Education to develop nutritional standards for all foods sold in schools (including snacks from vending machines), requires schools to sell fresh fruits and vegetables, ban deep-fat fried foods, provide students with nutrition education, buy locally grown food when possible, make potable water available, and screen children for obesity, type 2 diabetes, and eating disorders.

A summary of the qualitative themes, by question, is below:

<table>
<thead>
<tr>
<th>1. Who were the primary supporters of the bill?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legislative leadership</td>
</tr>
<tr>
<td>Peter Koutoujian, Rep. Sanchez (D), Sen. Moore (D), Sen. Fargo (D)(chair for Public Health)</td>
</tr>
<tr>
<td>Public health advocates</td>
</tr>
<tr>
<td>Heart Association, MA Public Health Association, Diabetes Association, School Nutrition Association, MA Health Council</td>
</tr>
<tr>
<td>Professional and clinical groups</td>
</tr>
<tr>
<td>MA Medical Society, Children’s Hospital</td>
</tr>
<tr>
<td>Community</td>
</tr>
<tr>
<td>School boards, city councils, interested community members, advocates who formed coalitions</td>
</tr>
</tbody>
</table>

There was agreement from both legislative and advocate stakeholders that the bill was promoted through a mix of legislative leadership and community/public health advocacy groups. The partnership is also recognized as vital for future legislative interventions. As described by one individual,
“Ultimately, without legislative leadership and community support, it is unlikely we’re able to achieve more aggressive nutrition standards for our students.”

The next question, regarding barriers to passage of the legislation, revealed two primary issues; agreement on legislative strategy and regulation specifics, and beverage industry opposition. A summary of question two is below:

<table>
<thead>
<tr>
<th>2. Who (or what) were the primary barriers to passing this legislation?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Finding agreement on an approach</strong></td>
</tr>
<tr>
<td>A number of similar, but different proposals were pending simultaneously</td>
</tr>
<tr>
<td>Deciding on the specific nutrition standards</td>
</tr>
<tr>
<td><strong>Beverage industry</strong></td>
</tr>
<tr>
<td>A bottling plant located in Worcester: had some influence within the Legislature</td>
</tr>
<tr>
<td>Some resistance from schools due to vending and competitive food revenues</td>
</tr>
</tbody>
</table>

Legislative resistance was associated with the beverage industry; the bottling plant was located in a key district of a legislator, which influenced the progress of the legislation for several years. This legislator was close to the Speaker of the House, and there was consensus among interviewees that some behind-the-scenes industry work may have affected the pace of passage. When House leadership changed, the new speaker was noted for his support on the issue.

Achieving consensus on the language of the regulation was also responsible for delaying passage of the legislation. Specifically, Senator Moore was a champion of the Clinton Foundation nutrition standards (Moore was a former Clinton administration official). The Clinton Foundation standards were a compromise that made public health advocates wary (one interviewee noted that “mid-90’s democrats” were more business friendly). Meanwhile, the standards set forth in the House were more prescriptive. The clash in approaches was an important issue to be resolved. Eventually the legislative compromise was to allow the
Department of Public Health to establish standards based on the IOM recommendations, but that specific regulations would not be prescribed within the legislation.

Perhaps compounding this delay, and noted only by the legislative stakeholders, was the issue of “legislative fatigue.” When Peter Kartoujian first proposed the legislation, youth obesity was not as significant a political target as it is today. Additionally, public health efforts in Massachusetts were focused on passage of major healthcare reform during the intervening years, as well as tobacco control measures. As one interviewee described it, a lot of capital was spent on these issues before attention turned back to youth obesity. School nutrition, to a degree, took a backseat as the policy window opened for these other causes.

**Schools**

While the interviewees indicated that schools did not unite towards a broad-based opposition, they expressed some initial concern related to the specific issues throughout the state. Some schools did not want to remove fryolators, and some legislators from western Massachusetts had to deal with backlash regarding elimination of an ethnic food day, which included a number of fried foods. The elimination of bake sales became a broad issue subsequent to a story in the Boston Herald. The regulations initially stated that bake sales would not be allowed 30 minutes prior to or after the school day (which would not effect Saturday football games, for example), while the Department of Public Health recommended applying the regulation at all times. The newspaper story and talk radio fervor interpreted this as forcing a required ban, and due to public backlash, the legislation was quickly revised to allow bake sales. Interviewees described this element of the process as very reactionary, and admitted legislators were not prepared for the response. According to one, “Pushback was really strong, by then it was too late to do anything about it. No legislator at the State House would touch it.”
The final question yielded a broader array of responses, primarily because detailed evaluations of the legislation in Massachusetts are not yet available.

<table>
<thead>
<tr>
<th>3. How would you describe the actual implementation of the policy (are schools satisfying the original intent of the policy?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
</tr>
<tr>
<td>Opposition</td>
</tr>
</tbody>
</table>

The primary issue that was noted among interviewees is that due to the timeframe of implementation, few data exist to determine how well schools are following the policy. Several, however, noted that anecdotal evidence points to variability by school district, with a combination of confusion and success stories. Some of this confusion is based on schools being overwhelmed with work, budget restrictions, as well as balancing state and federal policy. As one interviewee stated,

“I think implementation has been difficult, as schools struggle to conform to federal and state standards, and get conflicting messages from our Department of Public Health.”

Another noted,

“…there are some places that are unhappy with some aspects of the regulations, and are having a hard time implementing. It will take a couple of years to get any degree of consistency. Some (districts) implemented all this stuff years ago, and have nothing new to do.”

Overall, stakeholders in Massachusetts appear to be satisfied with the legislation, and look forward to more detailed data on the success of its implementation. While youth in the Commonwealth generally face a lower burden of obesity compared to the rest of the nation,
stakeholders also recognized the risks of becoming complacent. Major nutrition legislation here was only passed very recently. As summed up by one interviewee,

“Massachusetts is so far behind a state like Mississippi. In public schools, kids are the state’s responsibility.”

**North Carolina:**

Table 17: North Carolina Summary

<table>
<thead>
<tr>
<th>Year</th>
<th>% Poverty</th>
<th>% Bachelor's or higher</th>
<th>% White only</th>
<th>Annual unemployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>13.4</td>
<td>23.8</td>
<td>74</td>
<td>6.5</td>
</tr>
<tr>
<td>2005</td>
<td>13.8</td>
<td>25.3</td>
<td>73.5</td>
<td>5.3</td>
</tr>
<tr>
<td>2007</td>
<td>14.7</td>
<td>25.6</td>
<td>73.1</td>
<td>4.8</td>
</tr>
<tr>
<td>2009</td>
<td>15.4</td>
<td>26.5</td>
<td>72.6</td>
<td>10.5</td>
</tr>
</tbody>
</table>

Compared to Massachusetts, North Carolina faces a much higher burden of youth obesity. The state ranks as the 5th highest in the nation in terms of youth obesity, and among those aged ten to 17 years, 20% were overweight and 14% were obese in 2007 (NCDHHS 2009). In 2006, a year after the primary nutrition law was enacted in NC, one-third of children in the state consumed one serving or less of vegetables per day, and one in three youth ate fast food two times or more per week (NCDHHS 2009). Based on the most recently available data, percentages of NC youth who were overweight or obese did not change significantly from 2001 to 2011, however; in 2011 students who identify as black were significantly more likely than those who identify as white to be overweight, based on BMI (14.2% vs. 19.9%) (Public Schools of NC 2011).
The first major law related to nutrition in schools, H855, was enacted in 2005 and sponsored by Rep. Verla Insko (D). The legislation was well-supported in the General Assembly and passed 47-1. H855 directs the state Board of Education to establish statewide nutrition standards for schools meals, a la carte foods and beverages, and the After School Snack Program administered by the Department of Public Instruction, and child nutrition programs of local school administrative units.

1. Who were the primary supporters of the bill?

<table>
<thead>
<tr>
<th>Legislative leadership</th>
<th>Rep. Insko (D), Sen. Purcell (D), Rep. Weiss (D), Lt. Governor’s Office, Speaker of the House, democratic leadership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public health advocates</td>
<td>Heart Association, local health directors, NC Eat Smart Move More</td>
</tr>
<tr>
<td>Study Committee for Childhood Overweight/Obesity</td>
<td>Task force included legislators, educators, public health specialists</td>
</tr>
</tbody>
</table>

The overriding theme among both legislative and public health respondents was that Democratic leadership was key to garnering support for the law. In 2005, Sen. William Purcell, a pediatrician, co-sponsored the legislation and served on the North Carolina Health and Wellness Trust Fund Committee on Obesity Prevention. This committee was key to crafting the legislation and contacts reported that Sen. Purcell was looked to with great respect within the legislature. Some noted a clear difference between the political compositions of NC’s General Assembly in 2005 compared to 2013. Respondents noted that the current legislature is much less receptive to government interventions on behalf of public health, much more politically conservative, and comprehensive nutrition legislation would not gain traction in such a climate.

Study Committee for Childhood Overweight/Obesity

A pilot project in 16 NC schools (Child Nutrition Standards Pilot Programs) informed committee recommendations (Arnold 2005) and was key to passage of the legislation. The study
committee recommended modifications to vending selections and menu items, emphasizing an increase in fruits and vegetables and a decrease in foods high in total fat, trans fat, saturated fat, and sugar. The committee acknowledged that many schools rely on less-nutritious competitive foods to fund private school lunch programs and pay for operating costs. Interestingly, though several contacts noted that the pilot program helped garner support for the bill, the evaluation of the project indicated that including fresh fruits and vegetables was beyond the budget of most public schools involved. The results of the evaluation were not available until after the law was passed.

Question two, ‘what were the barriers to passing this legislation’, illustrated two very different responses. Schools and media were both cited consistently by multiple respondents.

<table>
<thead>
<tr>
<th>2. Who (or what) were the primary barriers to passing this legislation?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Schools</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Media</strong></td>
</tr>
</tbody>
</table>

*Schools*

As noted above, each school nutrition program in NC is a business that operates separately from the school districts themselves. School districts charge the nutrition programs for operating and personnel costs, and the Division of Public Instruction does not have oversight on how the funds are used. Thus, many schools have come to depend on money from the nutrition programs to alleviate tight budgets (for example, using funds to buy school band uniforms). As the nutrition legislation did not have funding attached to help pay for changes it mandated, many school nutrition directors and principals expressed concern over the fiscal challenges it would
create. One respondent noted that many unforeseen barriers to implementation exist; for example, switching to grilled chicken is difficult when students are provided with plastic utensils. Another expressed the tension between costs and nutrition in schools:

“Until we change the mission of the school nutrition associations, we’ll never make any progress…the focus is on money-making and not necessarily feeding kids the healthiest food we can give them.”

Media

Negative press related to “government involvement” in school meals sparked a general public backlash to nutrition legislation. The most significant example respondents described in NC occurred after H855 was enacted; however, it has likely influenced the ease with which additional legislation can be introduced. Local and national media publicized “nugget-gate” as a nanny-state government infringement (Sullivan 2012).

According to respondents, a pre-school child (this age group falls outside school meal regulations designed for public schools) brought a lunch to school but forgot milk. Rather than simply providing milk to augment the lunch, the child was provided with a full school lunch of chicken nuggets and her sandwich from home was uneaten. In pre-schools, parents may send any food they wish, but if an element is missing (such as milk), the teachers must augment the meal. The story reached the media, and one contact described the resulting reaction as a “huge spectacle.” Respondents noted that the school was slow to explain what happened, and the public didn’t understand the distinction between public school and pre-school settings. The incident resulted in passage of legislation to guarantee the right for any parent to opt out of the supplemental nutrition program. One respondent noted, “Nutrition has taken on additional ideology…that doesn’t belong there.”
In terms of implementation, NC schools do not appear to be consistently adhering to the legislation. Respondents emphasized the difficulty schools face in balancing nutrition goals and a lean fiscal environment. A summary of implementation themes is below:

<table>
<thead>
<tr>
<th>3. How would you describe the actual implementation of the policy (are schools satisfying the original intent of the policy?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
</tr>
<tr>
<td>Pilot evaluation showed a fiscal loss; districts not implementing without funds</td>
</tr>
<tr>
<td>Lack of strong data on current status</td>
</tr>
<tr>
<td>Federal regulations</td>
</tr>
<tr>
<td>Waiting for guidance before implementing local regulations</td>
</tr>
</tbody>
</table>

The first issue, data, presents two separate issues. First, when the pilot study data indicated that expenses increased when schools offered foods such as fresh fruits and vegetables, many districts agreed not to implement the law without additional funding. Schools were not bound to the regulations set out in the pilot and did not face consequences for failing to continue compliance. Another data issue involves the lack of evaluation information available. Respondents provided anecdotal information regarding the status of the H855; however, no systematic analysis of the law exists. Both issues are summed up by one legislative contact, “I am not sure how many schools are now following this plan but I do know the extra costs for healthier foods was a major problem as schools struggle for funds in NC.”

**Federal Regulations**

While H855 nutrition standards preceded those set forth by both AHA and the Clinton Foundation, respondents noted that they are still fairly strong. After a 2010/2011 review, some schools implemented improvements (primarily in elementary schools, while charging for less healthy a la carte items in middle and high schools). Other schools have opted to wait for federal standards. This has created a patchwork of school nutrition environments across the state, which is particularly problematic since schools independently contract with businesses to provide food services. One respondent noted,
“We have 115 schools systems, if they all have different standards, how does the food industry meet all the different standards? Hopefully all will do the same thing, and meet standards.”

Respondents sympathized with the financial barriers school face. Between limited budgets and a lack of political will in the current legislature, ensuring consistent nutrition standards across the state is clearly a challenge at this time.

Discussion:

Key Quantitative Findings

In terms of research question one, the data in this analysis do not support the hypothesis. None of the policy categories could be clearly linked to lower BMIs among youth or improved nutrition behaviors.

The implications of some quantitative findings are unclear, such as the relationship between greater salad consumption and higher BMI. Research indicates that describing a food with a healthful name influences the evaluation of the food’s healthfulness by dieters. For example, an identical product could be perceived differently depending on if it is labeled “pasta” or “salad” (Irmak 2011). It is possible that youth with higher BMIs are either eating more salads in an effort to control weight, or perceiving food with ambiguous nutrition as healthy due to identifying it as a salad. Other nutrition behaviors as defined by the YRBS survey have a complex relationship with BMI as well, such as consumption of foods like milk or potatoes which are less clearly defined as “nutritious.” Other assessments of YRBS data found similarly complicated relationships between nutrition behaviors and BMI, including higher BMIs among adolescents who consumed more milk or fruit juice (Taber 2011).

The relationship between some variables associated with socioeconomic status and higher consumption of fruit was also unexpected. These data indicated that youth in states with higher
unemployment rates also ate more fruit. This analysis indicated that state-level unemployment was strongly correlated with poverty levels. While research does indicate that families with higher incomes tend to have healthier diets, some studies have shown that fruit and vegetable intake among adolescents may be more complex (Lorson 2009). One study found that youth at greatest risk of not meeting U.S. dietary guidelines for fruit and vegetable consumption lived in households between 130% and 350% of the federal poverty line, compared to youth at higher and lower levels. Another noted that income differences in fruit intake for adolescents was not statistically significant until household incomes reached 400% of the poverty line, and then was mediated by education levels (Middaugh 2012).

*TV hours*

The findings of this analysis are consistent with previous research in regards to hours spent watching television. Television and computer use has been found to be positively associated with BMI for both male and female adolescents, and greater television use has also been associated with more unhealthful dietary behaviors (e.g. increased consumption of soft drinks, fried foods, and snacks) (Utter 2003). These results suggest that not only is time in front of a television important as a proxy physical activity measure, but it may have an important relationship to specific nutrition patterns as well. One unanticipated finding in this study was the relationship between greater hours of TV watching and higher fruit consumption, when an inverse relationship was expected. Another study of a multi-ethnic sample in Hawaii found no relationship between high intake of fruits and vegetables and TV hours (Chai 2010). The authors posited that rather than focusing on individual dietary components, researchers should consider other factors such as meal preparation, additional food groups, dining environment, social interactions, and the cultural aspects of food and diet.
**Sex**

The significant association of sex on BMI is mostly attributed to an increased prevalence of males who are rank at or above the 97th percentile on growth charts (Ogden 2010). The trend differences between males and females differ only in the obesity (and not simply overweight) category. The policies considered in this analysis are implemented equally in both male and female populations in the school setting. From a legislative context, the disparity between male and female students in the highest BMI category is not addressed. Future research should consider if some policies are more effective for particular BMI categories or sex groups.

**Policy Categories**

The policy categories themselves do not present a clear relationship between either BMI or more proximal nutrition behaviors. At the state level, the influence of policies varied by model. Structural policies appear most often associated with lower BMIs, however their effect is not consistently significant. In terms of nutrition behaviors, the influence of policies was even more variable. No policy category can be definitively identified as more effective in improving specific nutrition behaviors.

In fact, in one model communication policies were associated with a decrease in vegetable consumption. Some research found that while price reductions in a vending machine significantly increased purchases of healthier foods, promotional signs indicating “low fat” or “healthy” options did not increase sales of these items (French 2004). It is possible that highlighting foods as healthy had a reverse effect, and students were less inclined to purchase them if they were labeled as such.

Further complicating matters, states have demonstrated a heterogeneous trend in terms of fruit and vegetable consumption among adolescents (Taber 2011). Consumption of these foods
has increased in some states and decreased in others, while behaviors like milk consumption have changed more uniformly across states. The implications for state policy development are important. Trends in BMI and nutrition vary by state, even independent of legislation. Obesity trends, in particular, are both complex and dynamic. Since individual policy categories are not clearly associated with effective changes in nutrition behavior or BMI, and are generally enacted as part of a comprehensive legislative package, one should also consider the process involved with enactment in each state, local needs, and support for each component of interest.

**Key Qualitative Findings**

The hypothesis in research question two is supported by this analysis. Key stakeholders in each state were integral to promoting support for nutrition legislation. However, other factors played an important role in the likelihood of enacting the policies.

Despite their differing legislative implementation, health status, and political environments, Massachusetts and North Carolina share two key experiences in regards to nutrition policy. Respondents in both states cited examples from the media and its influence on legislation, and both are working through inconsistent implementation across school districts. In addition to these barriers faced by states, the qualitative analysis also suggests that broad-based or multidisciplinary coalitions were vital to promoting nutrition legislation, educating policymakers, and supporting passage of the policies. These examples offer lessons to other states working to implement nutrition standards.

**Media**

The role of the media, as well as symbols or focusing events (in this case, bake sales and chicken nuggets) have been cited for their influence on public policy (Kingdon 1995). Legislators and advocates in both Massachusetts and North Carolina noted that school food
received negative press based on specific or isolated situations. Respondents in both admitted that proponents of nutrition legislation did not handle the negative media in a timely manner, and the associated backlash affected their ability to implement some policy goals. Their reflections suggest that school nutrition stakeholders should have a plan in place to address the role of the media and respond appropriately to negative press. This can include ensuring that policies are interpreted properly, and addressing misinformation quickly.

_Inconsistent implementation_

Respondents from both Massachusetts and North Carolina also described inconsistent implementation of the enacted policies. The specific concerns surrounding this issue vary in that legislation has not been in place for equal timeframes in each state. Inconsistent implementation is particularly problematic in North Carolina, where the law has been in place since 2005. Some of the inconsistencies in Massachusetts were attributed to the fact that some districts had not had time to fully implement the law yet.

However, the fact that respondents in both case studies cited inconsistencies indicates that districts have disparate resources and needs in regards to nutrition legislation. While some districts are already meeting or exceeding legislative requirements, others face more barriers to meeting compliance. An analysis of school districts in low socio-economic areas of Australia found that implementation of canteen menu policies was dependent on local context, including economic and political factors within the community. While implementation can be successful in these areas, it was especially dependent upon local leadership (Ardzejewska 2013).

This issue should not be overlooked as states work to make changes to nutrition policy. While states did not have access to detailed evaluations of legislative progress, it is safe to predict that schools with fewer financial resources face more barriers to implementation. This should be
recognized so that legislation does not inadvertently worsen health disparities or disadvantage some districts. A study of 6 school districts in the southern United States illustrated that budgetary situations, concerns about overextending school personnel, and interfering with timing of tests and schedules were all barriers to successful implementation of school nutrition policies (Jain 2013). Failure to recognize and address these concerns will jeopardize successful implementation, so leadership must account for local concerns.

Inconsistent Implementation: Massachusetts

The Massachusetts Department of Public Health, and the Department Elementary and Secondary Education collaborated with the John C. Stalker Institute, Harvard School of Public Health, and the Boston Public Health Commission to provide a guidance document for schools in August 2012, just as the nutrition legislation compliance was required and implementation began. The document offers definitions, explanations for each element of the law, and examples of best practices already in place in school districts around the Commonwealth (MA Dept. of Public Health 2012).

In a May 3, 2013 letter from the Massachusetts Department of Public Health (DPH) to school superintendents across the Commonwealth, DPH noted that the USDA planned to update federal nutrition standards pursuant to the 2010 Healthy, Hunger-Free Kids Act. For this reason, DPH opted to delay implementation of the requirement that milk or milk substitutes contain equal or less sugar than plain or fat-free milk. DPH would review standards subsequent to release of the federal guidelines.

A review of unpublished data assessing district superintendents’ and food service directors’ understanding of the 2010 legislation revealed a fairly even distribution of policy comprehension, from districts indicating a full understanding of the law to districts that were unaware of the
provisions. The shifting of guidelines from state and federal levels likely contributes to confusion in implementing the policy at the district levels.

*Inconsistent Implementation: North Carolina*

The state of North Carolina is facing not only a vacuum of guidance from the federal level, but a lack of consequences for failure to implement legislation at the state level as well. Several contacts for this analysis cited the North Carolina Alliance for Health as a resource and advocate for improved nutrition in public schools (Health 2013). In collaboration with the North Carolina Department of Public Instruction, the School Nutrition Association of North Carolina, and the UNC Center for Health Promotion and Disease Prevention, the partners explicitly state on their website that state child nutrition programs receive no financial support and must rely on funds from federal school lunches and a la carte items to be self-supporting.

While the collaboration links to a number of resources designed to help schools reduce their financial reliance on unhealthy foods (including educational materials, technical assistance, and training), there is no specific reference to the 2005 law. In terms of policy implementation, very little clear guidance appears to be available. For the most part, it appears that schools and advocates recognize that effective implementation is impossible in the absence of adequate funding.

In a December 2011 presentation to the North Carolina Legislature’s House Select Committee on Childhood Obesity, the North Carolina Department of Public Instruction cited the nutrition law and the goal of compliance by the 2007-2008 school year. By 2008, the Department indicated that North Carolina schools that voluntarily implemented the law had lost collectively $23 million. The presentation also notes that the 2008 timeline for implementation has been “extended until funding is available.”
Interdisciplinary coalitions

Although the composition of coalitions varied between the states, respondents in both Massachusetts and North Carolina noted that passage of legislation required interdisciplinary groups of stakeholders that worked together to promote school nutrition. Stakeholders from legislative, public health, medicine, education, and community organizations all made important contributions to the legislative process. Based on the experiences described above, including media early in the process may also prove to be an important strategy.

Legislative Evaluation

Evaluation is key to understanding how a law is being implemented and whether it is effective. While the bills enacted in both North Carolina and Massachusetts reference monitoring and reporting, the status of a permanent mechanism to evaluate the policies is unclear in both cases.

The North Carolina nutrition law, H855, directs the Child Nutrition Services Section of the Department of Public Instruction to oversee pilot projects and modify the policy based on those results, as well as current science, best practices, and availability and affordability of new foods and beverages. The law also charges the Child Nutrition Services Section to monitor the progress of each local school administrative unit in achieving standards, provide technical assistance, and report annually to the State Board of Education and the Joint Legislative Education Oversight Committee. As noted above, while the pilot studies were conducted, no structured evaluations of policy implementation exist as the policy itself has not been implemented statewide.

The text of the Massachusetts law specifically cites that the Department of Public Health (MDPH), in collaboration with the Department of Elementary and Secondary Education, will
assist schools with implementing the nutrition standards. The assistance may include: Additional training in nutrition and diet for food service directors; an assessment of a school’s capacity, resources, and equipment to prepare and provide recommended foods; and provide recommendations on the duration of school lunch periods. Additionally, the law states that every five years, the MDPH, in consultation with the Department of Elementary and Secondary Education, must conduct a review of the nutritional standards and update them as needed. The findings must be reported to relevant members and committees within the Legislature.

An inquiry with the Massachusetts DPH indicated that the current legislative evaluation is being undertaken via a collaboration of local universities (Northeastern University, Harvard University, and Brandeis University) with funding from the Robert Wood Johnson Foundation (Cohen 2012). The evaluation includes 36 school districts in Massachusetts and seven districts in Rhode Island (for comparison)-each district includes one middle school and one high school. The primary methods of assessment include:

1. Site visits to measure compliance with legislation
2. Financial information to track food and beverage sales
3. A survey designed to assess barriers to change
4. Comparison of available foods to Stalker’s A-List food inventory to assess availability of healthy foods and reformulated products
5. A 24-hour dietary assessment of student’s food consumption

A researcher affiliated with the evaluation noted that the preliminary results will be available in fall 2013, and dissemination will include both state and national stakeholders. As this is a grant project, it is not clear how implementation will be evaluated over time. This collaboration was funded for 18 months. The Massachusetts DPH is responsible for review of the legislation.
Linking Mixed Methods

The qualitative findings illustrate the complex variation between states. Although Massachusetts and North Carolina share certain characteristics in terms of nutrition policy experience, the policy environments are very distinct. This helps to explain some of the quantitative findings, including the limits in identifying any specific policy categories as more effective in reducing BMI or improving nutrition across states. The primary finding that links the quantitative and qualitative results is states are diverse in population, health profile, and political environment. Policy needs will differ by state, as will the process necessary to enact legislation. While some strategies may be broadly useful, generally efforts should be tailored to meet local needs.

A detailed evaluation of Arkansas’ comprehensive Act 1220, enacted in 2003, was completed in 2012 (Phillips 2013). This evaluation included both quantitative and qualitative methods to assess the implementation of the school nutrition law that contained components of each of the policy categories described in this research. While the evaluation cited substantial changes to nutrition policies within schools, data were limited for reasons also relevant to Massachusetts and North Carolina. Evaluators used a conceptual model that would allow for flexibility to account for wide variability between school characteristics that might affect implementation (though demographic differences were not specifically described).

Another challenge was that few components were made operational and specific in advance (as in Massachusetts), and the framers of the legislation did not anticipate an evaluation component and so evaluators were not included in the planning process. Finally, the assessment recognized that the law is not a stable “intervention,” the components evolve, and incremental changes required a period of three to four years to reach a “maintenance” phase.
Complexity Theory

Complexity theory posits that systems or processes lack the order and stability required to produce universal rules about behavior and outcomes (Cairney 2012). Interrelationships among elements of the system produce patterns of behavior, but they are not always predictable (Litaker 2006). Novel behaviors, such as increased TV hours and fruit consumption, may occur despite anticipating a different outcome based on individual parts of the system. Some proponents of complexity theory specifically suggest a trial and error approach and learning from pilot projects, to acknowledge the changing environments in which public policy develops (Sanderson 2009). This theory is particularly relevant considering NC described a pilot study whose results indicated barriers to implementation existed. Had the evaluation been available prior to enactment of the legislation, some respondents noted that it might have provided a basis to support attaching a funding mechanism to the law.

In terms of public policy, complexity theory also suggests that a complex system cannot be explained merely by breaking it down into its component parts; elements interact with each other and combine to produce systemic behavior (Cairney 2013). That framework helps to explain the results from this research; the data illustrate differences in health status, between sex and race, by geographic location and trends over time. The presence of particular types of nutrition legislation exists in this dynamic environment. The complex nature of the legislative environment must be acknowledged when assessing policy efficacy and appropriateness. Again, this points to the importance of local expertise when working to develop and enact school nutrition policy.
Methodological Limitations

The quantitative analysis focuses only on nutrition, and at the state level. While select physical activity variables (TV hours, participation on a sports team, and participation in school PE) were included, the analysis does not include a detailed assessment of the role of physical activity, which is an important component of BMI outcome. This issue is addressed in part by consideration of more proximal nutrition behaviors in addition to BMI. Specific nutrition behaviors were assessed as the dependent variable to determine if policies influence nutrition in schools even if insufficient time passed to note a difference in BMI.

Additionally, the analysis was limited to 17 states, which provided weighted data for each of the years included in the analysis. While the states included represented a range of geographic, political, and health status indicators, there still may be important differences in other US states that were not captured.

While time was included as a constant variable and assessed for it’s effect on BMI and nutrition behaviors, the structure of the YRBS data do not allow for a more detailed longitudinal analysis. Because individuals are not followed over time and schools are sampled separately for each analysis year, trends at the individual level are not available.

The policy index lacks precision in that each category and each year were represented as a binary variable. This option was important in that it reduced the amount of error associated with producing a scaled variable, which could better specify the degree to which a policy existed in a state (for example, very strongly written legislation could be rated a 5, while weak or limited legislation could be a 1). While the scaled method would have been more precise and help to distinguish policies of varying strength, it would also be much more difficult to ensure consistency in rating the scale across states and years.
The analysis does not address issues related to local and district-wide policies, which may also influence nutrition behaviors and BMI. The study was designed to assess state-level legislation; however, more proximal policies are also critically important to understand variation between school districts. Implementation is not quantitatively measured, however this was a key question for the qualitative portion of the study.

Finally, in terms of the case studies, snowball sampling provided contacts who supported the legislation and worked to help enact it. The perspective of those opposed to nutrition legislation was not included.

**Conclusion**

The results of this analysis suggest that states enact nutrition legislation in a complex environment. The dynamic nature of obesity trends, nutrition behaviors, and political support make it difficult to broadly identify types of policies that may be most effective in reducing BMI among youth or improving nutrition behaviors. Even within individual states, differences in obesity and nutrition behaviors exist by race, age, sex, and over time. Other variables not included in the analysis also likely have important affects. Since changes in nutrition behaviors and BMI are difficult to broadly attribute to policy categories, it is worthwhile to consider more local challenges and supports.

Based on a review of the experiences in two states, some recommendations for policy enactment emerge. A foundation of support should be developed through an interdisciplinary coalition of stakeholders. Including a variety of perspectives can strengthen and broaden support for nutrition legislation. Because respondents from both states cited negative experiences with the media, including media early in the coalition building process may be a useful approach. Finally, ensuring that schools will be properly equipped to manage legislative requirements will
ensure that policies will actually be implemented. Disparities in school districts should be identified prior to enactment.

This analysis also identified some gaps that future research should address. First, systematic evaluations of existing policies are lacking. In order to be able to respond appropriately to the dynamic nature of youth obesity and nutrition, policymakers need more comprehensive and current data. Feedback systems should be developed that do not overburden school systems, but allow for empirical review of policy interventions. These systems should consider and include the perspective of those opposed to nutrition legislation. The reasons for opposition cannot be addressed without inclusive communication. Currently, policymakers are overly reliant on anecdotal evidence.

As noted above, the data systems currently available to quantitatively measure the effectiveness of nutrition policies across states are imperfect. A number of methodological considerations could improve such an analysis and overcome some of these limitations. A well-designed study should include longitudinal data, with a baseline beginning prior to implementation of a nutrition policy and sufficient subsequent data to realistically account for the time it would take to capture changes in both nutrition behavior and BMI. Research suggests that with comprehensive laws, changes in BMI can be demonstrated within three years (Taber 2012). However, this assumes the students were exposed to the laws, which means the legislation must be fully implemented and not simply enacted.

Quality data should include variables that align with the behaviors that a policy targets. For example, many laws cite standards for whole grains or maximum sugar content. Variables measuring consumption among students should reflect the same targets. Additionally, a strong analysis will account for the strength and comprehensiveness of a policy. This can be achieved
through a standardized scale that allocates more weight to stronger laws. When BMI is the outcome of interest, data should also be able to control for physical activity. Physical activity variables should not be limited to structured sports teams and physical education classes in school, but account for total average daily minutes of light, moderate, and strenuous physical activity.

Finally, while this analysis had to accommodate a change in the way in which race and ethnicity was collected, thus limiting the variables to white and nonwhite, a better design would allow for separate testing by both race and Hispanic ethnicity categories. This is important for exploring how policy categories may have a differential effect depending on specific racial or ethnic groups. Another demographic variable that would also be valuable to measure is the relative wealth of school districts. The resources available to school districts vary widely across states and may have very important impacts on implementation.

Future research should also consider the challenges of implementation. While this analysis explored the status of implementation, it did not assess the specific barriers associated with certain policies from the perspective of those implementing them. An analysis that captures the insights of those within the school districts (including school food service directs, food service workers, teachers and students) would be valuable to policymakers who are charged with determining which policies should be implemented. The difficulty of adhering to guidelines should be considered.
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Sullivan, R. (2012). USDA: Preschooler's meal was not 'replaced,' mom was never charged fee, MyFox8.


## Summary of key variables

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Definition</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelors</td>
<td>Percentage of individuals in state who have obtained a bachelor’s degree</td>
<td>N/A</td>
</tr>
<tr>
<td>Poverty</td>
<td>Percentage of individuals in state living in poverty, 2-year average</td>
<td>N/A</td>
</tr>
<tr>
<td>White</td>
<td>Percent in state identifying race as “white only”</td>
<td>0: nonwhite or multiple races, 1: white only</td>
</tr>
<tr>
<td>Unemployment</td>
<td>Percent of labor force unemployed, annual statewide average</td>
<td>N/A</td>
</tr>
<tr>
<td>Sex</td>
<td>Male or female</td>
<td>1: female, 2: male</td>
</tr>
<tr>
<td>Juice</td>
<td>During the past 7 days, how many times did you drink 100% fruit juices such as orange juice, apple juice, or grape juice?</td>
<td>1: I did not drink 100% fruit juice during the past 7 days, 2: 1 to 3 times during the past 7 days, 3: 4 to 6 times during the past 7 days, 4: 1 time per day, 5: 2 times per day, 6: 3 times per day, 7: 4 or more times per day</td>
</tr>
<tr>
<td>Fruit</td>
<td>During the past 7 days, how many times did you eat fruit?</td>
<td>1: I did not drink 100% fruit juice during the past 7 days, 2: 1 to 3 times during the past 7 days, 3: 4 to 6 times during the past 7 days, 4: 1 time per day, 5: 2 times per day, 6: 3 times per day, 7: 4 or more times per day</td>
</tr>
<tr>
<td>Salad</td>
<td>During the past 7 days, how many times did you eat green salad?</td>
<td>1: I did not drink 100% fruit juice during the past 7 days, 2: 1 to 3 times during the past 7 days, 3: 4 to 6 times during the past 7 days, 4: 1 time per day, 5: 2 times per day, 6: 3 times per day, 7: 4 or more times per day</td>
</tr>
<tr>
<td>Potatoes</td>
<td>During the past 7 days, how many times did you eat potatoes?</td>
<td>1: I did not drink 100% fruit juice during the past 7 days, 2: 1 to 3 times during the past 7 days, 3: 4 to 6 times during the past 7 days, 4: 1 time per day, 5: 2 times per day, 6: 3 times per day, 7: 4 or more times per day</td>
</tr>
<tr>
<td>Carrots</td>
<td>During the past 7 days, how many times did you eat carrots?</td>
<td>1: I did not drink 100% fruit juice during the past 7 days, 2: 1 to 3 times during the past 7 days, 3: 4 to 6 times during the past 7 days, 4: 1 time per day, 5: 2 times per day, 6: 3 times per day, 7: 4 or more times per day</td>
</tr>
<tr>
<td>Otherveg</td>
<td>During the past 7 days, how many times did you eat other vegetables?</td>
<td>1: I did not drink 100% fruit juice during the past 7 days, 2: 1 to 3 times during the past 7 days, 3: 4 to 6 times during the past 7 days, 4: 1 time per day, 5: 2 times per day, 6: 3 times per day, 7: 4 or more times per day</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Milk</td>
<td>During the past 7 days, how many glasses of milk did you drink?</td>
<td>1: I did not drink 100% fruit juice during the past 7 days, 2: 1 to 3 times during the past 7 days, 3: 4 to 6 times during the past 7 days, 4: 1 time per day, 5: 2 times per day, 6: 3 times per day, 7: 4 or more times per day</td>
</tr>
<tr>
<td>TVhours</td>
<td>On an average school day, how many hours do you watch TV?</td>
<td>1: I do not watch TV on an average school day, 2: Less than 1 hour per day, 3: 1 hour per day, 4: 2 hours per day, 5: 3 hours per day, 6: 4 hours per day, 7: 5 or more hours per day</td>
</tr>
<tr>
<td>PE</td>
<td>During an average week when you are in school, how many days do you go to physical education (PE) classes?</td>
<td>1: 0 days, 2: 1 day, 3: 2 days, 4: 3 days, 5: 4 days, 6: 5 days</td>
</tr>
<tr>
<td>Team</td>
<td>During the past 12 months, on how many sports teams did you play?</td>
<td>1: 0 teams, 2: 1 team, 3: 2 teams, 4: 3 or more teams</td>
</tr>
</tbody>
</table>

Note: see also YRBS questionnaire form in appendix 1
Appendix 2: Relevant YRBSS Survey Questions:

72. During the past 7 days, how many times did you drink 100% fruit juices such as orange juice, apple juice, or grape juice? (Do not count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.)
   A. I did not drink 100% fruit juice during the past 7 days
   B. 1 to 3 times during the past 7 days
   C. 4 to 6 times during the past 7 days
   D. 1 time per day
   E. 2 times per day
   F. 3 times per day
   G. 4 or more times per day

73. During the past 7 days, how many times did you eat fruit? (Do not count fruit juice.)
   A. I did not eat fruit during the past 7 days
   B. 1 to 3 times during the past 7 days
   C. 4 to 6 times during the past 7 days
   D. 1 time per day
   E. 2 times per day
   F. 3 times per day
   G. 4 or more times per day

74. During the past 7 days, how many times did you eat green salad?
   A. I did not eat green salad during the past 7 days
   B. 1 to 3 times during the past 7 days
   C. 4 to 6 times during the past 7 days
   D. 1 time per day
   E. 2 times per day
   F. 3 times per day
   G. 4 or more times per day

75. During the past 7 days, how many times did you eat potatoes? (Do not count french fries, fried potatoes, or potato chips.)
   A. I did not eat potatoes during the past 7 days
   B. 1 to 3 times during the past 7 days
   C. 4 to 6 times during the past 7 days
   D. 1 time per day
   E. 2 times per day
   F. 3 times per day
   G. 4 or more times per day

76. During the past 7 days, how many times did you eat carrots?
   A. I did not eat carrots during the past 7 days
   B. 1 to 3 times during the past 7 days
   C. 4 to 6 times during the past 7 days
   D. 1 time per day
77. During the past 7 days, how many times did you eat other vegetables? (Do not count green salad, potatoes, or carrots.)
A. I did not eat other vegetables during the past 7 days
B. 1 to 3 times during the past 7 days
C. 4 to 6 times during the past 7 days
D. 1 time per day
E. 2 times per day
F. 3 times per day
G. 4 or more times per day

78. During the past 7 days, how many times did you drink a can, bottle, or glass of soda or pop, such as Coke, Pepsi, or Sprite? (Do not count diet soda or diet pop.)
A. I did not drink soda or pop during the past 7 days
B. 1 to 3 times during the past 7 days
C. 4 to 6 times during the past 7 days
D. 1 time per day
E. 2 times per day
F. 3 times per day
G. 4 or more times per day

79. During the past 7 days, how many glasses of milk did you drink?
A. I did not drink milk during the past 7 days
B. 1 to 3 times during the past 7 days
C. 4 to 6 times during the past 7 days
D. 1 time per day
E. 2 times per day
F. 3 times per day
G. 4 or more times per day

81. On an average school day, how many hours do you watch TV?
A. I do not watch TV on an average school day
B. Less than 1 hour per day
C. 1 hour per day
D. 2 hours per day
E. 3 hours per day
F. 4 hours per day
G. 5 or more hours per day

83. In an average week when you are in school, on how many days do you go to physical education (PE) classes?
A. 0 days
B. 1 day
C. 2 days  
D. 3 days  
E. 4 days  
F. 5 days  

84. During the past 12 months, on how many sports teams did you play? (Count any teams run by your school or community groups.)
A. 0 teams  
B. 1 team  
C. 2 teams  
D. 3 or more teams  

**Codebook, demographics (2003-2005)**

17-17 Q1 How old are you?  
1 12 years old or younger  
2 13 years old  
3 14 years old  
4 15 years old  
5 16 years old  
6 17 years old  
7 18 years old or older  

18-18 Q2 What is your sex?  
1 Female  
2 Male  

19-19 Q3 In what grade are you?  
1 9th grade  
2 10th grade  
3 11th grade  
4 12th grade  
5 Ungraded or other grade  

20-21 Q4 How do you describe yourself?  
1 American Indian or Alaska Native  
2 Asian  
3 Black or African American  
4 Hispanic or Latino  
5 Native Hawaiian or Other Pacific Islander  
6 White  
7 Multiple - Hispanic  
8 Multiple - Non-Hispanic  

2-25 Q5 How tall are you without your shoes on? (Note: Data are in meters.)
26-31 Q6 How much do you weigh

**Codebook, demographics (2007-2009)**

17-17 Q1 How old are you?
1 12 years old or younger
2 13 years old
3 14 years old
4 15 years old
5 16 years old
6 17 years old
7 18 years old or older

18-18 Q2 What is your sex?
1 Female
2 Male

19-19 Q3 In what grade are you?
1 9th grade
2 10th grade
3 11th grade
4 12th grade
5 Ungraded or other grade

20-20 Q4 Are you Hispanic or Latino?
1 Yes
2 No

21-28 Q5 What is your race?
H
F
E
EF
D
D H
DE
C
C E
CD
B
B E
B D
BC
A
A H
29-32 Q6 How tall are you without your shoes on? (Note: Data are in meters.)

33-38 Q7 How much do you weigh without your shoes on? (Note: Data are in kilograms.)