School wellness policy strength, nutrition-related behaviors, and weight outcomes among high school students: An ecological study

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Ryhan M. Olson

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Approved by:

Co-Major Professor
Priscilla Brenes, PhD, MPH

Approved by:

Co-Major Professor
Jennifer Hanson, PhD

Abstract

Background: Adolescent health-related behaviors are less than ideal, and 1 in 3 adolescents in the U.S. is affected by overweight or obesity. The rates of overweight and obesity, as well as the behavioral risk factors associated with these conditions, vary by state. An improved understanding of the relationship between policy, health-related behaviors, and statewide weight outcomes is needed to inform public health strategies and programming.

Objective: To determine the association between school wellness policy strength, statewide health-related behaviors, and statewide weight outcomes among high school students.

Methods: Using an ecological study design, state-level data on overweight and obesity, fruit and vegetable consumption, soda consumption, and physical activity were collected from the Youth Risk and Behavior Surveillance Survey of high school students in 2023. Using the National Cancer Institute's 2022 Classification of Laws with School Students, a total policy score was calculated for each state using physical education and nutrition law scores. Pearson correlation analyses were used to measure the relationship between policy strength, statewide health-related behaviors, and statewide weight outcomes.

Results: Statewide combined rates for overweight and obesity ranged from 25.8% ─ 39.3%. Vegetable consumption ($r = -.84$, $p < .001$), fruit consumption ($r = -.59$, $p = .001$), and physical activity ($r = -.38$, $p = .038$) were negatively correlated with the combined rate of overweight and obesity. Soda consumption was positively correlated ($r = .78$, $p < .001$) with the combined rate of overweight and obesity. Policy scores ranged from 0 to 15. Obesity ($r = .38$, $p = .024$), overweight ($r = .415$, $p = 0.013$), overweight and obesity ($r = .47$, $p = .004$), and soda consumption ($r = .41$, $p = .029$) were positively correlated with policy scores. Vegetable

consumption which was negatively correlated with policy strength (r = - .62, p = .002) was the only health behavior variable significantly correlated with policy.

Conclusion: Higher statewide rates of fruit consumption, vegetable consumption, physical activity and lower rates of soda consumption were associated with lower rates of overweight and obesity. While overall state policy strength was not associated with improved weight or health behavior outcomes, these findings suggest that a continued emphasis should be placed on increasing these healthful behaviors in public efforts to shape adolescent weight outcomes.

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Key Words:

Health-related behaviors, adolescents, obesity and overweight, soda consumption, fruit and vegetable consumption, physical activity, policy

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Dedication

I dedicate this to my parents, who taught me nothing is impossible.

Chapter 1 - Introduction

Over recent decades, the prevalence of obesity among children and adolescents has risen to the point of becoming a global health crisis. In 2016, the World Health Organization (WHO) reported that, globally, there were over 340 million children and adolescents (5-19 years of age) who were overweight or obese (Di Cesare, 2019). In the U.S., there are approximately 14.7 million youth between the ages of 2 and 19 living with obesity, which is roughly 1 in 5 children (CDC, 2023). The epidemic of obesity cannot be linked to a single element. Complex interactions between biological, developmental, genetic, and environmental factors make it a complex problem (Kansra, 2021). Obesity prevention for children and adolescents is an ongoing area of research, with recently emerging studies on epigenetics and gut microbiome contributions (Kansra, 2021). Discussions regarding obesity's enduring pervasiveness and the widespread implications it has for population health are a prevailing public health topic. Obesity prevention in the adolescent age group continues to be a relevant area of research with the need to find practical and effective approaches to improve weight and health behavior outcomes for current youth and their future health outcomes as adults (Lipsky, 2015).

Adolescent obesity prevalence

Since the 1980s, adolescent obesity has been on the rise, specifically among low-income communities and communities of color (Anekwe, 2020). Comparatively, Asian groups have been shown to have the lowest obesity prevalence. Socioeconomic status (SES) has been identified as a more significant risk factor for obesity than race and plays a crucial role in the disparities seen among different ethnic groups. However, the disparity between low and high SES groups has

decreased over the last three decades as the obesity rates among high SES groups have increased significantly across a racial, ethnic, and gender categories (Anekwe, 2020).

During the coronavirus 2019 pandemic, the rates of weight gain increased dramatically (Hannon, 2023). An increase of 5.2 percent for overweight or obesity was found in 12- to 15-year-olds and 3.1 percent for 16- to 17-year-olds in a retrospective cohort study in California (Woolford, 2021). Children aged 10 to 19 comprise the adolescent age group, a developmental period initiated at puberty and ending at adulthood (Davis, 2021). Adolescence is a unique period within the lifespan as adolescents develop lifestyle habits that often continue into adulthood (Han, 2023). Poor health behaviors can become long-term habits, likely leading to obesity and unfavorable health outcomes (Medeiros, 2022). In a study by Ward et al. (2018), a mathematical model was developed and simulated to estimate the risk of adult obesity, given the current height and weight data of children in the U.S. The study projected that for today's youth between 2 and 19 years old, 57.3 percent will be obese by 35 years of age. The projected probability of being obese at the age of 35 increased with age for children and adolescents who were already obese, increasing from 74.9 percent at 2 years old to 88.2 percent at 19 years old. The percentage of projected adult obesity decreased with age for non-obese children and adolescents, from 57.8 percent at 2 years old to 44.4 percent at 19 years old. The positive correlation between adolescent and adult obesity may suggest the opportunity for preventing the future burden of chronic disease and comorbidities by correcting poor health behaviors early before reaching adulthood.

This is especially important as the risk of noncommunicable diseases, such as metabolic syndrome, nonalcoholic fatty liver disease, and type 2 diabetes mellitus (T2DM), is increased with adolescent obesity (Beal, 2019). These diseases not only pose health concerns within the adolescent population but are, in fact, the leading causes of mortality in the world. Thirty-eight

million of the 57 million annual deaths are caused by these chronic diseases (Bukhari, 2011). Heart disease, asthma, obstructive sleep apnea syndrome, orthopedic complications, and mental health disorders are also obesity-associated complications (Lister, 2023).

Risks of these diseases typically begin in adolescence with modifiable factors, including poor diet and indicators of metabolic syndrome (Bukhari, 2011). A systematic review from 2019 found that compared to children and adolescents with a healthy weight, youth living with obesity are 1.4 times more likely to have prediabetes, 1.7 times more likely to have asthma, 4.4 times more likely to have hypertension, and 26.1 times more likely to have fatty liver disease (Sharma, 2019). Other health concerns include the physical, social, and emotional ramifications of adolescent obesity, which may consist of impaired growth and developmental trajectories (Cardel, 2020).

As adolescents navigate the challenging landscape of social circumstances, they are also experiencing increased nutrient needs due to the demands of their rapidly developing bodies. These facts are noteworthy because the link between development and nutrition is significant. However, the food environment in the context of natural, social, cultural, political, and economic systems is not conducive to healthy diets (Neufeld, 2022). Researchers have also observed decreased physical activity among adolescents; most do not meet moderate-to-vigorous physical activity recommendations (Bogataj, 2021). The burden of these potential health issues can be lessened by influencing dietary and physical activity behaviors (Lee, 2018).

Public health implications of adolescent obesity

Implementing preventative measures for obesity into policy is critical due to its implications for public health at every stage of life, especially as people move from adolescence into adulthood.

The consequences of obesity can profoundly affect emotional well-being and quality of life for adolescents. Obesity is considered one of the most stigmatized conditions in childhood, as many overweight or obese children are bullied or teased because of their weight (Sahoo, 2015). The psychological effects of obesity from the stigmatization of the condition can lead to poor self-esteem, depression, negative mood states, eating disorders, attention deficit hyperactivity disorder, and internet addiction (Reinehr, 2018). Adolescents with obesity also are more prone to behavioral problems, and female adolescents are more likely to develop eating disorders than their normal-weight peers. These psychological effects can negatively impact their social life and relationships with peers or partners and lead to poor academic performance. The stigma of obesity can also follow these adolescents as they grow up into adulthood and search for employment (Reinehr, 2018). Employment can be difficult for individuals with obesity due to discrimination in the hiring processes for employment, which can be a cause for decreased employment rates among obese individuals (Tiwarai, 2021).

Obesity is a public health concern due to its relationship to morbidity as well. As previously mentioned, obesity has severe impacts on physical and emotional health. Many comorbidities and chronic diseases are associated with obesity starting in childhood and can persist or even evolve into adulthood (Sanyaolu, 2019). Many adolescents with obesity will go on to become adults with obesity or even more severe condition of obesity (Reinehr, 2018).. Diseases, such as T2DM, sleep apnea, hepatic steatosis, cardiovascular disease, and other

conditions previously only seen in adults, are now prevalent in children experiencing obesity (Sahoo, 2015). Patients with adolescent-onset obesity have a higher risk of dying than patients with adult-onset obesity (Reinehr, 2018). This often has to do with living with cardiovascular risk factors and T2DM for a more extended period, which can lead to stroke or myocardial infarction in adulthood. Treating obesity can also become more complex as it persists in adulthood.

Obesity is not a single-generation issue either; maternal obesity has been found to affect both the health of the mother and the phenotype of the child. This can predispose the next generation to chronic diseases later in life, including obesity, T2DM, dyslipidemia, and hypertension (Reinehr, 2018). Epigenetic changes can essentially " transfer " obesity from generation to generation. Potentially, an obese woman can pass down obesity to the next two generations during pregnancy, as there are epigenetic changes to the gonads of the fetus. Effectively, “transferring” obesity to the fetus, and possibly the future offspring of the fetus (Reinehr, 2018). Thus, promoting a cycle of obesity and its related health concerns. Obesity during pregnancy can also increase risks for birth and neonatal complications (Reinehr, 2018).

Adolescent obesity prevention is an investment that will save preventable health and societal costs (Loberstein, 2015). More than 20-percent of all healthcare expenditures in the U.S. are attributed to obesity (Tiwari, 2021). Obese individuals spend thirty to forty percent more on medical costs than normal-weight individuals. These costs can significantly affect the economy as direct costs for medical care and indirect costs can cost a nation billions (Agha, 2017). Some of the indirect costs of obesity include lost wages due to illness and premature death, increased payments for disability and insurance claims, and decreased productivity at work.

Rising obesity rates significantly affect population health and the population's ability to contribute to the economy and society. Simultaneously, healthcare costs and morbidity will continue to rise, which can lead to lower life expectancies (Agha, 2017). The stigmatization of obesity can also cause challenges related to education, health care, and employment. All these impacts are why it is crucial to focus on the adolescent population to create and improve upon policies to prevent and treat obesity before they reach adulthood effectively.

Preventative measures for adolescent obesity

The adolescent phase of life provides a recognized opportunity to foster nutritious eating patterns and routine physical activity. This opportunity exists because of the transition from dependency on caregivers to varying degrees of independence in responsibilities and roles regarding food and how it is procured, prepared, and consumed.

It is also understood that obesity has a multifactorial etiology composed of several environmental aspects that disturb regulatory processes and require a multifactorial approach to care (Lister, 2023). Adolescents experience increased autonomy, decreased self-regulatory skills, and reduced receptivity to adult input. Executive function changes within this period can increase impulsivity and risk-taking behaviors (Cardel, 2020). These adolescent tendencies create distinct challenges when working toward treatments and prevention tactics, reinforcing the importance of implementing effective strategies to prevent overweight and obesity in adolescents. For example, several interventions that have been tried for children are not as effective for adolescents in treating adolescent obesity on a population level (Lister, 2023).

The most effective interventions for adolescents acknowledge rapid emotional development and social forces driving decision-making (Hargreaves, 2021). For this reason,

interventions related to education and behavioral skills training work on primary school students but not as well on adolescents. Interventions should resonate with adolescents' values and social context to be successful in this population. Food choices are primarily influenced by modern food environments, autonomy, social norms, and peer approval. These factors are important to consider when designing effective nutrition programs and policies for adolescents (Hargreaves, 2021).

Modifications to lifestyle for adolescents, including increased fruit and vegetable consumption and moderate physical activity, have been a primary prevention tactic in combating obesity. Since excess energy intake is a crucial contributor to weight gain, dietary modifications to the quality and quantity of food consumed are routinely included within weight loss and management interventions, in addition to promoting less sedentary behavior and more moderate-to-vigorous physical activity (PA) (Cardel, 2020).

Physical activity is an essential addition to a healthy lifestyle to enhance cardiometabolic outcomes and to experience its preventative benefits (Ho, 2013). WHO recommends 60 minutes per day of moderate-to-vigorous physical activity for children under eighteen to improve fitness, develop movement and coordination control, and sustain healthy body weight (van Slujis, 2021). However, physical fitness typically declines in adolescence due to an increased focus on academics and the increased prevalence of sedentary lifestyles becoming a normative behavior amongst this demographic (Lee, 2021). It is estimated that eighty percent of adolescents do not meet WHO’s recommendations (Norris, 2020). Therefore, it is critical to prioritize time for active learning in physical education for adolescents' current and future health within interventions for obesity among adolescents (Garcia-Hermoso, 2020). Adolescents also do not meet nutrition guidelines, and their poor diet quality stems from inadequate consumption of

fruits, vegetables, and whole grains. The diet quality has been shown to decrease with age, with adolescents having poorer diets than younger youth (Ruiz, 2019). Poor diet is not only associated with high weight outcomes, but also a higher risk of suffering from chronic disease in adulthood (Ruiz, 2019).

Many interventions for lifestyle modifications have been implemented in school settings to use the time in attendance to facilitate an environment conducive to healthier living. A systematic review and meta-analysis performed by Pineda et al. (2019) reviewed 21 studies of the 4,307 retrieved between 2000 and 2019 to identify effective school interventions to prevent obesity. The researchers found that the most successful methods included banning sugary drinks and increasing the availability and accessibility of fruits and vegetables. Another study conducted in the Republic of Korea reported that researchers found significant improvements in health-related parameters in physical fitness after participating in a school-based physical activity program (Lee, 2021).

Schools' roles in health interventions

Students receive up to half their daily caloric intake in schools (Sanjeevi, 2022). Therefore, the food environment in schools can have a pivotal influence on the nutritional intake and overall health of children and adolescents. Substantial evidence shows that school interventions effectively modify behaviors, promoting healthier lifestyles. In a cluster randomized controlled trial in Texas called Texas Sprouts, researchers increased vegetable intake by implementing a school-based nutrition program centered around gardening and cooking as an intervention (Davis, 2021). A similar study reviewed how a nutrition curriculum in schools emphasizing Social Cognitive Theory may change attitudes and behaviors around nutrition. The

interventions used were aimed at building students' cooking and gardening skills. The results of this study also showed improved levels of vegetable consumption.

In another randomized controlled trial conducted in New Haven, Connecticut, researchers determined that schools that were randomized to receive support for implementing a nutrition policy saw lower body mass indexes (BMIs) over time. Researchers observed that in schools with implemented nutrition policies among eighth-grade students, fewer unhealthy foods and sugar-sweetened beverages were consumed, and students ate less frequently at fast food restaurants (Ickovics, 2019). Choice architecture in schools is also effective for improving adolescents' dietary strategies in the U.S. (Hargreaves, 2022). This intervention improves the selection, appeal, and prominence of healthier foods in schools. Implementing and enforcing policies that promote healthier food environments in schools is an encouraging method of providing essential nutrition and health benefits earlier in life to improve adolescents' current and future health (Perry, 2024).

School-based interventions have also been shown to increase PA among adolescents. Schools allow students to participate in sports and activities that are positively correlated to physical activity (van Slujis, 2021). There is strong evidence that school interventions promoting physical activity are effective, with multi-component interventions being more effective than single-component interventions (Messing, 2019). Multi-component approaches targeting physical education lessons have been shown to effectively promote physical activity among students, as shown in the systematic review conducted by Messing et. al (2019). The studies the researchers referenced increased the number of PE lessons and improved the quality of the lessons. Essentially increasing the time spent doing moderate-to-vigorous PA by twenty-four

percent. Other factors that were useful as effective strategies to promote PA in schools were specified teacher training and capacity building (Messing, 2019).

A study by Hargreaves et al. (2022) highlighted schools' roles in promoting nutrition by any means possible, including embedding nutrition into class curricula, facilitating PA and active transportation to school, implementing healthy food environments, and engaging faculty and staff to reinforce these initiatives. This is considered a “whole school approach.” It uses the opportunity to use the school curriculum to positively influence its students' dietary and physical behaviors (Hargreaves et al.).

Obesity prevention via government policy

A practical tool to implement interventions that address childhood obesity is government policy that encourages and teaches lifestyle modifications in schools. The U.S. has many laws and regulations that promote nutrition and health behaviors within educational settings. In 1946, Congress approved the Richard B. Russel National School Lunch Act as a measure of national security to safeguard the health of the nation’s youth. This act helped ensure that children had adequate access to nutritious agricultural commodities. It also required the federal government to assist states with grant money or other methods to provide food supplies and facilities to support the needs of nonprofit school lunch programs. Since 1966, the Child Nutrition Act has been the primary regulator for the School Lunch Act, enacted to establish better nutrition standards for meals to support the consumption of essential nutrients and healthy foods. The Child Nutrition Act was passed to recognize nutrition's relationship with children's capacity to develop and learn (1966). Due to the success of the School Lunch Act, the Child Nutrition Act provided the means to strengthen, expand, and extend the efforts the School Lunch

Act began in applied nutrition research. The Child Nutrition Act also established the School Breakfast Program (SBP) to encourage breakfast consumption.

The Federal government is responsible for establishing the National School Nutrition standards. Overall, the regulations at the national level have improved the diet quality for children and adolescents (Gu, 2017). The nutrition standards establish science-based nutrition standards for foods sold in schools other than those provided under the School Lunch Act and Child Nutrition Act. The standards regulate foods sold outside the school meal program, on the school campus, and at any time during the school day. In 2010, the Healthy, Hunger-Free Kids Act (HHFKA) was updated to direct the U.S. Department of Agriculture (USDA) to implement language that updated nutrition standards and meal patterns that better aligned with the Dietary Guidelines for Americans (DGA) for the National School Lunch Program (NSLP). The DGA provides information for nutrition and health professionals and policymakers to help Americans consume healthy, nutritionally adequate diets. The guidelines are required to develop, implement, and evaluate food, nutrition, and health policies, in addition to programs at the Federal level (USDA, 2020). The revised standards aimed to improve the availability of fruits, vegetables, and whole grains; provide only fat-free or low-fat milk options; decrease sodium and saturated fat levels; eliminate all trans fats; and target minimum and maximum calorie requirements for school meals. (Gearan, 2020) Since the establishment of the new standards, there have been substantial increases in healthy dietary behaviors and weight outcomes across the country (Sanjeevi, 2020). For example, California saw a downward trend or leveling off of prior increases in children who were overweight and obese between 2013 and 2016 after the implementation of the HHFKA.

Independent of the HHFKA, California reduced the state's prevalence of childhood overweight and obesity with state policies that were established in 2005. However, the prevalence was further decreased when the state and national policies worked concurrently (Sanchez-Vaznaugh, 2021). Massachusetts saw similar results when the state government implemented the national meal standards with their comprehensive competitive food and beverage standards. In an observational cohort study, researchers found that after the combined implementation, Massachusetts adolescent students consumed more school meals and 22 fewer grams of sugar daily with the reduction of unhealthy snacks within schools (Cohen, 2018). Since the Massachusetts state government implemented the time meal standards, children's 24-hour dietary intakes improved from 55% of the maximum score values of the Healthy Eating Index 2010 (HEI-2010) scores during 2011 and 2012 to 82% and 71% for school lunches and breakfasts, respectively (Gearan, 2020). The HEI-10 is a tool to assess the degree to which the 2010 DGA recommendations align with food sets served or consumed. Ensuring that the meals served under the NSLP and SBP are of better quality in schools than those served outside schools is essential to ensure that the programs are administered accordingly (Forrestal, 2021). These studies underscore the importance of states taking regulatory action with policies to compliment national policy.

States' responsibilities to enforce policy

State agencies are responsible for administering the NSLP and acting as a link between the USDA's Food Nutrition Service (FNS) and local program operators. A primary strategic goal of the NSLP is to promote student participation and consumption of program meals. State assistance is vital to achieving these goals. States also ensure the federal requirements are

managed accordingly to ensure the NSLP's success. There are minimum requirements for state agencies to meet compliance to ensure this success.

Subpart C of the NSLP regulations provides local educational agencies with school food authority participation requirements. This section defines nutritional standards, rules for competitive foods, and meal requirements for lunches and competitive foods served during the school day.

Subpart F of the NSLP regulations states that each local educational agency must implement a local school wellness policy that promotes student wellness, prevents and reduces childhood obesity, and provides assurance that minimum Federal standards are being upheld for all school meals and other food and beverages sold and made available on the school premises within the school day (USDA, 2023). There are minimum requirements for all wellness policies. These include the requirement of the local agency to set standards for all food and beverages provided and nutrition guidelines for all foods and beverages sold to students that comply with nutrition standards set by the USDA for meals and competitive foods. They must also permit the marketing of only healthy foods and drinks during the school day, promote student health, and reduce childhood obesity to a minimum. The Healthy, Hunger-Free Kids Act of 2010 required wellness policies to expand their scope to encourage physical activity and food marketing in schools. For competitive foods, the USDA requires state or local educational agencies to establish policies and procedures as necessary.

Role of state policies in schools and adolescent behavior

State statutes and regulations are primary drivers of school resource priorities, including time, attention, funding, and other resources. There has been a positive correlation between the strength of laws for competitive food and beverage, school meals, nutrition education, farm-to-school, and advertising and improved dietary intake (Palakshappa, 2016). Many studies of this nature focus on singular laws such as competitive foods and beverages have been inconclusive on any benefit for reducing obesity within student populations. One study performed in 2016 observed the relationship between the strength of a broad range of nutrition laws and weight for the years 2011 and 2012. In addition to this data, they also completed a longitudinal analysis of obesity changes over time and determined if there was a relationship between multiple state laws and weight. The researchers were able to determine that strong state laws that limited the sale of competitive foods and beverages in elementary schools and strong state laws that restricted the advertisement of foods and beverages that were not within federal guidelines across elementary, middle, and high schools had a positive correlation with reduced odds of obesity (Palakshappa, 2016). Another study that analyzed the relationship between youth obesity and state school nutrition and physical activity policy exhibited that policies on competitive foods and food service standards had the strongest correlation with the prevalence of obesity. However, physical activity policies did not produce significant results regarding youth obesity (Blitstein, 2016).

Evidence has also suggested that strong state nutrition laws positively affect adolescent students' weight and eating behaviors. Sanjeevi et al. (2020) found that states with strong farm-to-school laws increased fruit consumption and decreased soda and snack consumption compared to states with no regulations at all for farm-to-school programs. They also identified strong state laws regarding competitive foods decreased soda consumption and were associated

with better weight outcomes than states without these laws. In a cross-sectional study of a nationally representative sample of first to twelfth graders, Turner et al. (2020) found that consumption of solid fats and added sugars was 53.9 calories less per day in states with laws requiring schools to implement Smart Snacks than in states without such laws (Turner, 2020). "Smart Snacks" refers to the Smart Snacks in School standards, which were standards from the HHFKA that aligned with the DGA to increase the availability of healthful snacks and reduce the consumption of high-calorie, low-nutrient snacks. Rhode Island's healthier beverages policy in schools showcased schools' willingness to adhere to statewide policies quickly and effectively. This demonstrates the feasibility of states significantly impacting school districts with laws to improve student health and well-being (Jensen, 2012).

It is well documented that state and national policy has made some strides towards improving the health of children and adolescents in the U.S. Some studies have even pointed out that high school students may have less access to fruit and vegetables and more access to sugar-sweetened beverages and calorie-dense foods like French fries in lower-level schools (Terry-McElrath, 2015). Notably, there is consistency in lowering trends in obesity and the likelihood of obesity in states with strong policies for competitive foods in adolescents (Taber, 2012). Most of the literature on state policy focuses on competitive food policies and other nutrition-related policies concerning diet behaviors and weight outcomes. Policies set in place specifically for high schools and the effect that they may have on health behaviors and weight do not appear to be as prevalent. In addition, there is a lack of recent evidence (i.e., evidence from within the last three years) regarding policy influences on student weight status and nutrition-related behaviors. This study assesses the relationship between state policies and nutrition-related outcomes among high school students in the U.S.

Research questions and specific aims

This study aimed to answer the following questions:

1. Is there a relationship between the strength of state-level school wellness policies and statewide rates of overweight and obesity?
2. Is there a relationship between the strength of state-level wellness policies and statewide nutrition-related behaviors?
3. Is there a relationship between statewide nutrition-related behaviors and rates of overweight and obesity?

These aims were to add to existing literature for consideration in policy and health among adolescent populations.

Chapter 2 - Methods

An ecological study design was used to assess the relationship between the strength of state-level wellness policies and statewide nutrition-related outcomes among high school students in the U.S.

Health-related outcomes

Statewide rates of overweight and obesity and state-specific nutrition-related behaviors were obtained from the Centers for Disease Control and Prevention (CDC) Youth Risk and Behavior Surveillance Survey (YRBSS) from 2023. The 2023 YRBSS data set contains data on a nationally representative sample of youth from public and private schools in grades 9 through 12. The survey collected cross-sectional data on a broad spectrum of health risk behaviors. The methodology used was a three-stage probability sampling, which has been described previously (Brener, 2024). Students voluntarily completed the survey on a tablet during one class period. Trained data collectors distributed and collected tablets at each school. In all, 20,386 questionnaires were completed in 155 schools. Of these, 20,103 passed quality control measures to be used for analysis. The school response rate was 49.8%, the student response rate was 71.0%, and the overall response rate was 35.4%. The results were weighted to generalize the data to the high school student population in the U.S. Weights adjusted based on demographic information (sex, race and ethnicity, and grade) for school and student nonresponse (Brener, 2024)

For this study, data was extracted using the "Explorer" application on CDC.gov. This tool allows data to be extracted by sex, race (non-Hispanic white, non-Hispanic Black, Hispanic, Asian, and Native American or Alaskan Native), and grade (9^{th}-12^{th} grade) for the states who

opted to participate in the survey items. The survey information selected for this study included prevalence rates for:

- "Students who ate fruit or drank 100% fruit juice one or more times a day"
- "Students who ate vegetables one or more times a day"
- "Students who drank a can, bottle, or glass of soda or pop one or more times a day"
- "Students who had obesity"
- "Students who were overweight"
- "Students who were physically active at least 60 minutes per day on five or more days"

State-level wellness policy strength

The policies of the states that participated in the YRBSS data collection in 2023 were graded to determine the overall strength of their health and wellness policies. States that did not participate in the survey were not included in the policy score review.

The Classification of Laws Associated with School Students (CLASS) database developed by the National Cancer Institute was used to score the strength of each state's wellness policies, with greater scores corresponding to greater strength. The CLASS database classifies the strength of the state-level school nutrition and physical education laws in effect for a specific year. Stronger policies have higher scores in the database. The data for this study was collected from the year 2022. Score requirements are available in Appendix A for the CLASS policy topic score requirements.

The policy topics that were reviewed for the current study were those related to laws that address a) requirements for physical activity and physical education, b) nutrition education standards, c) snacks and food sold apart from the NSLP, d) marketing laws that address the

advertising of foods at school, and e) nutrition and wellness policy councils or wellness teams. The scores ranged from 0 to 5 for time requirements for physical education and activity, 0 to 4 for nutrition education standards, 0 to 6 for laws that address snacks and food sold apart from the NSLP, 0 to 5 for marketing laws that address advertising of foods at school, and 0 to 3 for laws that address the nutrition and wellness policy councils or wellness teams. In addition to a score for each policy topic, a total state policy score was calculated by summing each state's individual policy topic scores.

Statistics

Descriptive analysis was performed to quantify the rates of overweight, obesity, and overweight and obesity combined as well as health behaviors and policy scores. States were categorized by region to control for geographic variance. The states were split into 4 groups: Northeast, South, West, and Midwest based on the U.S. Census's categorization of states by region. Levene's test was used to determine homogeneity of variance among the regions with regard to each variable. A one-way ANOVA was then used to determine significant differences between regions for each of the variables. Pearson correlation coefficients ($p \leq .05$) were calculated to measure the relationships between weight outcomes, total policy score, and health-related behaviors. All data were analyzed using IBM SPSS Statistics for Windows, Version 29.0 (IBM, Armonk, NY, USA).

Chapter 3 - Results

Descriptive Statistics

A total of 34 states were included in the 2023 Youth, Risk, and Behavior Survey. All other states either did not participate or did not have representative data available. The average statewide obesity rate equaled 16.2%, the average statewide overweight rate equaled 15.4%, and the total statewide average of both groups equaled 31.6%. The Southern states (n =11) had the highest average statewide rates of overweight, obesity, and overweight and obesity combined with obesity at 18.4%, overweight at 16.1%, and the total for both overweight and obesity at 34.5%. The Northeast states (n = 9) had the lowest average statewide rate of obesity at 14.1%, and the Midwest states (n = 9) had the lowest average statewide rates of overweight students at 14.6%. The Northeast states (n = 7) had the highest average statewide rate for overall fruit and vegetable consumption, at 55.9% and 64.3%, respectively. The Western states (n = 5) had the lowest average statewide rate of students who ate fruit or drank 100% fruit juice one or more times a day at 48.2%, and the Southern states had the lowest average statewide rate of students who ate vegetables one or more times a day at 50.3%. The Midwestern states had the highest statewide rate of students reporting they were physically active for at least 60 minutes on five or more days, with a rate of 49.6%, and the Southern states had the lowest rate at 43.1%. Soda consumption was highest in the South, with the average statewide rate of students reporting drinking at least one soda daily equaling 20.8%. The region with the lowest statewide rate Of daily soda consumption was the northeast (n = 3), with a mean of 10.4%. For the complete breakdown of outcomes from the survey, refer to Table 3.1. Refer to Table 1.

Table 3.1 *Average weight and behavior outcomes by state*

	Obesity (%)	Over-weight (%)	Obesity and Overweight (%)	Physical Activity (%)	Fruit Consumption (%)	Vegetable Consumption (%)	Soda Consumption (%)
South							
Arkansas	21.5	15.8	37.3	44.9	45.8	45.6	22.1
Delaware	17.8	16.5	34.3	43.4	No Data	No Data	16.1
Kentucky	22.1	15.3	37.4	41.8	47.9	46.2	27.2
Maryland	15.7	15.4	31.1	39.5	52.5	56.8	12.3
Mississippi	20.6	18.7	39.3	38.3	49.6	42.2	23.9
N. Carolina	13.6	13.8	17.4	42.8	53.9	No Data	12.1
Oklahoma	19.8	12.9	32.7	44.3	46.4	58	16.7
Tennessee	15.5	13.4	28.9	53.2	51.1	56	17.1
Texas	18	16.5	34.5	35.5	47.7	48.5	23.5
Virginia	13.7	14.1	27.8	52.1	57.5	68.8	No Data
W. Virginia	13.7	15.7	19.4	42.8	53.4	61.1	17
West							
Alaska	17.2	16.3	33.5	40	42.8	56.2	14.3
Hawaii	14.7	15.1	29.8	42	43.4	71.6	9.9
Nevada	16.3	13.1	19.4	55.5	52	57.9	14
New Mexico	12.3	16.7	19.0	50.2	52.2	No Data	9.4
Utah	18.5	15.2	33.7	44.7	52.1	52.1	17.6
Northeast							
Connecticut	14.1	15.6	29.7	50.8	59	61.9	No Data
Maine	15.3	13.9	29.2	46.3	59.8	No Data	No Data
Massachusetts	13.3	15	18.3	47.3	55.4	62.1	9.6
New Hampshire	15.4	17.3	32.7	36.7	No Data	No Data	14
New Jersey	12.5	13.3	25.8	No Data	No Data	No Data	No Data
New York	17.5	16.5	34.0	49.5	48.9	56.8	17.1
Pennsylvania	17.9	16.5	34.4	49.1	42.7	48.3	22.2
Vermont	12.6	15.1	37.7	47.4	55.1	62	15.5
Rhode Island	16.6	15.4	31.0	50.5	53.7	No Data	No Data

Midwest							
Illinois	13.5	14.5	28.0	47.7	No Data	No Data	13
Indiana	17.4	15.1	32.5	44.5	No Data	No Data	18.3
Michigan	16.9	15.5	31.4	50.7	50.8	53.2	13.4
Missouri	15.9	17	32.9	47.7	50	53.1	19.4
Nebraska	14	14.6	18.6	51.7	50.9	58.3	14.9
N. Dakota	17.1	14.1	31.2	42.1	52.4	51.6	19.2
Ohio	16.3	14.7	31.0	54.5	53.8	58.9	18.5
S. Dakota	15.3	16.1	31.4	39.9	No Data	No Data	No Data
Wisconsin	19.5	17.4	36.9	51.6	48.8	No Data	27.2
Mean	16.2	15.4	31.6	46.1	51.1	56.0	17.0
(% error)	(0.427)	(0.223)	(0.540)	(0.891)	(0.839)	(1.49)	(0.918)

Policy strength and health behaviors

The total policy strength score ranged between 0 and 15. Hawaii had the lowest score at 0. Rhode Island and Mississippi had the highest scores, both at 15. Of the participating states, the average score was 6.83. The Southern region of the U.S. had the highest overall policy scores of all the regions, totaling 8.81 (Table 3.3). The Midwest was found to have the lowest overall policy score, with a mean of 3.89.

A test of homogeneity of variances was accomplished to determine whether the variances between groups were equal for the ANOVA test. All results were nonsignificant, except for soda consumption. Thus, the soda consumption data was put through a Welch test instead. The Welch test resulted in the soda consumption variables' mean being statistically different ($P < 0.001$) from the sample groups.

It was determined from the ANOVA tests ($p \leq 0.05$) that there were statistically significant differences between averages by region. The overall policy scores were statistically significantly different for the different outcome variables in this study (overweight, obesity, total overweight and obesity, overall average fruit consumption, overall average vegetable consumption, overall average soda consumption, and physical activity), $F(3, 31) = 4.557$, $p = 0.009$. Obesity ($F(3, 31) = 8.805$, $p < 0.001$), overweight ($F(3, 31) = 3.201$, $p = 0.037$), total overweight and obesity ($F(3, 31) = 8.772$, $p < 0.001$), fruit consumption (($F(3, 24) = 6.502$, $p = .002$), vegetable consumption ($F(3, 19) = 7.92$, $p = 0.001$), and physical activity ($F(3, 30) = 3.758$, $p = 0.021$) were all statistically significantly different from the total policy score and each outcome variable.

Table 3.2 *Analysis of variance for policy and health-related outcome variables*

	Sum of Squares	df	Mean Square	F	P-Value
Overall Policy Score					
Between Groups	135.557	3	45.186	4.557	0.009
Within Groups	307.414	31	9.917		
Total	442.971	34			
Total Average Obesity					
Between Groups	99.896	3	33.299	8.805	<0.001
Within Groups	117.231	31	3.782		
Total	217.127	34			
Total Average Overweight					
Between Groups	14.120	3	4.707	3.201	0.037
Within Groups	45.584	31	1.470		
Total	59.704	34			
Total Average Obesity and Overweight					
Between Groups	159.613	3	53.204	8.772	<0.001
Within Groups	188.026	31	6.065		
Total	347.639	34			
Overall Average Fruit					
Between Groups	238.429	3	79.476	6.502	0.002
Within Groups	293.360	24	12.223		
Total	531.789	27			
Overall Average Vegetable					
Between Groups	625.029	3	208.343	7.920	0.001
Within Groups	499.803	19	26.305		
Total	1124.832	22			
Overall Average Soda					
Between Groups	335.259	3	111.753	8.896	<0.001

	Within Groups	301.482	24	12.562	
	Total	636.741	27		
Overall Average PA					
	Between Groups	243.590	3	81.197	3.758	0.021
	Within Groups	648.209	30	21.607	
	Total	891.799	33		

*$p < 0.05$

A post hoc analysis using Tukey's Test of the policy scores supported the presence of significant differences in the means by region. The Midwest and the South had a significant mean difference between groups for overall policy scores (mean difference = 4.93, p = 0.008) and total average physical activity (mean difference = -6.57, p = 0.019). For obesity outcomes, the South had a significant mean difference from the Northeast (mean difference = 4.32, p < 0.001) and West (mean difference = -3.17, p = 0.016). The South had a significant mean difference from all regions in terms of total obesity and overweight outcomes. The Northeast fruit consumption average was statistically different from the West (mean difference = -7.71, p = 0.005) and South (mean difference = 6.64, p = 0.004) regions' averages. As for vegetable consumption, the South had a significant mean difference from the West (mean difference = 10.7, p = 0.007) and the Northeast (mean difference = 14.0, p = 0.003). There were no significant differences between group averages for overall average overweight for the regions.

Since the soda consumption group violated the homogeneity of variances test, the Games-Howell Post Hoc test was used to conduct pairwise comparisons between regions. The results of this test conclude that the South has a group average that is statistically different from the West (mean difference = 6.48, p = 0.010) and the Northeast (mean difference = 10.4, <0.001).

Table 3.3 *Average policy, weight, and behavior outcome variables by region*

	N	Mean	Std. Deviation	Std Error
Overall Policy Score				
South	11	8.82	3.03	.913
West	6	6.00	4.05	1.65
Northeast	9	7.89	3.37	1.12
Midwest	9	3.89	2.32	.772
Total	35	6.83	3.61	.610
Overall Average Obesity				
South	11	18.4	2.47	.746
West	6	15.2	1.89	.770
Northeast	9	14.1	1.41	.471
Midwest	9	16.5	1.67	.556
Total	35	16.2	2.52	.427
Overall Average Overweight				
South	11	16.1	1.23	.371
West	6	15.8	1.04	.425
Northeast	9	14.9	1.16	.388
Midwest	9	14.6	1.33	.444
Total	35	15.4	1.33	.224
Overall Average Overweight and Obesity				
South	11	34.5	3.10	.925
West	6	31.1	2.69	1.10
Northeast	9	29.0	1.94	.646
Midwest	9	31.1	1.86	.619
Total	35	31.6	3.20	.540
Overall Average Vegetable Consumption				
South	9	50.3	5.87	1.96
West	5	61.0	6.35	2.84
Northeast	3	64.3	3.93	2.27
Midwest	6	56.2	2.53	1.03

Total	23	56.0	7.15	1.50
Overall Average Fruit Consumption				
South	10	49.3	3.41	1.08
West	5	48.2	5.19	2.32
Northeast	7	56.0	2.89	1.09
Midwest	6	50.7	2.47	1.01
Total	28	51.1	4.44	.839
Overall Average Soda Consumption				
South	11	20.8	4.73	1.42
West	6	14.3	2.73	.984
Northeast	3	10.4	1.50	.868
Midwest	8	16.3	2.50	.884
Total	28	17.0	4.86	.918
Overall Physical Activity				
South	11	43.1	4.59	1.38
West	6	44.6	5.87	2.40
Northeast	8	47.5	1.94	.646
Midwest	9	49.6	1.86	1.37
Total	34	46.1	3.20	.892

Table 3.4 *Policy topics and total policy score by state*

	Avg Score of PE/PA Time Requirements	Nutrition Education Standards	Average of Competitive Foods and Beverages	Nutrition and Wellness Policy Councils or Wellness Teams	Marketing Laws that Address the Advertising Foods at School	Total Policy Score
South						
Arkansas	2	2	5	3	2	13
Delaware	1	3	1	0	0	5
Kentucky	1	0	6	0	0	7
Maryland	1	2	1	2	0	6
Mississippi	2	4	4	3	2	15
N. Carolina	1	2	4	0	0	7
Oklahoma	1	2	4	3	0	10
Tennessee	3	2	4	0	0	9
Texas	1	4	0	3	0	8
Virginia	1	2	2	1	1	7
W. Virginia	1	4	4	0	1	10
West						
Alaska	2	4	0	0	4	10
Hawaii	0	0	0	0	0	0
Nevada	2	4	0	0	0	6
New Mexico	2	3	4	2	0	11
Utah	1	0	4	0	0	5
Northeast						
Connecticut	2	2	1	0	0	5
Maine	1	3	2	0	4	10
Massachusetts	1	2	3	3	0	9
New Hampshire	2	2	2	0	0	6
New Jersey	2	0	4	0	3	9
New York	2	3	2	1	0	8

Pennsylvania	2	4	0	1	0	7
Rhode Island	1	3	4	3	4	15
Vermont	2	1	0	1	0	4
Midwest						
Illinois	1	2	4	0	0	7
Indiana	2	0	4	1	0	7
Michigan	1	0	0	0	0	1
Missouri	1	2	0	0	0	3
Nebraska	1	2	0	0	0	3
N. Dakota	1	0	0	0	0	1
Ohio	1	2	3	0	0	6
Wisconsin	1	2	0	0	0	3

Weight outcomes and policy and health behavior

The Pearson correlation coefficients showed significant relationships between weight outcomes and behavior ($p </= .05$). There was a positive, moderate correlation between policy strength and weight outcomes ($r_{ow} = 0.415$, $r_{ob} = 0.318$, $r_{ow+ob} = 0.473$). Vegetable consumption had a moderate, negative correlation to overweight outcomes ($r_{ow} = -0.476$). A high, negative correlation existed between vegetable consumption and obesity and total overweight and obesity outcomes ($r_{ob} = -0.798$, $r_{ow+ob} = -0.844$). Fruit consumption outcomes were moderately and negatively correlated to all weight outcomes ($r_{ow} = -0.327$, $r_{ob} = -0.560$, $r_{ow+ob} = -0.586$). Soda consumption was positively correlated with weight outcomes, with a moderate correlation with overweight outcomes and high correlations with obesity and total overweight and obesity outcomes ($r_{ow} = 0.353$, $r_{ob} = 0.779$, $r_{ow+ob} =0781$). Physical activity was negatively correlated with weight outcomes, moderately correlated with overweight and total overweight and obesity outcomes and weakly correlated with obesity outcomes ($r_{ow} = -0.365$, $r_{ob} = -0.253$, $r_{ow+ob} = -0.357$).

Table 3.5 *Correlation among statewide variables and weight outcomes*

	Overweight (*r*)	P-Value	Obesity (*r*)	P-Value	Overweight and Obesity (*r*)	P-Value
Policy	0.415	.013	0.381	.024	0.473	.004
Vegetable	-0.476	.022	-0.798	<.001	-0.844	<.001
Fruit	-0.327	.089	-0.560	.002	-0.586	.001
Soda	0.353	.065	0.779	<.001	0.781	<.001
PA	-0.365	.034	-0.253	.149	-0.357	.038

The policy scores had some statistically significant relationships to weight outcomes and health-related behaviors as well (p </= .05). The total policy scores had a moderate, positive correlation to weight outcomes ($r_{ow} = 0.415$, $r_{ob} = 0.381$, $r_{ow+ob} = 0.473$). A moderate, negative relationship existed for vegetable consumption ($r_v = 0.623$). Soda also had a moderate, positive relationship with policy score ($r_s = 0.413$). The correlation coefficient for the relationship for fruit was not statistically significant, as was the physical activity correlation coefficient (Table 3.6).

Table 3.6 *Correlation between policy and behavior variables*

	Policy Score (*r*)	P-value
Vegetable	-0.632	0.002
Fruit	-0.119	0.545
Soda	0.413	0.029
Physical Activity	-0.277	0.113

Chapter 4 - Discussion

This ecological study aimed to determine the relationship between the strength of state-level wellness policies and statewide nutrition-related outcomes among adolescents in grades 9-12 in the U.S. The results also provide updated data on the relationship between health behaviors and adolescent weight outcomes. Meanwhile, the data reflects potentially reactive relationships between policy strength and health outcomes.

Policy scores relationship with health outcomes and behaviors

The results of this study showed that some of the highest policy scores were associated with higher weight outcomes and less healthful behaviors. These outcomes were unexpected because it was anticipated that healthy weight and behavior outcomes would increase with higher policy scores and that unhealthy behaviors would decrease. However, the inverse was found in this study. The singular period of this study may be a factor in these results, as this study does not compare prior years with potential trends. The study conducted by Sanjeevi et al. (2020) is a similar study that observed the relationship between state policy scores and adolescents' eating behaviors and weight statuses. Their study used data from the NEXT study, a nationally representative sample of adolescents assessed annually for 7 years. They concluded that stronger school nutrition laws were related to better weight outcomes and healthier dietary behaviors (Sanjeevi, 2020).

The overall policy scores for the Southern states were the highest, with an average score of 8.82 of 15 possible points. Concurrently, the Southern region had the highest rate of obesity, at 18.4 percent. The correlation between policy and weight outcomes reflected a statistically significant positive relationship. Two states with the highest rates of obesity and highest scores

for overall policy were Mississippi and Arkansas. Further investigation into their school policies shows that they most recently updated their Child Nutrition policies in 2022. Mississippi strengthened its competitive foods and Smart Snacks policies in September of 2022, and Arkansas revised its Nutrition and Physical Activity policy in November of the same year. The policy data collected for the CLASS policy map was also taken in 2022. The timeframe between the policy updates and data collection by the CDC is relatively short in terms of being able to reflect significant changes in the outcomes reported in 2023 for the YRBSS.

Mississippi has historically been the state with the highest rates of obesity in the country. (Zhang, 2025) There has been an upward trend among high school students, and agencies in the state have been fighting this over the last few decades. There have been multiple collaborations with the Mississippi and federal agencies to address the obesity epidemic in the state, including incorporating strict health education, PA, and nutrition standards in schools. However, the rate of obesity remains the highest in the nation. Further research may be necessary to address what has been effective and what has not been in the state to determine where the focus for policymakers should be on continuing to fight obesity in this state and other states with similar rates in obesity.

As mentioned before, this study contradicts previous literature, which associates lower body weight and overweight/obesity with laws, including stronger competitive school laws (Sanjeevi, 2020). Another study found that Mississippi's legislation on nutrition has been effective in changing behavior since the 2007 Mississippi Health Act and that school-based interventions can regulate weight and fitness (Jang, 2020). The same study found that school nutrition policies could increase the consumption of fruits and vegetables from state policies in Texas and Utah. The difference between these studies and the one conducted here is that these were longitudinal, covering multiple years. Therefore, policies may reduce high-risk health

behavior, but it will take time to reflect on the changes. States with higher-risk behaviors may also have a high reduction in obesity-determinant behaviors. Since this study only analyzed one year, the data does not showcase trends and if there were improvements over time in obesity, overweight, or health-related behaviors.

Health behaviors' relationship to overweight and obesity outcomes

This study also supported determinant dietary and health behaviors related to weight outcomes. Higher fruit and vegetable consumption had a strong correlation to lower rates of obesity, as supported by previous literature. However, fruit consumption had a non-significant relationship with overweight outcomes. Vegetable consumption has been found to have a protective effect against overweight and obesity outcomes. Adolescents who do not eat vegetables have a higher risk of being obese than those who significantly increase their consumption (Mahumud, 2021).

Similar results were captured in a study reviewing dietary and health behaviors among school-aged adolescents in Pakistan, albeit with weaker correlations (Tanveer, 2024). In contrast, the Texas SPROUTS study, the cluster randomized controlled trial, did not find that increased vegetable consumption decreased obesity parameters (Davis, 2019). The research is inconsistent for lower weight outcomes from fruit and vegetable consumption. However, eating more fruits and vegetables may correlate to eating less healthy, convenient, or fast foods. Convenient, ready-to-eat foods are also predictive of BMI (Hanson, 2019). Evidence shows that increasing cooking and food skills correlates with higher fruit and vegetable consumption and better dietary behaviors in adolescents (Leblanc, 2022). Gardening and cooking skills programs can develop long-term habits with lasting effects on health (Ruiz, 2020). Adolescents with better cooking

skills are almost twice as likely to meet fruit and vegetable recommendations versus their peers with lower cooking abilities (Ruiz, 2020). Similar results were found for high school students who frequently garden at home or in the community and are more likely to try new fruits and vegetables (Ruiz, 2020).

Based on the results, soda consumption had a positive relationship with rates of obesity and total obesity and overweight outcomes but was not significantly correlated to overweight outcomes. The previously mentioned 2024 study of Pakistani youth also had positive correlation results for weight status and soda consumption (Tanveer, 2024). Another study that reviewed data from the 2013 YRBSS also found that soda consumption is associated with obesity (Heo, 2020). Sugar-sweetened beverages (SSB), including soda, create a higher risk of overweight and unhealthy diets, as well as the risk of developing metabolic disorders and T2DM (Abdullatif, 2022). A 2023 systematic review and meta-analysis found that each additional 12-ounce serving a day of SSB was associated with a 0.07-kg/m^2 (95% CI: 0.04 kg/m^2, 0.10 kg/m^2; P< 0.01) increase in BMI (Nguyen, 2023). The study also supported that the reduction of SSBs decreased the BMIs of children and adolescents. Reducing or eliminating soda consumption is a good step to limit excess energy intake that would lead to gaining weight (Heo, 2020).

The market dominance of soda makes it more distinct from other SSBs, and targeting soda specifically may be an important area for policy to continue cracking down on (Miller, 2020). A strategy that has had significant results is a “soda tax” on these beverages to deter purchase. Soda consumption was effectively reduced in obese and overweight high school student populations where their cities have implemented the tax (Edmondson, 2021). Although the tax is not widespread in the U.S., it could improve health disparities and outcomes with a more prominent presence.

Physical activity had a strong negative correlation to overweight and total overweight and obesity outcomes, but the correlation between physical activity and obesity was not significant. Previous literature supports the association between physical activity and lower weight outcomes. One study cites the weight-control benefit of meeting aerobic and muscle-strengthening activity guidelines (Garcia-Hermoso, 2020). Moderate-to-vigorous PA (MVPA) has many health benefits, including better mental health, cardiorespiratory fitness, and less weight gain among adolescents than light PA (Kalaja-Tilga, 2020). Not meeting MVPA recommendations is a significant behavioral predictor for adolescent obesity (Menon, 2019). Literature also supports that inactivity is significantly associated with obesity and in adolescents trying to lose weight as well (Heo, 2020).

The association of physical inactivity among adolescents to non-communicable disease risk makes it a concern to public health (van Sluijs, 2021). It is estimated that the costs associated with physical inactivity have direct healthcare costs of $54 billion, $31 billion being paid by taxpayer dollars (van Sluijs, 2021). Adolescence is a prime developmental period to enable physical activity habits. This is especially important because as adolescents advance in age, there is a downward trend in PA, and it does not level off until young adulthood (van Sluijs, 2021). This evidence of the negative correlation of PA and weight outcomes and the negative impacts of inactivity has emphasized the importance of public health policy promoting physical activity among adolescents.

Strengths and Limitations

It is important to note that this study had many strengths and weaknesses. One strength was its use of the 2023 YRBSS data, the most recent set of data on the dietary and health behavior of

American high school-aged adolescents. The YRBS data provided a large and nationally representative sample of adolescents in the U.S. However, the nature of the YRBS is that it is a survey, so social or recall bias could be present due to students' self-reported information. Therefore, there could be the occurrence of some over- or underreporting within the data set. Another limitation was the relatively small sample size of states and the absence of more states in some regions than others. For example, the Western region had very low participation. Without equal representation throughout the nation, some patterns or relationships may be misrepresented in lower represented regions.

The ecological design of this study comes with some innate limitations as well. While the design allows for a relationship between exposure (health behaviors and policy) and an outcome across populations (weight outcomes), there is a risk of "ecological fallacy" (Aggarwal, 2019). This term is defined as an association between exposure and outcome at the group level that may not be valid at the individual level (Aggarwal, 2019). Therefore, some health-related behavior and weight outcomes at the state or regional level may not be representative at the individual level. Other limitations to this type of study can be related to a potential third factor associated with exposure and the outcome. Socioeconomic status is a variable that was not controlled in this study and could be an example of a potential confounding variable. The advantage of an ecological study is that the data is already available and from reliable sources, such as the CDC and National Cancer Institute. This type of study is also beneficial in determining the potential disease burden in a population and can help in identifying geographic variations among the population of the U.S.

Conclusions

This ecological study analyzed the most current data regarding adolescents' health outcomes and behaviors, specifically those of high school age. The findings supported greater fruit and vegetable consumption, higher levels of physical activity, and lower soda consumption as behaviors associated with lower weight outcomes. Since behaviors developed in adolescence have the common effect of carrying over into adulthood, policies and programs should be tailored to the unique needs of adolescents. Adapting to meet the needs for autonomy and social acceptance of this age group is essential to developing buy-in and results from this population.

This study is important because it highlights the necessity to continue pushing for strategies to promote the determinant behaviors identified in this study. Further research should continue to assess what methodologies are most successful in attaining adolescent participation in the short term and promoting long-term habits. As obesity among adolescents is still a primary health concern, results from studies such as this can help in informing policy makers to improve the environment for more healthy behaviors.

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Appendix A - CLASS Scoring Keys

Appendix Figure A.1 Physical education time requirements CLASS scoring guide

Physical Education (PE) Time Requirements – High School (HS)
Variable name in data set: (TIMEHS2)

Score	**Description:** The Physical Education (PE) Time Requirements score reflects the degree to which state law addresses the amount of PE instruction with respect to the National Association for Sport and Physical Education (NASPE) recommended standard at the HS grade level.
5	State requires school districts to provide PE for a minimum of 225 minutes per week (or the equivalent in credit(s) based on the Carnegie unit).*
4	State requires public school districts to provide PE for a minimum 150 minutes per week but less than 225 minutes per week (or the equivalent in credit(s) based on the Carnegie unit).*
3	State requires public school districts to provide PE for a minimum of 90 minutes per week but less than 150 minutes per week (or the equivalent in credit(s) based on the Carnegie unit).*
2	State requires public school districts to provide PE for less than 90 minutes per week; or state requires PE without a specified time requirement.
1	State only recommends a PE time requirement for public school districts; or state requirement for physical activity includes an option for PE.
0	No PE time requirement or recommendation.
Enhancing / Inhibiting Factors	**Description:** These are features in the codified law that may enhance or inhibit implementation of PE Time Requirement policies at the HS grade level, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year Potential enhancement factor *(TimeBonusHS)*: Applies if state specifies *daily* participation in PE. Potential inhibiting factor (*TimePenHS*): Applies if state permits substitution for PE based on a course or activity; *or* if state specifies that PE instruction is not required for the full school year. Potential inhibiting factor (*ComboPenHS*): Applies if state allows for a combination of Physical Activity (PA) and PE to meet PE time requirement. Potential inhibiting factor (*TimePenDisHS*): Applies if state allows exemption from PE based on medical or disability. Potential inhibiting factor (*TimeSuspendHS*): Applies if state suspended PE time requirements at any time during the calendar year. *New 2020

***FOR PE TIME REQUIREMENT VARIABLE (ALL GRADES)*:** If state does not specify the value of a credit, 1.0 credit unit of PE instruction is equivalent to 120 hour/year of PE instruction.

Appendix Figure A.2 Physical activity time requirements CLASS scoring guide

Physical Activity (PA) Time Requirements – High School (HS)
Variable name in data set: (PATIMEHS)

Score	**Description**: The Physical Activity (PA) Time Requirements score reflects the degree to which state law addresses the amount of PA occurring in schools and may or may not include time allocated for PE and other activities during the school day at the HS grade level.
5	State requires school districts provide PA for a minimum of 225 minutes per week.
4	State requires school districts provide PA for a minimum of 150 minutes per week but less than 225 minutes per week.
3	State requires school districts provide PA for a minimum 90 minutes per week but less than 150 minutes per week.
2	State requires school districts provide PA for less than 90 minutes per week; or state requires PA without a specified time requirement.
1	State only recommends a PA time requirement.
0	No PA time requirement or recommendation.
999	State law not scored for years 2003-2007.
Enhancing / Inhibiting Factors	**Description:** These are features in the codified law that may enhance or inhibit implementation of PA Time Requirement policies at the HS grade level, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year Potential enhancement factor *(PATimeBonHS)*: Applies if state specifies daily participation in PA. Potential enhancement factor *(CSPAPHS)*: Applies if state references the CDC Comprehensive School Physical Activity Program. *New 2016 Potential inhibiting factor *(PAtimesuspendHS)*: Applies if state suspended PA time requirements at any time during the calendar year. *New 2020

Appendix Figure A.3 Nutrition Education requirements CLASS scoring guide

Nutrition Education Requirements

Note: The italicized text below corresponds to the variable names in the CLASS Data Set. The scoring criteria for this policy are identical at Elementary (ES), Middle (MS), and High (HS) School levels.

Variable name in data set: **ES Level-** ***EDUC_ES,*** **MS Level-** ***EDUC_MS,*** **HS Level-** ***EDUC_HS***

Score	**Description:** The nutrition education score reflects the degree to which state law addresses the amount of nutrition education with respect to the USDA National School Lunch Program and the Center for Disease Control recommended standard at the ES, MS, HS grade level.
4	State requires a curriculum to incorporate/integrate sequential nutrition education content into standards-based health education curriculum with reference to specific nutrition standards for specified grade levels. For example, standards may specify that by a certain grade level, certain standards, concepts or content should be completed by grades 2, 5, 8 and 12. Nutrition education components can be included as part of overall health curriculum.
3	State requires a curriculum to incorporate/integrate sequential nutrition education content into standards-based health education curriculum without reference to specific nutrition standards or grades. Nutrition education components can be included as part of overall health curriculum.
2	State requires a curriculum to incorporate nutrition education content into health curriculum without reference to any additional requirements. Note: If state requires comprehensive health education that is consistent with CDC's Coordinated School Health Program (CSHP), this would qualify, since nutrition is included.
1	State recommends a curriculum to incorporate nutrition education content into health curriculum without reference to any additional requirements. Note: If state recommends comprehensive health education that is consistent with CDC's Coordinated School Health Program (CSHP), this would qualify since nutrition is included.
0	No provision for broad health education provision with no mention of nutrition.
Tracking variables	**Description:** These are features in the codified law that may enhance or inhibit implementation of Nutrition Education Requirement policies, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year Potential enhancement factor (ES- *educfoodserves,* MS- *educfoodservims,* HS- *educfoodservihs*): Applies if state specifies that schools must integrate/ coordinate nutrition instruction in the school with the food service program and/or instruction in other subjects. Potential enhancement factor (ES- *educrefes,* MS- *educrefms,* HS- *educrefhs*): Applies if state references the National Health Education Standards, the Dietary Guidelines for Americans, or MyPyramid, in language regarding nutrition education.[12] Potential enhancement factor (ES- *educinses,* MS- *educinsms,* HS- *educinshs*): Applies if state specifies hours of student instruction per year (e.g., 50 hours per year) and/or hours of nutrition education professional development (e.g., 10 hours per year). Potential enhancement factor (ES- *educcshpes,* MS- *educcshpms,* HS- *educchsphs*): Applies if state requires health education (based on CDC's CSHP) for any grade.

Appendix Figure A.4 Marketing requirements CLASS scoring guide

Marketing: Advertising Requirements

Note: This policy applies across all grade levels. The italicized text below corresponds to the variable names in the CLASS Data Set.

Variable name in data set: MARKTING

Score	**Description:** The marketing advertising score reflects the degree to which state law addresses the amount of advertising within the school with respect to the IOM and American College of Preventive Medicine recommended standard.
5	State prohibits the sales, commercial promotion/advertising, or giving away of food and beverages, during the school day, that do not conform to specified nutrition standards that meet or exceed federal dietary guidelines.[3]
4	State prohibits commercial advertising/promotion of all food and beverages, during the school day, that do not conform to specified nutrition standards that meet or exceed federal dietary guidelines.[3]
3	State limits certain types of commercial advertising/promotion for low-nutrient food and beverages in certain locations and/or at certain times (e.g., direct advertising, such as a requirement to switch vending machine signage for soda to signage for water; or indirect advertising, such as in-school fundraisers involving branded foods).
2	State requirement for advertising/marketing is undefined (e.g. schools must promote "healthy" food choices and prohibit advertising/marketing of "less healthy" food and beverages); or state requires districts or schools to develop and adopt a standard for commercial advertising/promotion of food or beverages.
1	State recommends a standard for nutrition-based marketing of food and beverages to students during the school day.
0	No provision.
Tracking variables	**Description:** These are features in the codified law that may enhance or inhibit implementation of Marketing: Advertising Requirement policies, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year Potential enhancement factor (*incentive*): Applies if a state prohibits the use of commercial food products (through coupon, incentives or other means) as a reward for school achievement. Potential enhancement factor (*intructban*): State prohibits all advertising associated with instruction (such as the use of logos and brands for food/beverage items on educational materials provided by the school).

Decision rules:
Credit is given for restrictions on commercial advertising/promotion that include foods of low-nutritive value as a subset. For example, a policy that prohibits commercial advertisements on instructional materials unless local school boards meet state-mandates procedures, descriptive terms for food/beverages to be **promoted** must be consistent and based on specified definitions (e.g., state must promote "healthy foods" is insufficient without specifics which conform to US Dietary Guidelines).

Appendix Figure A.5 Fundraiser beverage requirements CLASS scoring guide

Fundraisers Beverage Requirements

Note: The italicized text below corresponds to the variable names in the CLASS Data Set. The scoring criteria for this policy are identical at Elementary (ES), Middle (MS), and High (HS) School levels.

Variable name in data set: **ES Level-** ***BEVFUNDES,*** **MS Level-** ***BEVFUNDMS,*** **HS Level-** ***BEVFUNDHS***

Note: If state policy sets out standards for all competitive food items without specifying the category (e.g., there is no separation for vended items versus school stores versus canteens versus fundraisers), the policy should still receive a score in 4 areas Vending Machines-non entrée foods/snacks only; Vending Machines – beverages only; School stores, canteens, and snack bars – foods only, and School stores, canteens, and snack bars – beverages only).

If the policy ***specifically*** *identifies fundraisers as an area in which the standards apply, than score the policy using the Fundraisers: Foods/Snacks and Fundraisers: Beverages in addition to the 4 areas listed above.*

Score	**Description:** The fundraisers beverages score reflects the degree to which state law addresses the amount of beverages with respect to the IOM recommended standard at the ES, MS, and HS grade level.
6	State prohibits the sale or service of beverages through school-based, on campus fundraisers ***or*** allows only the following exceptions. Beverages limited to: • Water without added flavorings, additives or carbonation, ***and/or*** • Nonfat or 1% only, flavored or non-flavored milk, ***and/or*** • Other beverages with at least 100% fruit/vegetable juice with no added caloric or non-caloric sweeteners, ***and/or*** • Caffeine-free, with the exception of trace amounts of naturally occurring caffeine substances.
5	State allows the sale or service of only the following beverages through school-based, on campus fundraisers: Beverages limited to: • Water, ***and/or*** • Nonfat or 1% only, flavored or non-flavored milk, ***and/or*** • Other beverages with at least 100% fruit/vegetable juice with no added caloric sweeteners, ***and/or*** • Caffeine-free, with the exception of trace amounts of naturally occurring caffeine substances. Additional beverages allowed with limits on total calories and/or added sugar (would allow for some sports drinks, juice drinks, flavored waters, and diet sodas).
4	State mandates nutrition standards for the sale of beverages through school-based, on campus fundraisers with specified limits on calories, ***or*** fats (saturated and trans), ***or*** total or added sugar, ***or*** sodium ***or*** caffeine.
3	State restricts sale of beverages through school school-based, on campus fundraisers of low nutritive value that meets federal requirements for FMNV,[12] but without establishing nutrition standards that meet or exceed federal dietary guidelines.[3]
2	State requirement of beverages sold through school-based, on campus fundraisers is undefined (e.g.,

	"healthy" foods and beverages must be sold); or state requires a state agency to develop and adopt nutrition standards applicable to fundraisers.
1	State recommends nutrition standards for beverages sold through school-based, on campus fundraisers.
0	No provision.
Tracking variables	**Description:** These are features in the codified law that may enhance or inhibit implementation of Fundraisers Beverage Requirement policies, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year Potential enhancement factor (ES- *bevfundnofoodes,* MS- *bevfundnofoodms,* HS- *bevfundnofoodhs*): Applies if state specifies that only non-food items are permitted for fundraisers. Potential enhancement factor (ES- *bevfundafteres,* MS- *bevfundafterms,* HS- *bevfundafterhs*): Applies if state requires/encourages the promotion of healthy food and beverage options or non-food options during after-school fundraising events and activities either on school property or off site. Potential enhancement factor (ES- *bevfundpores,* MS- *bevfundporms,* HS- *bevfundporhs*): Applies if state specifies portion sizes. Potential enhancement factor (ES- *bevfundpenes,* MS- *bevfundpenms,* HS- *bevfundpenhs*): Applies if penalties are established for violations. Potential enhancement factor (ES- *bevfundmilkes,* MS- *bevfundmilkms,* HS- *bevfundmilkhs*): Attempts are made to limit the amount of added sugar in flavored milk/dairy products. Potential inhibiting factor (ES- *bevfund50es,* MS- *bevfund50ms,* HS- *bevfund50hs*): Policy allows for a certain percentage of unhealthy/junk food items. Potential inhibiting factor (*bevfund2cgy*): Applies if there is a funding contingency written into the law that requires funding to implement the enhancements/improvements to beverages. Potential inhibiting factor (ES- *bevfundlessdayes,* MS- *bevfundlessdayms,* HS- *bevfundlessdayhs*): Applies if standards apply for less than the school day.

Appendix Figure A.6 Fundraiser food requirements CLASS scoring guide

Fundraisers Non-entrée Food/Snacks Requirements

Note: The italicized text below corresponds to the variable names in the CLASS Data Set. The scoring criteria for this policy are identical at Elementary (ES), Middle (MS), and High (HS) School levels.

Variable name in data set: **ES Level-** ***FUND_ES,*** **MS Level-** ***FUND_MS,*** **HS Level-** ***FUND_HS***

Note: If state policy sets out standards for all competitive food items without specifying the category (e.g., there is no separation for vended items versus school stores versus canteens versus fundraisers), the policy should still receive a score in 4 areas Vending Machines-non entrée foods/snacks only; Vending Machines – beverages only; School stores, canteens, and snack bars – foods only, and School stores, canteens, and snack bars – beverages only).

If the policy ***specifically*** *identifies fundraisers as an area in which the standards apply, than the policy is scored using the Fundraiser Non-entree: Foods/Snacks Requirements and Fundraisers Beverages Requirements in addition to the 4 areas listed above.*

Score	**Description:** The fundraiser food/snacks score reflects the degree to which state law addresses the amount of snacks with respect to the IOM recommended standard at the ES, MS, and HS grade level.
6	State prohibits the sale or service of food through school-based, on campus fundraisers ***or*** allows only the following exceptions: Non-entrée food items limited to: • Non-fried fruit (fresh or packed in juice or water) and vegetables, whole grain products, nonfat or 1% only, flavored or non-flavored dairy products that are 200 calories or less per serving[6] ***and*** • No more than 35% of total calories from fat (with the exception of nut/seed products) ***and*** • Less than 10% calories from saturated fat ***and*** • Zero trans fat ***and*** • 35% or less by weight of total sugars or 35% or less of calories from total sugars (does not apply to fruit or dairy) ***and*** • Sodium content 200 mg or less *Note*: Points will apply if state has established a standard that uses a *gram* limit that is comparable to the % limits identified above for fat, saturated fat and sugar (i.e., no more than 6 grams of total fat per 150 calorie portion).
5	State allows the sale or service of only the following food items through school based, on campus fundraisers, throughout the school day: Non-entrée food items limited to: • 200 calories or less per serving ***and***: • No more than 35% of total calories from fat (with the exception of nut/seed products) ***and*** • No more than 10% calories from saturated fat ***and*** • Zero trans fat ***and*** • 35% or less by weight of total sugars or 35% or less of calories from total sugars (does not apply to fruit or dairy) ***and*** • Sodium content 200 mg or less *Note*: Points will apply if state has established a standard that uses a *gram* limit that is comparable to the % limits identified above for fat, saturated fat and sugar (i.e., no more than 6 grams of total fat per 150 calorie portion).

4	State mandates nutrition standards for the sale of foods through school based, on campus fundraisers with specified limits on calories, ***or*** fats (saturated or trans), ***or*** total or added sugar, ***or*** sodium.
3	State restricts sale of foods through school based, on campus fundraisers of low nutritive value that meets federal requirements for FMNV,[11] but without establishing nutrition standards that meet or exceed federal dietary guidelines.[3]
2	State requirement of foods sold through school based, on campus fundraisers is undefined (e.g., "healthy" foods and beverages must be sold); or state requires a state agency to develop and adopt nutrition standards applicable to fundraisers.
1	State recommends nutrition standards for sold through school based, on campus fundraisers.
0	No provision.
Tracking variables	**Description:** These are features in the codified law that may enhance or inhibit implementation of Fundraisers Non-entrée Food/Snacks Requirement policies, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year *Note*: Exceptions to total sugar limit are allowed for dairy products and fruits. Potential enhancement factor (ES- *fundnofoodes,* MS- *fundnofoodms,* HS- *fundnofoodhs*): Applies if state specifies that only non-food items are permitted for fundraisers. Potential enhancement factor (ES- *fundafteres,* MS- *fundafterms,* HS- *fundafterhs*): Applies if state policy requires/encourages the promotion of healthy food and beverage options or non-food options during after-school fundraising events and activities either on school property or off site. Potential enhancement factor (ES- *fundpores,* MS- *fundporms,* HS- *fundporhs*): Applies if state specifies portion sizes. Potential enhancement factor (ES- *fundpenes,* MS- *fundpenms,* HS- *fundpenhs*): Applies if penalties are established for violations. Potential enhancement factor (ES- *fundmilkes,* MS- *fundmilkms,* HS- *fundmilkhs*): Attempts are made to limit the amount of added sugar in flavored milk/dairy products (yogurt). Potential inhibiting factor (ES- *fund50es,* MS- *fund50ms,* HS- *fund50hs*): Policy allows for a certain percentage of unhealthy/junk food items. Potential inhibiting factor (*fund2cgy*): Applies if there is a funding contingency written into the law that requires funding to implement the enhancements/improvements to food/snacks. Potential inhibiting factor (ES- *fundlessdayes,* MS- *fundlessdayms,* HS- *fundlessdayhs*): Applies if standards apply for less than the school day.

Appendix Figure A.7 School store beverage requirements CLASS scoring guide

School Stores, Canteens, and Snack Bars Non-Entrée Beverage Requirements

Note: The italicized text below corresponds to the variable names in the CLASS Data Set. The scoring criteria for this policy are identical at Elementary (ES), Middle (MS), and High (HS) School levels.

Variable name in data set: **ES Level-** ***BEVENUES,*** **MS Level-** ***BEVENUMS,*** **HS Level-** ***BEVENUHS***

Note: If state policy sets out standards for all competitive food items without specifying the category (e.g., there is no separation for vended items versus school stores versus canteens versus fundraisers), the policy should still receive a score in 4 areas Vending Machines-non entrée foods/snacks only; Vending Machines – beverages only; School stores, canteens, and snack bars – foods only, and School stores, canteens, and snack bars – beverages only).

Score	**Description:** The school stores, canteens, and snack bar beverage score reflects the degree to which state law addresses the amount of beverages with respect to the IOM recommended standard at the ES, MS, and HS grade level.
6	State prohibits the sale or service of beverages through school stores, canteen or snack bars ***or*** allows only the following exceptions: Beverages limited to: • Water without added flavorings, additives or carbonation, ***and/or*** • Nonfat or 1% only, flavored or non-flavored milk, ***and/or*** • Other beverages with at least 100% fruit/vegetable juice with no added caloric or non-caloric sweeteners, ***and/or*** • Caffeine-free, with the exception of trace amounts of naturally occurring caffeine substances.
5	State allows the sale or service of only the following beverages through school stores, canteen or snack bars: Beverages limited to: • Water, ***and/or*** • Nonfat or 1% only, flavored or non-flavored milk, ***and/or*** • Other beverages with at least 100% fruit/vegetable juice with no added caloric sweeteners, ***and/or*** • Caffeine-free, with the exception of trace amounts of naturally occurring caffeine substances. Additional beverages allowed with limits on total calories and/or added sugar (would allow for some sports drinks, juice drinks, flavored waters, and diet sodas).
4	State mandates nutrition standards for the sale of beverages through school stores, canteen or snack bars with specified limits on calories, ***or*** fats (saturated and trans), ***or*** total or added sugar, ***or*** sodium, ***or*** caffeine.
3	State restricts sale of beverages through school stores, canteen or snack bars of low nutritive value that meets federal requirements for FMNV,[10] but without establishing nutrition standards that meet or exceed federal dietary guidelines.[3]
2	State requirement of beverages sold through school stores, canteen or snack bars is undefined (e.g., "healthy" foods and beverages must be available); or state requires a state agency to develop and adopt

	nutrition standards applicable to *a la carte* sales/service or other competitive foods.
1	State recommends nutrition standards for beverages sold through school stores, canteen or snack bars.
0	No provision.
Tracking variables	**Description:** These are features in the codified law that may enhance or inhibit implementation of School Stores, Canteens and Snack Bars Non-entrée Beverage Requirement policies, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year Potential enhancement factor (ES- *bevenupores,* MS- *bevenuporms,* HS- *bevenuporhs*: Applies if state specifies portion sizes. Potential enhancement factor (ES- *bevenupenes,* MS- *bevenupenms,* HS- *bevenupenhs*): Applies if penalties are established for violations. Potential enhancement factor (ES- *bevenumilkes,* MS- *bevenumilkms,* HS- *bevenumilkhs*): Attempts are made to limit the amount of added sugar in flavored milk/dairy products. Potential inhibiting factor (ES- *bevvenu50es,* MS- *bevvenu50ms,* HS- *bevvenu50hs*): Policy allows for a certain percentage of unhealthy/junk food items. Potential inhibiting factor (*bevenufundcgy*): Applies if there is a funding contingency written into the law that requires funding to implement the enhancements/improvements to beverages. Potential inhibiting factor (ES- *bevenulessdayes,* MS- *bevenulessdayms,* HS- *bevenulessdayhs*): Applies if standards apply for less than the school day.

Appendix Figure A.8 - School store food requirements CLASS scoring guide

School Stores, Canteens and Snack Bars Non-entrée Food/Snacks Requirements

Note: The italicized text below corresponds to the variable names in the CLASS Data Set. The scoring criteria for this policy are identical at Elementary (ES), Middle (MS), and High (HS) School levels.

Variable name in data set: **ES Level-** ***VENUE_ES,*** **MS Level-** ***VENUE_MS,*** **HS Level-** ***VENUE_HS***

Note: If state policy sets out standards for all competitive food items without specifying the category (e.g., there is no separation for vended items versus school stores versus canteens versus fundraisers), the policy should still receive a score in 4 areas Vending Machines-non entrée foods/snacks only; Vending Machines – beverages only; School stores, canteens, and snack bars – foods only, and School stores, canteens, and snack bars – beverages only).

Score	**Description:** The school store, canteens and snack bar score reflects the degree to which state law addresses the amount of food/snacks with respect to the IOM recommended standard at the ES, MS, and HS grade level.
6	State prohibits the sale or service of food through school stores, canteens and snack bars ***or*** allows only the following exceptions: Non-entrée food items limited to: • Non-fried fruit (fresh or packed in juice or water) and vegetables, whole grain products, non-fat and low fat dairy products (nonfat or 1% only, flavored or non-flavored) that are 200 calories or less per serving[6] ***and*** • No more than 35% of total calories from fat (with the exception of nut/seed products) ***and*** • Less than 10% calories from saturated fat ***and*** • Zero trans fat ***and*** • 35% or less by weight of total sugars or 35% or less of calories from total sugars (does not apply to fruit or dairy) ***and*** • Sodium content 200 mg or less *Note*: Points will apply if state has established a standard that uses a *gram* limit that is comparable to the % limits identified above for fat, saturated fat and sugar (i.e., no more than 6 grams of total fat per 150 calorie portion).
5	State allows the sale or service of only the following food items through school stores, canteens and snack bars: Non-entrée food items limited to: • 200 calories or less per serving ***and*** • No more than 35% of total calories from fat (with the exception of nut/seed products) ***and*** • No more than 10% calories from saturated fat ***and*** • Zero trans fat ***and*** • 35% or less by weight of total sugars or 35% or less of calories from total sugars (does not apply to fruit or dairy) ***and*** • Sodium content 200 mg or less *Note*: Points will apply if state has established a standard that uses a *gram* limit that is comparable to the % limits identified above for fat, saturated fat and sugar (i.e., no more than 6 grams of total fat per 150 calorie portion).
4	State mandates nutrition standards for the sale of foods through school stores, canteens and snack bars with specified limits on calories, ***or*** fats (saturated or trans), ***or*** total or added sugar, ***or*** sodium.

3	State restricts sale of foods through school stores, canteens and snack bars of low nutritive value that meets federal requirements for FMNV,[9] but without establishing nutrition standards that meet or exceed federal dietary guidelines.[3]
2	State requirement of foods sold through school stores, canteens and snack bars is undefined (e.g., "healthy" foods and beverages must be available); or state requires a state agency to develop and adopt nutrition standards applicable to *a la carte* sales/service or other competitive foods.
1	State recommends nutrition standards for sold through school stores, canteens and snack bars.
0	No provision.
Tracking variables	**Description:** These are features in the codified law that may enhance or inhibit implementation of School Stores, Canteens and Snack Bars Non-entrée Food/Snacks Requirement policies, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year *Note*: Exceptions to total sugar limit are allowed for dairy products and fruits Potential enhancement factor (ES- *venupores,* MS- *venuporms, HS- venuporhs*): Applies if state specifies portion sizes. Potential enhancement factor (ES- *venupenes,* MS- *venupenms,* HS- *venupenhs*): Applies if penalties are established for violations. Potential enhancement factor (ES- *venumilkes,* MS- *venumilkms,* HS- *venumilkhs*): Attempts are made to limit the amount of added sugar in flavored milk/dairy products (yogurt). Potential inhibiting factor (ES- *venu50es,* MS- *venu50ms,* HS- *venu50hs*): Policy allows for a certain percentage of unhealthy/junk food items. Potential inhibiting factor (*venufundcgy*): Applies if there is a funding contingency written into the law that requires funding to implement the enhancements/improvements to food/snacks. Potential inhibiting factor (ES- *venulessdayes,* MS- *venulessdayms,* HS- *venulessdayhs*): Applies if standards apply for less than the school day.

Appendix Figure A.9 Vending Machine Beverage requirements CLASS scoring guide

Vending Machines Beverages Requirements

Note: The italicized text below corresponds to the variable names in the CLASS Data Set. The scoring criteria for this policy are identical at Elementary (ES), Middle (MS), and High (HS) School levels.

Variable name in data set: **ES Level-** ***BEVENDES,*** **MS Level-** ***BEVENDMS,*** **HS Level-** ***BEVENDHS***

Note: If state policy sets out standards for all competitive food items without specifying the category (e.g., there is no separation for vended items versus school stores versus canteens versus fundraisers), the policy should still receive a score in 4 areas Vending Machines-non entrée foods/snacks only; Vending Machines – beverages only; School stores, canteens, and snack bars – foods only, and School stores, canteens, and snack bars – beverages only).

Score	**Description:** The vending machine beverage score reflects the degree to which state law addresses the amount of vending beverage with respect to the IOM recommended standard at the ES, MS, and HS grade level.
6	State prohibits the sale or service of beverages through vending ***or*** allows only the following exceptions: Beverages limited to: • Water without added flavorings, additives or carbonation, ***and/or*** • Nonfat or 1% only, flavored or non-flavored milk, ***and/or*** • Other beverages with at least 100% fruit/vegetable juice with no added caloric or non-caloric sweeteners, ***and/or*** Caffeine-free, with the exception of trace amounts of naturally occurring caffeine substances.
5	State allows the sale or service of only the following beverages through vending machines: Beverages limited to: • Water, ***and/or*** • Nonfat or 1% only, flavored or non-flavored milk, ***and/or*** • Other beverages with at least 100% fruit/vegetable juice with no added caloric sweeteners, ***and/or*** • Caffeine-free, with the exception of trace amounts of naturally occurring caffeine substances. Additional beverages allowed with limits on total calories and/or added sugar (would allow for some sports drinks, juice drinks, flavored waters, and diet sodas).
4	State mandates nutrition standards for the sale of beverages through vending machines with specified limits on calories, ***or*** fats (saturated and trans), ***or*** total or added sugar, ***or*** sodium, ***or*** caffeine.
3	State restricts sale of beverages through vending machines of low nutritive value that meets federal requirements for FMNV,[8] but without establishing nutrition standards that meet or exceed federal dietary guidelines.[3]
2	State requirement of beverages sold through vending machines is undefined (e.g., "healthy" foods and beverages must be available); or state requires a state agency to develop and adopt nutrition standards applicable to *a la carte* sales/service or other competitive foods.
1	State recommends nutrition standards for beverages sold through vending machines .
0	No provision.
Tracking variables	**Description:** These are features in the codified law that may enhance or inhibit implementation of Vending Machines Beverages Requirement policies, and are coded as:

	"1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year *Note*: Exceptions to total sugar limit are allowed for dairy products and fruits. Potential enhancement factor (ES- *bevendpores,* MS- *bevendporms,* HS- *bevendporhs*): Applies if state specifies portion sizes. Potential enhancement factor (ES- *bevendpenes,* MS- *bevendpenms,* HS- *bevendpenhs*): Applies if penalties are established for violations. Potential enhancement factor (ES- *bevendmilkes,* MS- *bevendmilkms,* HS- *bevendmilkhs*): Attempts are made to limit the amount of added sugar in flavored milk/dairy products. Potential inhibiting factor (ES- *bevend50es,* MS- *bevend50ms,* HS- *bevend50hs*): Policy allows for a certain percentage of unhealthy/junk food items. Potential inhibiting factor (*bevendfundcgy*): Applies if there is a funding contingency written into the law that requires funding to implement the enhancements/improvements to beverages. Potential inhibiting factor (ES- *bevendlessdayes,* MS- *bevendlessdayms,* HS- *bevendlessdayhs*): Applies if standards apply for less than the school day.

Appendix Figure A.10 Vending machine food requirements CLASS scoring guide

Vending Machines Non-entrée Food/Snacks Requirements

Note: The italicized text below corresponds to the variable names in the CLASS Data Set. The scoring criteria for this policy are identical at Elementary (ES), Middle (MS), and High (HS) School levels.

Variable name in data set: **ES Level-** ***VEND_ES*****, MS Level-** ***VEND_MS*****, HS Level-** ***VEND_HS***

Note: If state policy sets out standards for all competitive food items without specifying the category (e.g., there is no separation for vended items versus school stores versus canteens versus fundraisers), the policy should still receive a score in 4 areas Vending Machines-non entrée foods/snacks only; Vending Machines – beverages only; School stores, canteens, and snack bars – foods only, and School stores, canteens, and snack bars – beverages only).

Score	**Description**: The vending machine food/snack score reflects the degree to which state law addresses the amount of vending food/snacks with respect to the IOM recommended standard at the ES, MS, and HS grade level.
6	State prohibits the sale or service of food through vending ***or*** allows only the following exceptions. Non-entrée food items limited to: • Non-fried fruit (fresh or packed in juice or water) and vegetables, whole grain products, nonfat or 1% only, flavored or non-flavored dairy products that are 200 calories or less per serving[6] ***and*** • No more than 35% of total calories from fat (with the exception of nut/seed products) ***and*** • Less than 10% calories from saturated fat ***and*** • Zero trans fat ***and*** • 35% or less by weight of total sugars or 35% or less of calories from total sugars (does not apply to fruit or dairy) ***and*** • Sodium content 200 mg or less *Note*: Points will apply if state has established a standard that uses a *gram* limit that is comparable to the % limits identified above for fat, saturated fat and sugar (i.e., no more than 6 grams of total fat per 150 calorie portion).
5	State allows the sale or service of only the following food items through vending machines: Non-entrée food items limited to: • 200 calories or less per serving ***and*** • No more than 35% of total calories from fat (with the exception of nut/seed products) ***and*** • No more than 10% calories from saturated fat ***and*** • Zero trans fat ***and*** • 35% or less by weight of total sugars or 35% or less of calories from total sugars (does not apply to fruit or dairy) ***and*** • Sodium content 200 mg or less *Note*: Points will apply if state has established a standard that uses a *gram* limit that is comparable to the % limits identified above for fat, saturated fat and sugar (i.e., no more than 6 grams of total fat per 150 calorie portion).
4	State mandates nutrition standards for the sale of foods through vending machines with specified limits on calories, ***or*** fats (saturated or trans), ***or*** total or added sugar, ***or*** sodium.
3	State restricts sale of foods through vending machines of low nutritive value that meets federal

	requirements for FMNV,[7] but without establishing nutrition standards that meet or exceed federal dietary guidelines.[3]
2	State requirement of foods sold through vending machines is undefined (e.g., "healthy" foods and beverages must be available); or state requires a state agency to develop and adopt nutrition standards applicable to *a la carte* sales/service or other competitive foods.
1	State recommends nutrition standards for sold through vending machines.
0	No provision.
Tracking variables	**Description:** These are features in the codified law that may enhance or inhibit implementation of Vending Machines Non-entrée Food/Snacks Requirement policies, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year *Note*: Exceptions to total sugar limit are allowed for dairy products and fruits. Potential enhancement factor (ES- *vendpores,* MS- *vendporms,* HS- *vendporhs*): Applies if state specifies portion sizes. Potential enhancement factor (ES- *vendpenes,* MS- *vendpenms,* HS- *vendpenhs*): Applies if penalties are established for violations. Potential enhancement factor (ES- *vendmilkes,* MS- *vendmilkms,* HS- *vendmilkhs*): Attempts are made to limit the amount of added sugar in flavored milk/dairy products (yogurt). Potential enhancement factor (ES- *vendgraines,* MS- *vendgrainms,* HS- *vendgrainhs*): Applies if state further defines whole grains to be consistent with FDA and USDA guidance on whole grains (see below) Potential inhibiting factor (ES- *vend50es,* MS- *vend50ms,* HS- *vend50hs*): Policy allows for a certain percentage of unhealthy/junk food items. Potential inhibiting factor (*vendfundcgy*): Applies if there is a funding contingency written into the law that requires funding to implement the enhancements/improvements to food/snacks. Potential inhibiting factor (ES- *vendlessdayes,* MS- *vendlessdayms,* HS- *vendlessdayhs*): Applies if standards apply for less than the school day.

Appendix Figure A.11 Smart Snacks beverage requirements CLASS scoring guide

Smart Snacks Beverage Requirements

Note: This variable was added beginning with the CLASS 2014 data set. Please note that the Smart Snacks Beverage Requirement variable is coded in addition to the IOM related competitive food and beverages variables included in the 2003-2014 CLASS data sets. The new variable written below will be coded only if Smart Snacks or its beverage standards are specifically addressed.

Variable name in data set: **ES Level-** ***BEVSMARTSNACKES,*** **MS Level-** ***BEVSMARTSNACKMS,*** **HS Level-** ***BEVSMARTSNACKHS***

Score	**Description**: The Smart Snacks Requirement score reflects the degree to which state law addresses compliance with the federal rule known as "Smart Snacks" standards[9] at the ES, MS, and HS grade level.
6	State institutes a complete ban on competitive food sales.
5	State requires compliance with Smart Snacks/Federal Rule/ 7 CFR 210.11 requirements for beverages sold at school and defines the standards **or** requires compliance with articulated standards that meet or exceed Smart Snacks requirements, even if no reference to Smart Snacks/Federal Rule/ 7 CFR 210.11 exists. **Smart Snacks requires that beverages be limited to the following in elementary and middle schools:** • Plain water (with or without carbonation but no flavorings) • Unflavored low fat milk • Unflavored or flavored fat free milk and milk alternatives permitted by NSLP/SBP • 100% fruit/vegetable juice • 100% fruit/vegetable juice diluted with water (with or without carbonation) and no added sweeteners **High Schools may additionally sell:** • No more than 20-fluid ounce portions of calorie-free, flavored water (with or without carbonation); and other beverages containing < 5 calories/8 fl. oz. (or ≤ 10 calories/20 fl. oz.) • No more than 12-fluid ounce portions of beverages with ≤ 40 calories/8 fl. oz. or ≤ 60 calories/12 fl. oz. **Serving sizes are limited as follows:** ES—8 fl. oz. for all beverages except water MS—12 fl. oz. for all beverages except water HS—12 fl. oz. for milk and juice; 20 fl. oz. portions of calorie-free, flavored water (with or without carbonation) and other beverages that are labeled to contain <5 calories/8 fl. oz. or ≤ 10 calories/20 fl. oz.; 12 fl. oz. other beverages ≤ 40 calories/8 fl. oz. or ≤ 60 calories/12 fl. oz.
4	State requires compliance with Smart Snacks/Federal Rule/ 7 CFR 210.11 requirements for beverages sold at school without specifying actual standards.
3	State requires compliance with the following Smart Snacks/Federal Rule/ 7 CFR 210.11 requirements for beverages sold at school, without limiting serving sizes. **Smart Snacks requires that beverages be limited to the following in elementary and middle schools:** • Plain water (with or without carbonation but no flavorings)

	• Fat free or low fat unflavored milk • Fat free flavored milk • 100% juice • 100% juice diluted with water **High Schools may additionally sell:** • Calorie-free, flavored water (with or without carbonation); and other beverages containing < 5 calories/8 fl. oz. (or ≤ 10 calories/20 fl. oz.) • Beverages with ≤ 40 calories/8 fl. oz. or ≤ 60 calories/12 fl. oz.
2	State requires some nutrition standards that meet or exceed Smart Snacks requirements with specified restrictions on water ***or*** milk fat ***or*** juice ***or*** serving size ***or*** other beverages.
1	State recommends compliance with Smart Snacks/Federal Rule/ 7 CFR 210.11 requirements for beverages sold at school.
0	No provision related to Smart Snacks/Federal Rule/ 7 CFR 210.11.
Tracking Variables	**Description:** These are features in the codified law that may enhance or inhibit implementation of Smart Snacks Requirement policies, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year Potential enhancement factor (ES-*bevfundnoexemptes*; MS-*bevfundnoexemptms*; HS-*bevfundnoexempths*): Applies if policy allows for 0 exempt fundraisers each year. Potential inhibiting factor (ES-*bevfundexemptes*; MS-*bevfundexemptms*; HS-*bevfundexempths*): Applies if policy allows for a certain number of exempt fundraisers each year.

Appendix Figure A.12 Smart Snacks food requirements CLASS scoring guide

Smart Snacks Food Requirements

Note: This variable was added beginning with the CLASS 2014 data set. Please note that the Smart Snacks Food Requirement variable is coded in addition to the IOM related competitive food and beverages variables included in the 2003-2014 CLASS data sets. The new variable written below will be coded only if Smart Snacks or its nutrient standards are specifically addressed.

Variable name in data set: **ES Level-** ***SMARTSNACKES,*** **MS Level-** ***SMARTSNACKMS,*** **HS Level-** ***SMARTSNACKHS***

Score	**Description**: The Smart Snacks Requirement score reflects the degree to which state law addresses compliance with the federal rule known as "Smart Snacks" standards[16] at the ES, MS, and HS grade level.
6	State institutes a complete ban on competitive food sales.
5	State requires compliance with Smart Snacks/Federal Rule/ 7 CFR 210.11 requirements for food sold at school and defines the standards **or** requires compliance with articulated standards that meet or exceed Smart Snacks requirements, even if no reference to Smart Snacks/Federal Rule/ 7 CFR 210.11 exists. Smart Snacks requires that all food fall into one of the general standards as well as meet the specific nutrient standards. **General food standard requires that food sold must:** • Be a grain product that contains 50 percent or more whole grains by weight or have the first ingredient a whole grain; or • Have as the first ingredient a fruit, vegetable, dairy product, protein food; or • Be a combination food that contains at least ¼ cup of fruit and/or vegetable; or • Contain 10% of the daily value of one of the nutrients of public health concern based on the most recent Dietary Guidelines for Americans[17] (calcium, potassium, vitamin D, or dietary fiber)*; and • If water is the first ingredient, the second ingredient must be on be of the food items above. **Nutrient standards:** • No more than 200 calories per snack portion • No more than 350 calories per entrée • No more than 230 mg of sodium per snack item** • No more than 480 mg of sodium per entrée item • No more than 35% total calories from fat*** • Less than 10% total calories from saturated fat*** • Zero grams trans fat per portion (less than 0.5g per portion) • No more than 35% of weight from total sugars**** *Beginning July 1, 2016 foods may not qualify using the 10% DV criteria.

	** Effective July 1, 2016, these snack items and side dishes must have not more than 200 mg of sodium per item as packaged or served. ***Exemptions to fat/saturated fat requirements: reduced fat cheese and part skim mozzarella cheese, nuts, seeds, nut/seed butters, dried fruit with nuts and/or seeds with no added nutritive sweeteners or fat, seafood with no added fat. ****Exemptions to sugar requirements: dried whole fruits or vegetables, dried whole fruit or vegetable pieces, dehydrated fruits or vegetables with no added nutritive sweeteners, dried fruits with nutritive sweeteners required for processing, products that consist of only dried fruit with nuts and/or seeds, fresh frozen and canned fruits and vegetables with no added ingredients.
4	State requires compliance with Smart Snacks/Federal Rule/ 7 CFR 210.11 requirements for food sold at school without specifying actual standards.
3	State requires compliance with all of the specific nutrient standards of Smart Snacks. **Nutrient standards:** • No more than 200 calories per snack portion • No more than 350 calories per entrée • No more than 230 mg of sodium per snack item** • No more than 480 mg of sodium per entrée item • No more than 35% total calories from fat*** • Less than 10% total calories from saturated fat*** • Zero grams trans fat per portion (not more than 0.5g per portion) • No more than 35% of weight from total sugars**** *Beginning July 1, 2016 foods may not qualify using the 10% DV criteria. **Effective July 1, 2016, these snack items and side dishes must have not more than 200 mg of sodium per item as packaged or served. ***Exemptions to fat/saturated fat requirements: reduced fat cheese and part skim mozzarella cheese, nuts, seeds, nut/seed butters, dried fruit with nuts and/or seeds with no added nutritive sweeteners or fat, seafood with no added fat. ****Exemptions to sugar requirements: dried whole fruits or vegetables, dried whole fruit or vegetable pieces, dehydrated fruits or vegetables with no added nutritive sweeteners, dried fruits with nutritive sweeteners required for processing, products that consist of only dried fruit with nuts and/or seeds, fresh frozen and canned fruits and vegetables with no added ingredients.
2	State requires some nutrition standards that meet or exceed Smart Snacks requirements with specified limits on calories ***or*** sodium, ***or*** fat, ***or*** saturated fat, ***or*** trans fat, ***or*** sugar.
1	State recommends compliance with Smart Snacks/Federal Rule/ 7 CFR 210.11 requirements for food sold at school.
0	No provision related to Smart Snacks/Federal Rule/ 7 CFR 210.11.
Tracking Variables	**Description:** These are features in the codified law that may enhance or inhibit implementation of Smart Snacks Requirement policies, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year Potential enhancement factor (ES-*fundnoexemptes*; MS-*fundnoexemptms*; HS-*fundnoexempths*): Applies if policy allows for 0 exempt fundraisers each year. Potential inhibiting factor (ES-*fundexemptes*; MS-*fundexemptms*; HS-*fundexempths*): Applies if policy allows for a certain number of exempt fundraisers each year.

Appendix Figure A.13 Wellness council requirements CLASS scoring guide

Coordinated School Health

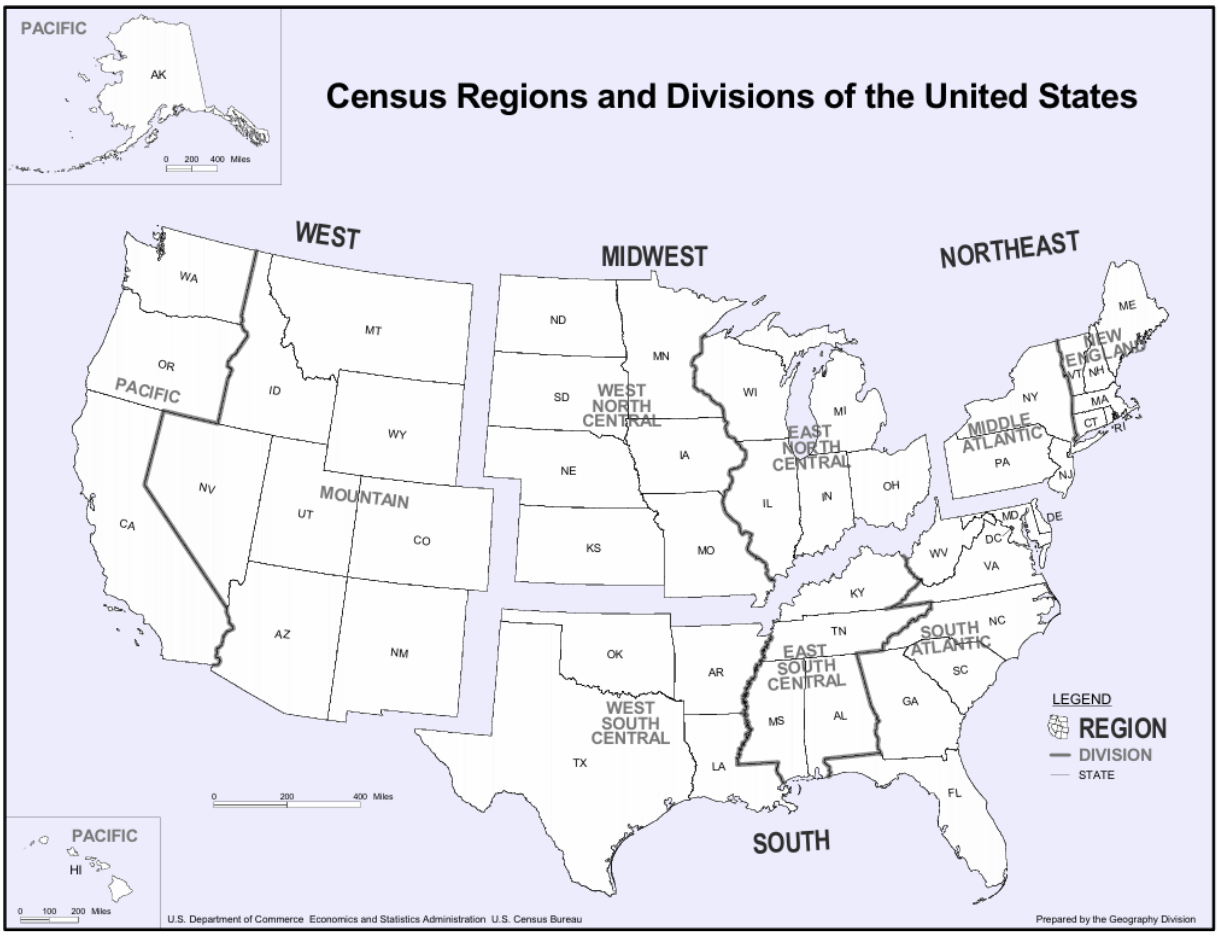
Note: The italicized text below corresponds to the variable names in the CLASS Data Set. The scoring criteria for this policy are identical at Elementary (ES), Middle (MS), and High (HS) School levels. *new 2016 data

Variable name in data set: **ES Level-** ***WSCCES,*** **MS Level-** ***WSCCMS,*** **HS Level-** ***WSCCHS***

Score	**Description:** The coordinated school health score reflects the degree to which state law addresses the Whole School, Whole Community, Whole Child Model developed by the Center for Disease Control[18] and Prevention's at the ES, MS, HS grade level.
3	State institutionalizes the Whole School, Whole Community, Whole Child Model as a framework for coordinated school health.
2	State includes language to institutionalize a coordinated school health model, but not WSCC.
1	State recommends utilizing either a coordinated school health model or the WSCC Model.
0	No provision related to coordinated school health.
Tracking variables	**Description:** These are features in the codified law that may enhance or inhibit implementation of Nutrition Education Requirement policies, and are coded as: "1" in data set if the factor applies "0" if it does not apply "999" if it was not scored for that particular year Potential inhibiting factor: (*wsccdist*) Applies if state only recommends that districts use or incorporate the materials that the state develops/adopts.

Appendix B - 2022 Census Map

Appendix Figure B.1 United States map broken into regions



[us_regdiv.pdf]